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Appendix A
Acronyms and Abbreviations

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ACRONYMS AND ABBREVIATIONS

°	degree
°C	degrees Celsius
°F	degrees Fahrenheit
%	percent
36 CES/CEVN	36th Civil Engineering Squadron Environmental Flight
36 WG	36th Wing
AAV	amphibious assault vehicle
AFB	Air Force Base
AFI	Air Force Instruction
AFPBM TG-31	Armed Forces Pest Management Board Technical Guide No. 31
AGL	above ground level
AMT	Adaptive Management Team
APHIS	Animal and Plant Health Inspection Service
ASN	Assistant Secretary of the Navy
AT/FP	anti-terrorism/force protection
BA	Biological Assessment
BASH	Bird Aircraft Strike Hazard
BE	Biological Evaluation
BECQ	Bureau of Environmental and Coastal Quality
BMP	Best Management Practice
BO	Biological Opinion
BSO	Budget Submitting Office
BTS	brown treesnake
CATM	Combat Arms and Training Maintenance
CATEX	Categorical Exclusions
CCA	crustose coralline algae
CDZ	Cargo Drop Zone
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CESU	Cooperative Ecosystem Studies Units
CFR	Code of Federal Regulations
CGC	Coast Guard Cutter
CNIC	Commander, Navy Installations Command
CNMI	Commonwealth of the Northern Mariana Islands
CNO	Chief of Naval Operations
CO_2	carbon dioxide
COMNAVMAR	Commander Naval Forces Marianas
COMPACFLT	Commander U.S. Pacific Fleet
COTS	crown-of-thorns seastar
CPA	Commonwealth Ports Authority
CRB	coconut rhinoceros beetle
CRCP	Coral Reef Conservation Program

ACRONYMS AND ABBREVIATIONS

CRMO	Coastal Resources Management Office
CTD	conductivity, temperature, and depth
CWA	Clean Water Act
CWCS	Comprehensive Wildlife Conservation Strategy
CZMA	Coastal Zone Management Act
DCRM	Division of Coastal Resources Management
DDT	Dichlorodiphenyltrichloroethane
DEQ	Division of Environmental Quality
DFW	Division of Fish and Wildlife
DLNR	Department of Lands and Natural Resources
DoD	Department of Defense
DoDI	Department of Defense Instruction
DoDM	Department of Defense Manual
DON	U.S. Department of the Navy
DPS	Distinct Population Segment
DUSD	Deputy Under Secretary of Defense
EA	Environmental Assessment
EEZ	Exclusive Economic Zone
EDS	Early Detection Surveys
EFH	Essential Fish Habitat
EI&E	Energy, Installations, and Environment
EIS	Environmental Impact Statement
EMS	Environmental Management System
EMUA	Exclusive Military Use Area
EO	Executive Order
EOD	Explosive Ordnance Disposal
EPR-Web	Environmental Program Requirements Web
ERA	Ecological Reserve Area
ER-L	Effects Range-Low
ER-M	Effects Range-Median
ERL	Environmental Readiness Level
ESA	Endangered Species Act
ESQD	Explosive Safety Quantity Distance
FAA	Federal Aviation Administration
FDM	Farallon de Medinilla
FEP	Fishery Ecosystem Plan
FES	Forest Enhancement Site
FMC	Fishery Management Council
FMP	Fishery Management Plan
FORT	Fort Collins Science Center
FWCA	Fish and Wildlife Coordination Act
FY	Fiscal Year
GDPR	Guam Department of Parks and Recreation

ACRONYMS AND ABBREVIATIONS

GDPW	Guam Department of Public Works
GHS	Guam Homeland Security
GIS	Geographic Information System
GISD	Global Invasive Species Database
GovGuam	Government of Guam
gpd	gallons per day
GPS	Global Positioning System
Guam DAWR	Guam Division of Aquatic and Wildlife Resources
Guam EPA	Guam Environmental Protection Agency
GWA	Guam Water Authority
HACCP	Hazard Analysis and Critical Control Point
HAPC	Habitat Area of Particular Concern
HERA	Haputo Ecological Reserve Area
HMU	Habitat Management Unit
HPO	Historic Preservation Office(r)
I&E	Installations and Environment
IBB	International Broadcasting Bureau
IHA	Incidental Harassment Authorization
INRMP	Integrated Natural Resources Management Plan
IPM	Integrated Pest Management
IRP	Installation Restoration Program
IREI	Island Research & Education Initiative
ISR	Intelligence/Surveillance/Reconnaissance
JGPO	Joint Guam Program Office
JRM	Joint Region Marianas
kph	kilometers per hour
LBA	Lease Back Area
LCAC	Landing Craft Air Cushion
LCU	Landing Craft, Utility
LEED	Leadership in Energy and Environmental Design
LFA	little fire ant
LID	Low Impact Development
LIDAR	Light Detection and Ranging
LMR	living marine resource
LOA	Letter of Authorization
lpd	liters per day
MAPS	Monitoring Avian Productivity and Survivorship
MARAMP	Mariana Archipelago Reef Assessment and Monitoring Program
MARFORPAC	U.S. Marine Corps Forces, Pacific
MBTA	Migratory Bird Treaty Act
MCAG	Marine Corps Activity Guam
MCB	Marine Corps Base
MCBCB	Marine Corps Base Camp Blaz

ACRONYMS AND ABBREVIATIONS

MCE	Mesophotic coral ecosystems
MEDU	Marine Natural Resources Educational Outreach
MFB-RPA	Mariana Fruit Bat-Recovery Plan Action
mgd	million gallons per day
MGIS	Marine GIS and Data Management
MHM	Marine Habitat Management
MHW	Mean High Water
MIG	Migratory Bird Management
MILCON	Military Construction
MIRC	Mariana Islands Range Complex
MIS	Marine Invasive Species Management
MISTCS	Mariana Islands Sea Turtle and Cetacean Survey
MITT	Mariana Islands Training and Testing
MLA	Military Lease Area
MLAW	Marine Natural Resources Law Enforcement
mld	million liters per day
MMPA	Marine Mammal Protection Act
MMRP	Military Munitions Response Program
MOA	Memorandum of Agreement
MOU	Memorandum of Understanding
MOUT	Military Operations in Urban Terrain
mph	miles per hour
MPS	Marine Protected Species Management
MPVCO	Marine Patrol Volunteer Conservation Officer
MRP	Marine Resources Preserve
MSA	Munitions Storage Area
MSC	Military Sealift Command
MSFCMA	Magnuson-Stevens Fishery Conservation and Management Act
MSL	above mean sea level
MUNS	Munitions Squadron
MUS	Management Unit Species
MWR	Morale, Welfare and Recreation
NA	not applicable
N/A	not available
NAVFAC	Naval Facilities Engineering Systems Command
NBG	Naval Base Guam
NCCOS	National Centers for Coastal Ocean Science
NCP	National Oil and Hazardous Substance Pollution Contingency Plan
NCTS	Naval Computer and Telecommunications Station
NDAA	National Defense Authorization Act
NEC	Northern Equatorial Current
NEPA	National Environmental Policy Act
NFA	No-Fire Area

ACRONYMS AND ABBREVIATIONS

NGLA	Northern Guam Lens Aquifer
NHPA	National Historic Preservation Act
NISA	National Invasive Species Act
NMFS	National Marine Fisheries Service
NMS	Naval Munitions Site
NNE	non-nesting emergence
NOAA	National Oceanic and Atmospheric Administration
NOTAM	Notice to Airmen
NOTMAR	Notice to Mariners
NRCS	Natural Resources Conservation Service
NWF	Northwest Field
NWI	National Wetlands Inventory
NWR	National Wildlife Refuge
O&M	Operations and Maintenance
OEIS	Overseas Environmental Impact Statement
OPAREA	Operating Area
OPERA	Orote Peninsula Ecological Reserve Area
OPNAV	Office of the Chief of Naval Operations
OPNAV M	OPNAV Manual
OPNAVINST	Chief of Naval Operations Instruction
OSD	Office of the Secretary of Defense
OUSD	Office of the Under Secretary of Defense
Pacific RAMP	Pacific Reef Assessment and Monitoring Program
PARC	Partners in Amphibian and Reptile Conservation
PCB	Polychlorinated biphenyl
pCO_2	partial pressure carbon dioxide
PIF	Partners in Flight
PIFSC	Pacific Islands Fisheries Service Center
PL	Public Law
PMUS	Pelagic Management Unit Species
POL	Petroleum, Oil, and Lubricants
POM	Program Objectives Memorandum
PPBES	Planning, Programming, Budget, and Execution System
QRP	Qualified Recycling Program
RAMP	Reef Assessment and Monitoring Program
R-	Restricted Area
RBP	Regional Biosecurity Plan
REPI	Readiness Environmental Protection Integration
RF	radio frequency
RPM	Real Property Maintenance
SAIA	Sikes Act Improvement Act
SDZ	Surface Danger Zone
SeaBees	Naval Mobile Construction Battalions

ACRONYMS AND ABBREVIATIONS

SECNAV	Secretary of the Navy
SECNAVINST	Secretary of the Navy Instruction
SERDP	Strategic Environmental Research and Development Program
SME	Subject Matter Expert
SOGCN	Species of Greatest Conservation Need
SPAWAR	Space and Naval Warfare Systems Command
SVL	snout-to-vent length
SWAT	Soil and Water Assessment Tool
TEDU	Terrestrial Natural Resources Educational Outreach
TGIS	Terrestrial GIS and Data Management
THAAD	Terminal High-Altitude Area Defense
THM	Terrestrial Habitat Management
TIS	Terrestrial Exotic and Invasive Species Management
TLAW	Terrestrial Natural Resources Law Enforcement
TNC	The Nature Conservancy
TNWRE	Tom Nance Water Resource Engineering
TPS	Terrestrial Protected Species Management
TS	Telecommunications Site
TSB	Training Support Battalion
U.S.	United States
UOG	University of Guam
USACE	U.S. Army Corps of Engineers
USAF	U.S. Air Force
USC	U.S. Code
USCG	U.S. Coast Guard
USDA	U.S. Department of Agriculture
USDA-NWRC	U.S. Department of Agriculture-National Wildlife Research Center
USEPA	U.S. Environmental Protection Agency
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
USINDOPACOM	U.S. Indo-Pacific Command
USMC	U.S. Marine Corps
UXO	unexploded ordnance
VCO	Volunteer Conservation Officer
VCOP	Volunteer Conservation Officer Program
WAP	Wildlife Action Plan
WERI	Water and Environmental Research Institute
WPRFMC	Western Pacific Regional Fishery Management Council
WWII	World War II

Appendix B
Relevant Environmental Laws, Regulations, Policies, Guidance, Instructions, and Executive Orders

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APPENDIX B

Relevant Environmental Laws, Regulations, Policies, Guidance, Instructions, Executive Orders, and Consultations

FEDERAL LAWS, REGULATIONS, AND EXECUTIVE ORDERS FOR NATURAL RESOURCES

- Animal Damage Control Act (7 United States Code [USC] 426 et seq.)
- Anti-Deficiency Act (31 USC 1341 et seq.)
- Brown Treesnake Control and Eradication Act (7 USC 8501 et seq.)
- Clean Air Act, as Amended (42 USC 7401 et seq.)
- Clean Water Act (CWA) Sections 401 and 404 (33 USC 1251 et seq.)
- CWA Section 404(b)(1) Regulations (40 Code of Federal Regulations [CFR] 230)
- Coastal Barrier Resources Act of 1982 (16 USC 3501 et seq.)
- Coastal Zone Management Act (16 USC 1451-1465)
- Consolidated Appropriations Act of 2005 (Public Law [PL] 108-447)
- Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) (Superfund) of 1980, (42 USC 9601 et seq.)
- Conservation and Rehabilitation Program on Military and Public Lands, as Amended (16 USC 670 et seq.)
- Coral Reef Conservation Act of 2000 (16 USC 6401 et seq.)
- Council on Environmental Quality (CEQ) Regulations on Implementing National Environmental Policy Act (NEPA) Procedures (40 CFR 1500-1508)
- Defense Environmental Restoration Program (10 USC 2701)
- Department of Defense (DoD) Appropriation Act (PL 102-393)
- Dredge and Fill Nationwide Permit Program (33 CFR 330)
- Endangered and Threatened Wildlife and Plants (50 CFR 17)
- Endangered Species Act (ESA), as Amended (16 USC 1531 et seq.)
- Entering Military, Naval, or Coast Guard Property (18 USC 1382)
- Environmental Effects in the United States (U.S.) of DoD Actions (32 CFR 188)
- Erosion Protection Act (33 USC 426)
- Estuary Protection Act (16 USC 1226)
- Executive Order (EO) 11514, *Protection and Enhancement of Environmental Quality* (as amended by EOs 11541 and 11991)
- EO 11644, *Use of Off-Road Vehicles on the Public Lands*
- EO 11987, *Exotic Organisms*
- EO 11988, *Floodplain Management*
- EO 11989, *Off-Road Vehicles Use on Public Lands*
- EO 11990, *Protection of Wetlands*
- EO 12780, *Federal Agency Recycling and the Council on Federal Recycling and Procurement Policy*
- EO 12902, *Energy Efficiency and Water Conservation at Federal Facilities*
- EO 12962, *Recreational Fisheries*
- EO 13089, *Coral Reef Protection*
- EO 13112, *Invasive Species*
- EO 13158, *Marine Protected Areas*
- EO 13186, *Responsibilities of Federal Agencies to Protect Migratory Birds*
- EO 13352, *Facilitation of Cooperative Conservation*
- EO 13423, *Strengthening Federal Environmental, Energy, and Transportation Management*

- EO 13751, *Safeguarding the Nation from the Impacts of Invasive Species*
- Farmland Protection Policy Act (7 USC 4201 et seq.)
- Federal Aid in Wildlife Restoration Act (16 USC 669-669i); also known as the "Pittman-Robertson Act"
- Federal Compliance with Pollution Control Standards (42 USC 4321)
- Federal Consistency with Approved Coastal Management Programs under Coastal Zone Management Act (CZMA) (15 CFR 930)
- Federal Environmental Pesticide Control Act (7 USC 2809)
- Federal Facilities Compliance Act (42 USC 6961)
- Federal Insecticide, Fungicide, and Rodenticide Act, as amended (7 USC 136 et seq.)
- Federal Land Policy and Management Act (43 USC 1701 et seq.)
- Federal Noxious Weed Act (7 USC 2801 et seq.)
- Federal Plant Pest Act (7 USC 150aa et seq.)
- Federal Water Pollution Control Act (CWA) (33 USC 1251-1376)
- Federal Water Pollution Control Act, as Amended by the CWA (PL 92-500)
- Fish and Wildlife Conservation Act (16 USC 2901-2911)
- Fish and Wildlife Conservation and Natural Resources Management Programs on Military Reservations (PL 96-561)
- Fish and Wildlife Coordination Act (16 USC 661-667e)
- Fish and Wildlife Improvement Act (16 USC 7421)
- Fishery Ecosystem Plan for the Mariana Archipelago (Western Pacific Regional Fishery Management Council 2009)
- Forest Resources Conservation and Shortage Relief Act (16 USC 620 et seq.)
- Hunting and Fishing on Federal Lands (10 USC 2671 et seq.)
- Interagency Cooperation, ESA of 1973, as Amended (50 CFR 402)
- Lacey Act of 1900 (16 USC 701), and Lacey Act Amendments (16 USC 3371-3378)
- Land and Water Conservation Act (16 USC 4601 et seq.)
- Legacy Resource Protection Program Act (PL 101-511)
- Magnuson Stevens Fishery Conservation and Management Act of 1976 (16 USC 1801 et seq.)
- Marine Mammal Protection Act, as Amended (16 USC 1361 et seq.)
- Marine Protection, Research, and Sanctuaries Act (also referred to as the Ocean Dumping Act) (16 USC 1431 et seq. and 33 USC 1401 et seq.)
- Migratory Bird Conservation Act (16 USC 715 et seq.)
- Migratory Bird Permits; Take of Migratory Birds by the Armed Forces, U.S. Fish and Wildlife Service (USFWS) Final Rule (72 Federal Register 8931-8950 [February 28, 2007])
- Migratory Bird Treaty Act (MBTA) of 1918 (16 USC 703-712)
- Military Construction Authorization Act of 1956, Leases; Non-Excess Property (10 USC 2667)
- Military Construction Authorization Act of 1956, Sale of Certain Interests in Lands, Logs (10 USC 2665)
- Military Construction Authorization Act of 1975 (10 USC 2665)
- Military Readiness Rule (50 CFR Part 21.15)
- Military Reservation and Facilities: Hunting, Fishing and Trapping (10 USC 2671)
- Multiple-Use Sustained Yield Act (16 USC 528)
- National Defense Authorization Act for Fiscal Year 2003
- National Defense Authorization Act for Fiscal Year 2015 (PL 113-291)
- National Defense Authorization Act for Fiscal Year 2016 (PL 114-92)
- National Defense Authorization Act for Fiscal Year 2017 (PL 114-328)
- NEPA of 1969, as Amended (42 USC 4321 et seq.)

- National Historic Preservation Act (NHPA) (PL 89-665) (54 USC 300101 et seq.)
- National Invasive Species Act of 1996 (Formerly, Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990), as Amended (16 USC 4701 et seq.)
- National Oceanic and Atmospheric Administration Coastal Zone Management Program Development and Approval Regulation (15 CFR 923, Subparts A-K)
- National Wildlife Refuge (NWR) System Administration Act of 1996 (16 USC 668dd-668ee)
- Natural Resources Management Program (32 CFR 190)
- Pacific Islands Regional Action Plan (December 2016)
- National Oceanic and Atmospheric Administration (NOAA) Fisheries Climate Science Strategy, NOAA Technical Memorandum NMFS-F/SPO-155 (August 2015)
- Noxious Plant Control Act (43 USC 1241)
- Ocean Dumping Regulations and Criteria (40 CFR 220-229)
- Oil Pollution Act (33 USC 2701 et seq.)
- Outdoor Recreation, Federal/State Program Act (16 USC 4601 et seq.)
- Partners for Fish and Wildlife Act (16 USC 3771 et seq.)
- Plant Quarantine Act (7 USC 151-167)
- Pollution Prevention Act (42 USC 13101 et seq.)
- Presidential Proclamation 9077 – Commonwealth of the Northern Mariana Islands (CNMI), Reserving Certain Submerged Lands in the CNMI (January 15, 2014)
- Presidential Proclamation 4347 – American Samoa, Guam, and the Virgin Islands (February 1, 1975)
- President's Directive on Environmentally and Economically Beneficial Practices on Federal Landscaped Grounds
- Regulations Concerning Marine Mammals (50 CFR 18, 216, 228)
- Resource Conservation and Recovery Act (42 USC 6901 et seq.)
- Rivers and Harbors Act of 1889 (33 USC 403 et seq.)
- Safe Drinking Water Act (42 USC 300(f) et seq.)
- Sales of Forest Products on Federal Lands (10 USC 2665 et seq.)
- Sikes Act Improvement Act (16 USC 670a et seq.)
- Soil and Water Conservation Act (16 USC 2001-2009)
- Soil Conservation Act (16 USC 5901)
- Territorial Submerged Lands Act (PL 93-435)
- USFWS Guidelines for Coordination on Integrated Natural Resources Management Plans (June 2015)
- Water Pollution Prevention and Control (33 USC 1251 et seq.)
- Wetland Resources (16 USC 3901)

FEDERAL GUIDELINES FOR NATURAL RESOURCES

- U.S. Army Corps of Engineers (USACE) 1987 Wetland Delineation Manual
- Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Hawaii and Pacific Islands Region (Version 2.0)
- USFWS Reducing Bird Collisions with Buildings and Building Glass Best Practices (July 2016)

DEPARTMENT OF DEFENSE DIRECTIVES, INSTRUCTIONS, REGULATIONS, AND POLICIES FOR NATURAL RESOURCES

- Deputy Under Secretary of Defense Memorandum, Integrated Natural Resources Management Plan Template
- DoD Directive 3200.15, *Sustaining Access to the Live Training and Test Domain*
- DoD Directive 4140.1, *DoD Supply Chain Material Management Policy*
- DoD Directive 4700.4, *Natural Resources Management Program*
- DOD Directive 4705.01E, *Management of Land-Based Water Resources in Support of Contingency Operations*
- DoD Directive 4710.1, *Archaeological and Historic Resources Management*
- DoD Directive 4715.21, *Climate Change Adaptation and Resilience*
- DoD Directive 5030.41, *Oil and Hazardous Substance Pollution Prevention and Contingency Program*
- DoD Directive 6050.1, *Environmental Effects in the U.S. of DoD Strategies*
- DoD Directive 6050.15, *Prevention of Oil Pollution from Ships Owned or Operated by the Department of Defense*
- DoD Directive 6050.2 (as Amended), *Use of Off-Road Vehicles on DoD Lands*
- DoD Directive 6050.4, *Marine Sanitation Devices for Vessels Owned or Operated by DoD*
- DoD Integrated Natural Resources Management Plan (INRMP) Handbook, *Resources for INRMP Implementation*
- DoD Instruction 4001.01, *Installation Support*
- DoD Instruction 4150.07, *DoD Pest Management Program*
- DoD Instruction 4165.57, *Air Installations Compatible Use Zones*
- DoD Instruction 4165.59, *DoD Implementation of the Coastal Zone Management Act*
- DoD Instruction 4700.2, *Secretary of Defense Award for Natural Resources and Environmental Management*
- DoD Instruction 4715.03, *Natural Resources Conservation Program*
- DoD Instruction 4715.4, *Pollution Prevention*
- DoD Instruction 4715.06, *Environmental Compliance in the United States*
- DoD Instruction 4715.07, *Environmental Restoration Program*
- DoD Instruction 4715.9, *Environmental Planning and Analysis*
- DoD Instruction 5000.13, *Natural Resources - The Secretary of Defense Natural Resource Conservation Award*
- DoD Instruction 6050.05, *DoD Hazard Communication Program*
- DoD Instruction 6055.06, *DoD Fire and Emergency Services Program*
- DoD Manual 4715.03, *Integrated Natural Resources Management Plan Implementation Manual*
- DoD 2014 Climate Change Adaptation Roadmap (June 2014)
- DoD Environmental Management Systems Compliance Management Plan (November 2009)
- DoD Supplemental Guidance for Implementing and Operating a Joint Base, Office of the Under Secretary of Defense (April 15, 2008)
- Supplemental Guidance for Implementation of the Sikes Act Improvement Act, Office of the Secretary of Defense (November 1, 2004)
- Supplemental Guidance for Implementation of the Sikes Act Improvement Act, Office of the Secretary of Defense (September 5, 2005)
- Updated Guidance For Implementation of the Sikes Act Improvement Act, Office of the Under Secretary of Defense (October 10, 2002)
- Army Regulation 200-1, *Environmental Protection and Enhancement* (December 13, 2007)

U.S. DEPARTMENT OF THE NAVY DIRECTIVES, REGULATIONS, AND POLICIES FOR NATURAL RESOURCES

- Office of the Chief of Naval Operations (OPNAV), Assignment of Accountability for Leased Property in the Northern Mariana Islands (November 1, 1983)
- CINCPACFLTINST 5090.1B, *Pacific Fleet Environmental Protection Program*
- Commander Naval Forces Marianas (COMNAVMARIANAS) Instruction 11320.1, *Fire Prevention Program Instruction*
- U.S. Department of Navy (DON) Procedures for Implementing NEPA (32 CFR 775)
- Final Guam Landscaping Guidelines (2011)
- NAVBASEGUAMINST 5090.2A, *Saltwater Fishing*
- Naval Facilities Engineering Command (NAVFAC) Instruction 11010.45, *Regional Shore Infrastructure Planning*
- NAVFAC Instruction 11012.111A, *Land Use Conservation Planning*
- NAVFAC Instruction 6250.3H, *Applied Biology Program Services and Training*
- NCTAMS Western Pacific Guam Instruction 11011.1C (currently undergoing revision as COMNAVMARIANAS Instructions)
- Chief of Naval Operations Instructions (OPNAVINST) 11010.20F, *Facilities Projects Manual*
- OPNAVINST 5090.1, *Environmental Readiness Program*
- OPNAVINST 5090.6, *Management and Recreation of Natural and Cultural Resources on U.S. Naval Activities, Guam*
- OPNAVINST 6250.4C, *Pest Management Program*
- OPNAVINST 8000.16, *Environmental Security Management*
- OPNAVINST 8026.2C, *Navy Munitions Disposition Policy*
- OPNAV M-5090.1, *Environmental Readiness Program Manual*
- Secretary of the Navy Instruction (SECNAVINST) 5090.6A, *Environmental Planning For Department of the Navy Actions*
- SECNAVINST 5090.8A, *Policy for Environmental Protection, Natural Resources, Cultural Resources Programs*
- SECNAVINST 6240.6E, *Implementation of DoD Directives under DoD Instruction 4700.4*
- INRMP Guidance For Navy Installations (April 2006)
- Management Plan for the Haputo Ecological Reserve Area (ERA) (January 1986)
- Guam Submerged Lands Management Plan. U.S. Navy Region Marianas (September 2007)
- Orote Peninsula ERA General Management Plan (August 2010)
- Haputo ERA General Management Plan (August 2010)
- Joint Region Marianas (JRM) Naval Base Guam Ungulate Management Plan (December 2013)
- JRM Andersen AFB Ungulate Management Plan (December 2013)
- A Cooperative Strategy for 21st Century Seapower (March 2015)
- DON Environmental Strategy (April 2008)

U.S. DEPARTMENT OF THE AIR FORCE DIRECTIVES, REGULATIONS, AND POLICIES FOR NATURAL RESOURCES

- Air Force Instruction (AFI) 32-1053, *Pest Management Program*
- AFI 32-7024, *Integrated Natural Resources Management*
- AFI 32-7060, *Interagency and Intergovernmental Coordination for Environmental Planning*
- AFI 32-7061, *Environmental Impact Analysis Process (EIAP)*
- AFI 32-7064, *Integrated Natural Resources Management*
- AFI 32-7081, *Forest Management Manual*
- AFI 91-202, *U.S. Air Force Mishap Prevention Program*
- Policy Memo for Implementation of Sikes Act Improvement Amendments, U.S. Air Force (USAF) Environmental Office (HQ USAF/ILEV) on January 29, 1999
- Air Force Policy Directive 32-70, *Environmental Quality*
- *Environmental Protection, EIAP* (32 CFR 989)
- 36th Air Base Wing Instruction 32-7003, *Conservation and Management of Natural Resources*
- Sea Turtle (*Chelonia mydas*) Management Plan for Andersen Air Force Base (AFB), Guam (2022)
- Final Mariana Fruit Bat (*Pteropus mariannus mariannus*) Management Plan for Andersen AFB, Guam (August 2008)
- Draft Adaptive Management Plan, Andersen AFB, Guam (February 2011)
- 36th Wing Bird Aircraft Strike Hazard Plan, Andersen AFB, Guam (March 1, 2008)

MEMORANDUMS OF AGREEMENT, MEMORANDUMS OF UNDERSTANDING, AND COOPERATIVE AGREEMENTS REGARDING NATURAL RESOURCES

- DoD Memorandum on Implementation of Ecosystem Management in DoD
- Memorandum of Agreement (MOA) for Brown Treesnake Control among the U.S. Department of Interior, DoD, U.S. Department of Agriculture (USDA), U.S. Depatment of Commerce, U.S. Department of Transportation, National Invasive Species Council, GovGuam, the State of Hawaii, and CNMI (1992, 1999, 2011)
- MOA, and Associated Modification, between the DON and USFWS Regarding Conservation of Guam Micronesian Kingfisher Recovery Habitat in Northern Guam (June and December 2015)
- Memorandum of Understanding (MOU) between the DoD and the USFWS for the Ecosystem-based Management of Fish, Wildlife and Plant Resources on Military Lands (May 17, 1999)
- MOU between the DoD and the USFWS to Promote the Conservation of Migratory Birds (September 5, 2014)
- MOA for Professional and Technical Assistance Conducting Biological Surveys, Research and Related Activities between the DoD and the National Biological Service of the Department of the Interior
- MOA for Cooperative Law Enforcement between the USFWS and Division of Aquatic and Wildlife Resources Department of Agriculture, Territory of Guam (July 9, 1990)
- MOU among the GovGuam and the U.S. Air Force and the U.S. Navy and the USFWS for the Establishment and Management of the Guam NWR, Guam (December 14, 1993)
- MOU between DoD, USFWS, and the Association of Fish and Wildlife Agencies for a Cooperative INRMP on Military Installations (July 29, 2013)
- MOU between the U.S. Environmental Protection Agency (USEPA) and the DoD with Respect to Integrated Pest Management (IPM)
- MOU for Watchable Wildlife Programs
- MOU to Foster the Ecosystem Approach between the CEQ, USDA, Department of the Army, Department of Commerce, DoD, Department of Energy, Department of Housing and Development, Department of the Interior, Department of Justice, Department of Labor, Department of State,

Department of Transportation, USEPA, and Office of Science and Technology Policy (December 15, 1995)
- Mutual DoD and USFWS Guidelines for Streamlined Review of INRMP Updates (July 20, 2015)
- Cooperative Agreement between the DoD and The Nature Conservancy for Assistance in Natural Resources Inventory
- Cooperative Agreement between the U.S. Navy and the USFWS for the Establishment and Management of the Guam NWR, Guam (March 1994)
- Cooperative Agreement between the USAF and the USFWS for the Establishment and Management of the Guam NWR, Guam (March 1994)
- Guam NWR Comprehensive Conservation Plan, Prepared by Guam NWR and USFWS (September 2009)
- Cooperative Agreement for the Protection, Development and Management of Fish and Wildlife Resources at U.S. Naval Communication Area Master Station, Western Pacific (March 14, 1988)
- Cooperative Agreement for the Protection, Development and Management of Fish and Wildlife Resources at U.S. Naval Magazine, Guam (March 7, 1988)
- Cooperative Agreement for the Protection, Development and Management of Fish and Wildlife Resources at U.S. Naval Station, Guam (April 12, 1988)
- Cooperative Agreement for the Protection, Development and Management of Fish and Wildlife Resources at U.S. Navy Public Works Center, Guam (April 11, 1988)
- Cooperative Agreement for the Protection, Development and Management of Fish and Wildlife Resources at U.S. Naval Supply Depot, Guam (February 29, 1988)
- Dedication of Tinian Military Retention Area Land for Wildlife Conservation, Tinian; agreement between the U.S. Government and CNMI Government (September 23, 1999)
- Partial Release of Leasehold Interest by and between the CNMI and the United States of America (September 23, 1999)
- Programmatic Agreement Among the DoD, the Advisory Council on Historic Preservation, the Guam State Historic Preservation Officer, and the CNMI State Historic Preservation Officer Regarding the Military Relocation to the Islands of Guam and Tinian (March 9, 2011)
- Record of Decision for the Final Supplemental Environmental Impact Statement (EIS) for Guam and CNMI Military Relocation (August 28, 2015)
- Record of Decision for Guam and CNMI Military Relocation including Relocating Marines from Okinawa, Transient Nuclear Aircraft Carrier Berth, Air and Missile Defense Task Force (September 21, 2010)
- Conservation and Management of Natural Resources, 36 WGI 32-7003 (July 30, 2007)

GOVERNMENT OF GUAM LAWS, REGULATIONS, AND POLICIES FOR NATURAL RESOURCES

- An Act to Establish Rules and Regulations for the Control of Fisheries by the Department of Agriculture (April 30, 1997) (Guam Public Law 24-21)
- CNMI Guam Stormwater Management Manual (2006)
- ESA of Guam (5 GCA 63205)
- EO 78-37, *Guam Land-Use Policies* (November 15, 1978)
- Game, Forestry and Conservation (5 GCA, Chapter 63, PL 6-85)
- Guam Code Annotated (1 GCA 4002 (a) as Amended by PL 20-185)
- Guam Comprehensive Wildlife Conservation Strategy (2006)
- Guam Coral Bleaching Response Plan (2017)
- Guam Hazard Mitigation Plan (2014)
- Guam Invasive Species Council Act of 2011 (5 GCA 70101 et seq.)
- Guam Marine Biosecurity Action Plan (Miller 2014)
- Guam Soil Erosion And Sediment Control Regulations, 22 GAR, Division II, Chapter 10, § 10103.C.5(d)
- Guam Water Pollution Control Act (10 GCA 47010-47112)
- Importation: Harboring (5 GCA 63124)
- Organic Act of Guam of 1950 (48 USC 1421, et seq., 64 Stat. 384)
- Protection of Wild Animals (5 GCA 63121)
- Protection of Wild Birds (5 GCA 63120)
- Regional Biosecurity Plan (RBP) for Micronesia and Hawaii (formerly referred to as the Micronesia Biosecurity Plan) (University of Guam [UOG] and Secretariat of the Pacific Community 2014)

GOVERNMENT OF THE COMMONWEALTH OF THE NORTHERN MARIANA ISLAND LAWS, REGULATIONS, AND POLICIES FOR NATURAL RESOURCES

- CNMI Comprehensive Wildlife Conservation Strategy (2005)
- CNMI Guam Stormwater Management Manual (2006)
- CNMI Wildlife Action Plan (2015)
- Fish, Game, and ESA (PL 2-51)
- Non-commercial Fish and Wildlife Regulations (CNMI Administrative Code 85-30.1)

TABLE B-1 FORMAL, INFORMAL, TECHNICAL ASSISTANCE, AND TERMINATED CONSULTATIONS

Title of Consultation	*Year*	*Date*	*Location*	*Type*
Mariana Islands Training and Testing Program	2015	2/20/2015	JRM	Formal
Marine Corps Relocation to Guam - Reinitiation 2017	2017	7/18/2017	MCBCB	Formal
Brown Tree Snake Control in the Habitat Management Unit 20180516	2018	5/16/2018	AAFB	Formal
Marine Corps Relocation to Guam - Amendment 2018	2018	10/30/2018	MCBCB	Formal
Marine Corps Relocation to Guam - 2020 Clarification	2020	2/27/2020	MCBCB	Formal
Munitions Storage Area (MSA) Igloo	2020	6/30/2020	AAFB	Formal
Utilities and Infrastructure Area Development Plan Supporting the Terminal High-Altitude Air Defense (THAAD) System	2020	12/18/2020	AAFB	Formal
Haputo Ungulate Eradication	2022	5/6/2022	MCBCB	Formal
Removal of Ungulates from the Haputo Ecological Reserve Area	2022	5/25/2022	MCBCB	Formal
Relay Ground Station-Asia (RGS-A) Site	2022	12/11/2022	MCBCB	Formal
Firefighter Training Facility (J-008)	2023	9/14/2023	MCBCB	Formal
Construction of Ungulate Fence	2015	6/26/2015	NBG	Informal
Reinitiation Testing a Remote Video Monitoring System at Mahlac and Maemong Caves	2018	3/5/2018	NBG	Informal
Reinitiation on Testing a Remote Video Monitoring System at Mahlac and Maemong Caves	2018	3/5/2018	NBG	Informal
Tarague Triangle Fence	2019	6/25/2019	AAFB	Informal
South Parking Pad Radomes at DET2, Northwest Field	2019	10/29/2019	AAFB	Informal
Swiftlet Cave Photography	2020	7/29/2020	NMS	Informal
Air Force Space Command (AFSPC) Snorkel Radome in DET2	2020	10/30/2020	AAFB	Informal
Ungulate Control Using Air Rifle and Archery Equipment	2020	10/30/2020	AAFB	Informal
Fuel Tie In Military Construction (MILCON) P661	2020	11/19/2020	NBG	Informal
Ungulate Fence and Eradication	2021	4/23/2021	AAFB	Informal
Recreational Hunting on AAFB	2021	4/23/2021	AAFB	Informal
Tarague II Fence	2021	4/23/2021	AAFB	Informal
Construction of Ungulate Fence, Scout Beach Road to Serena Beach Road	2021	4/23/2021	AAFB	Informal
Recreational Hunting Using Archery Equipment	2021	7/8/2021	AAFB	Informal
Cultural Site Visit at Mahlac Cave	2021	7/29/2021	NBG	Informal

Title of Consultation	*Year*	*Date*	*Location*	*Type*
Tree Removal at Mahlac and Maemong Caves	2021	9/24/2021	NBG	Informal
Swiftlet Cave Vegetation Management	2021	10/12/2021	NMS	Informal
Night Work Within and Adjacent to the Munitions Storage Annex 2	2021	11/2/2021	AAFB	Informal
Water Quality Monitoring on JRM Submerged Lands Guam	2022	1/6/2022	JRM Submerged Lands Guam	Informal
Tinian Harbor Repairs	2022	1/31/2022	Tinian	Informal
Little Fire Ant Eradication, Urban Training Complex (Andersen South)	2022	3/14/2022	MCBCB	Informal
Recreational Hunting Using Archery Equipment	2022	6/22/2022	AAFB	Informal
Missile Defense Agency (MDA) Munitions and Explosives of Concern (MEC) Reconnaissance Surveys Within JRM	2022	7/8/2022	JRM	Informal
"Tarague 3" Ungulate Exclusion at Tarague Basin Conservation Area	2022	8/4/2022	AAFB	Informal
Water Quality Monitoring on JRM Submerged Lands Tinian	2022	12/8/2022	Tinian	Informal
Water Quality Monitoring on Joint Region Marianas Submerged Lands	2022	12/8/2022	Tinian	Informal
Little Fire Ant Eradication at Haputo Ecological Reserve Area	2022	12/29/2022	MCBCB	Informal
Installation Restoration Program and Munitions Response Program, Guam	2022	8/30/2022	Guam	Technical Assistance
Tinian North Field Adaptive Rehabilitation Project	2023	8/9/2023	Tinian	Technical Assistance
Establishment and Operation of an Intelligence, Surveillance, Reconnaissance, and Strike Capability Project	2020	5/8/2020	AAFB	Termination

Key: AAFB = Andersen Air Force Base; JRM = Joint Region Marianas; MCBCB = Marine Corps Base Camp Blaz; NBG = Naval Base Guam; NMS = Naval Munitions Site

Appendix C
Status of the Implementation of Past and Present Integrated Natural Resources Management Plan Actions/Projects

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Table 13-6. Planned Implementation Summary of JRM Regional Projects				Year Funded						
Goals and Objectives	**INRMP Project Code/Title (Abbreviated)**	**EPR#**	**EPR Project Title**	**FY18**	**FY19**	**FY20**	**FY21**	**FY22**	**FY23**	**FY24**
Terrestrial Habitat Management										
1:1-2; 2:1-6; 3:1-2, 4	THM-1: Forest Enhancement	61128NR209	Listed Plant Surveys, Propagation, Planting, and Establishment in the Wild	X	X	X	X	X	X	X
		61128NR210	Monitoring Native Ecosystem Health and Growth	-	-	-	-	-	X	X
1:1-5; 2:1-8; 3:1-4; 4:1-4; 5:1-2; 6:1-2; 7:1-3	THM-2: JRM INRMP	61128NR201	JRM INRMP	X	X	X	X	X	X	X
Terrestrial Invasive Species Management										
1:1-2; 2:2-4; 3:1, 4; 4:1-4	TIS-1: Mariana Islands Training and Testing Implementation of the Biological Opinion	61128NR218	Mariana Islands Training and Testing Implementation of the Biological Opinion	X	X	X	X	X	X	X
1:1; 2:3; 3:1-2, 4; 4:1-4; 7:1	TIS-2: Implementation of Regional Biosecurity Plan for Micronesia and Hawaii	61128NR860	Implementation of Regional Biosecurity Plan for Micronesia and Hawaii	X	X	X	X	X	X	X
1:1-2; 2:3-4; 3:1, 4; 4:1-3	TIS-3: Brown Treesnake Control and Suppression	61128NR202	Brown Treesnake Eradication, Control and Adaptive Management to Support Recovery of ESA-listed Species	X	X	X	X	X	X	X
1:1-2; 2:3, 6; 3:1, 4; 4:1-3	TIS-4: Invasive Species Management	61128NR207	Little Fire Ant Surveys and Eradication	X	X	X	X			
Terrestrial Protected Species Management										
1:1-2; 2:1-6; 3:1-4; 4:1-3; 7:3	TPS-1: Guam Micronesian Kingfisher Memorandum of Agreement Implementation	Not available (NA)	Develop and Implement Guam Micronesian Kingfisher 10-year Plan	X	X	X	X	X	X	X
1:1; 2; 1, 3-6; 3:1-2, 4; 4:2-3	TPS-2: Conservation Management of Tinian Cycas micronesica Plantings	61128NR162	Conservation Management of Tinian Cycas micronesica Plantings	X	X	X	X	X	X	X
1:1-2; 3:1-2, 4; 4:2	TPS-3: Protection of Listed Invertebrates	61128NR203	Conservation Management of Endangered Mariana Eight-Spot Butterfly, Guam Tree Snail, Humped Tree Snail and Fragile Tree Snail	X	X	X	X	X	X	X
1:1-2; 3:1-2, 4	TPS-4: Perform Moth Skink and Pacific Slender-toed Gecko Surveys	61128NR204	Moth Skink and Pacific Slender-toed Gecko Surveys	-	-	-	-	-	-	-
1:1-2; 2:1-6; 3:1-2, 4; 4:2; 6:1-2	TPS-5: Sea Turtle Population Protection and Enhancement	61128NR211	Monitoring of Sea Turtle Nesting	X	X	X	X	X	X	X
		61128NR211	Barriers for Sea Turtle Nesting Protection	X	X	X	X	X	X	X
		61128NR211	Beach Marine Debris and Trash Removal for Sea Turtle Nesting Habitat Enhancement	X	X	X	X	X	X	X
1:1-2; 2:4; 3:1-2, 4	TPS-6: Conservation of Mariana Common Moorhen	61128NR211	Mariana Common Moorhen Monitoring	X	X	X	X	X	X	X
Migratory Bird Management										
1:1-2; 3:1-2, 4; 6:1	MIG-1: Monitoring of MBTA-listed Birds	61128NR211	Migratory Bird Monitoring	X	X	X	X	X	X	X
Terrestrial Natural Resources Educational Outreach										
1:1-2; 2:4; 3:4; 4:1, 4; 6:1; 7:1-2	TEDU-1: ESA-listed Species and Terrestrial Resources Outreach	NA	Broadcast Television and Radio Biosecurity Outreach and Education Public Service Announcements	-	-	-	-	-	-	-
1:1-2; 2:4; 3:4; 4:1,4; 6:1-2; 7:1-3	TEDU-2: JRM Natural Resources Stewardship Outreach and Public Engagement Program	61128NR962	JRM Natural Resources Stewardship Outreach and Public Engagement Program	X	X	X	X	X	X	X
Terrestrial Natural Resources Law Enforcement										
1:1-3; 2:1-2, 4; 3:4; 6:1-2; 7:1-3	TLAW-1: Conservation Law Enforcement	61755NR009, 61128NR589	Conservation Law Enforcement Program	-	-	-	-	X	X	X
Terrestrial GIS and Data Management										
1:1-2; 2:1-5; 3:1, 4	TGIS-1: Terrestrial Natural Resources GIS and Data Management	61128NR200	GIS Database Management	X	X	X	X	X	X	X
Marine Natural Resources Educational Outreach										
1:1-2; 2:4; 3:4; 4:1, 4; 6:1; 7:1-2	MEDU-1: ESA-listed Species and Marine Resources Outreach	61128NR217	Marine Resources Program Support	-	-	-	-	X	X	X

Table 13-7. Planned Implementation Summary of Projects at NBG Main Base				Year Funded						
Goals and Objectives	**INRMP Project Code/Title (Abbreviated)**	**EPR#**	**EPR Project Title**	**FY18**	**FY19**	**FY20**	**FY21**	**FY22**	**FY23**	**FY24**
Terrestrial Habitat Management										
1:1-2; 2:1-6; 3:1-4; 4:2	THM-1: Forest Enhancement	61128NR209	Listed Plant Surveys, Propagation, Planting and Establishment in the Wild	X	X	X	X	X	X	X
		61128NR210	Monitoring Native Ecosystem Health and Growth	-	-	-	-	-	-	-
		61755NR807	NBG Ungulate Management Population Control	X	X	X	X	X	X	X
		61755NR894	NBG Ungulate Fencing	X	X	X	X	X	X	X
		61755NR897	Restore Micronesian Starling to Native Forest Habitats	-	-	-	-	-	-	-
Terrestrial Invasive Species Management										
1:1-2; 2:3-4; 3:1, 4; 4:1-3; 7:3	TIS-1: Brown Treesnake Interdiction	61128NR202	Brown Treesnake Eradication, Control and Adaptive Management to Support Recovery of ESA-listed Species	X	X	X	X	X	X	X
1:1-2; 2:1-4, 6; 3:1, 4; 4:1-3; 7:3	TIS-2: Brown Treesnake Suppression	61128NR202	Brown Treesnake Eradication, Control and Adaptive Management to Support Recovery of ESA-listed Species	X	X	X	X	X	X	X
1:1-2; 2:1-4, 6; 3:1, 4; 4:1-3; 7:3	TIS-3: Brown Treesnake Management for the Recovery of Protected Species	61128NR202	Brown Treesnake Eradication, Control and Adaptive Management to Support Recovery of ESA-listed Species	X	X	X	X	X	X	X
1:1; 2:3; 3:1-2, 4; 4:1-4; 7:1	TIS-4: Implementation of Regional Biosecurity Plan Micronesia and Hawaii	61128NR860	Implementation of Regional Biosecurity Plan for Micronesia and Hawaii	X	X	X	X	X	X	X
1:1-2; 2:3, 6; 3:1, 4; 4:1-3	TIS-5: Invasive Species Management	61755NR354	Invasive Species Survey and Management	X	X	X	X	X	X	X
1:1-2; 2:3, 6; 3:1, 4; 4:1-3	TIS-5: Invasive Species Management	NA	Hazard Analysis Critical Control Point Program Implementation and Effectiveness Monitoring	-	-	-	-	-	-	-
1:1-2; 2:2-4; 3:1, 4; 4:1-4	TIS-6: Mariana Islands Training and Testing Implementation of the Biological Opinion	61128NR218	Mariana Islands Training and Testing Implementation of the Biological Opinion	X	X	X	X	X	X	X
1:1-2; 3:1, 4; 4:2	TIS-7: Control Feral Dogs and Cats	61755NR358	Control Feral Dogs and Cats	X	X	X	X	X	X	X
Terrestrial Protected Species Management										
1:1-2; 2:4; 3:1-4	TPS-1: ESA-listed Species Monitoring	61755NR142	Endangered Species Monitoring	X	X	X	X	X	X	X

1:1-2; 2:1-6; 3:1-2, 4; 4:2; 6:1-2	TPS-2: Sea Turtle Population Protection and Enhancement	61755NR142	Protection and Monitoring of Sea Turtle Nesting	X	X	X	X	X	X	X
		61755NR808	Green and Hawksbill Sea Turtle Nesting Habitat – Invasive Plant and Predator Control	X	X	-	-	-	-	-
1:1-2; 3:1-4; 4:2	TPS-3: Mariana Common Moorhen Habitat Enhancement	61755NR895	Mariana Common Moorhen Habitat Enhancement	X	X	X	X	X	X	X
1:1-2; 2:4; 3:1-2, 4	TPS-4: Mariana Islands Training and Testing Implementation of the Biological Opinion	61128NR218	Mariana Islands Training and Testing Implementation of the Biological Opinion	X	X	X	X	X	X	X
1:1-2; 2:1, 3-4; 3:1, 4	TPS-5: Mariana Fruit Bat Population Monitoring	61128NRFBM	Mariana Fruit Bat Population Monitoring	-	-	-	X	X	X	X
Migratory Bird Management										
1:1-2; 3:1-2, 4; 6:1	MIG-1: Monitoring and Analysis of MBTA-listed Bird Species	61128NR142	Monitoring of Migratory Birds	X	X	X	X	X	X	X
		61744NR896	Analysis of Long-term MBTA Monitoring Data	-	-	-	-	-	-	-
1:1-2; 3:1, 4	MIG-2: Checklist of BMPs and Conservation Measures for Migratory Birds	61755NR142	Checklist of BMPs and Conservation Measures for Migratory Birds	-	-	-	-	-	-	-
Terrestrial Natural Resources Educational Outreach										
1:1-2; 2:4; 3:4; 4:1,4; 6:1-2; 7:1-2	TEDU-1: ESA-listed Species and Terrestrial Resources Outreach	61755NR305	Threatened and Endangered Species Outreach Signage	X	X	X	X	X	X	X
		61755NR306	Listed Species Outreach Materials	X	X	X	X	X	X	X
1:1-2; 2:4; 3:4; 4:1,4; 6:1-2; 7:1-3	TEDU-2: JRM Natural Resources Stewardship Outreach and Public Engagement Program	61128NR962	JRM Natural Resources Stewardship Outreach and Public Engagement Program	X	X	X	X	X	X	X
		61128NR962	Reef-safe Sunscreen Outreach Materials to Protect Marine Resources	-	-	-	-	-	-	-
		61128NR962	Marine Debris Clean-up to Protect Threatened and Endangered Species	-	-	-	-	-	-	-
1:1-3; 2:1-2, 4; 3:4; 6:1-2; 7:1-3	TLAW-1: Conservation Law Enforcement	61755NR009, 61128NR589	Conservation Law Enforcement Program	-	-	-	-	X	X	X
Terrestrial GIS and Data Management										
1:1-2; 2:1-5; 3:1, 4	TGIS-1: Terrestrial Natural Resources GIS and Data Management	61128NR200	GIS Database Management	X	X	X	X	X	X	X
Marine Habitat Management										
1:1-2; 2:1, 3-6; 3:1-2, 4; 5:1-2; 6:1-2	MHM-1: Coral Habitat Enhancement	61755NR168	Ecosystem Monitoring and Coral Reef Indicators	X	X	X	X	X	X	X
		61128CN222	Monitoring and Control of Acute Impacts on Coral Reefs (Crown-of-Thorns Seastar and Coral Bleaching)	X	X	X	X	X	X	X
		61128NR214	Coral Nursery and Outplanting for Reef Restoration and Resilience	-	-	-	-	-	-	-
1:1-2; 2:1, 3-6; 3:1-2, 4; 5:1-2; 6:1-2	MHM-1: Coral Habitat Enhancement	61755NR849	Coral Protection Mooring Buoys	X	X	X	X	X	X	X
1:1; 2:1, 3-5; 3:1	MHM-2: Marine Flora Management	61755NR804	Green and Hawksbill Sea Turtle Habitat – Sea Grass Survey	-	-	-	-	-	-	-
		61128NR213	Macroalgae Control	-	-	-	-	-	-	-
1:1; 2:1, 3-5, 7; 3:1, 4	MHM-3: Evaluate Mangrove Functionality in the Atantano Watershed	61128NR656	Evaluate and Enhance Mangrove Functionality of the Atantano Watershed to Protect Essential Fish Habitat	-	-	-	-	-	-	-
1:1-2; 2 :1, 3-4; 3:4; 6:1	MHM-4: Avoid and Minimize Adverse Effects of DON Activities on Marine Resources	NA	Avoid and Minimize Adverse Effects of DON Activities on Marine Resources	-	-	-	-	-	-	-
1:1; 2:1, 3-4; 3:4; 7:3	MHM-5: Marine Resources Data Analysis and Coordination	61128NR742	Mariana Archipelago Reef Assessment and Monitoring Program Data Analysis and Coordination	-	-	-	-	-	-	-
1:1; 2:1, 3-5; 3:1, 4; 5:1; 7:3	MHM-6: Marine Habitat Mapping Efforts	61755NR818	Benthic Habitat and Coral Mapping and Management	-	-	-	-	-	-	-
		61128NR212	Marine Bathymetric Mapping Survey	X	X	X	X	X	X	X
1:1, 2; 2:4; 3:4; 7:3	MHM-7: U.S. Navy Diver Training for Submerged Natural Resources Management	61128NR716	U.S. Navy Diver Training for Submerged Natural Resources Management	X	X	X	X	X	X	X
1:1-2; 3:1-2, 4	MHM-8: Acoustic Telemetry Network	61128NR168	Ecosystem Monitoring and Coral Reef Indicators	X	X	X	X	X	X	X
Marine Invasive Species Management										
1:1; 2:3; 3:1-2, 4; 4:1-4; 7:1	MIS-1: Implementation of Regional Biosecurity Plan for Micronesia and Hawaii	61128NR860	Implementation of Regional Biosecurity Plan for Micronesia and Hawaii	X	X	X	X	X	X	X
1:1; 2:4; 4:4; 7:3	MIS-2: Federal and Territorial Coordination and Collaboration for Marine Invasive Species Prevention	61128NR860	Federal and Territorial Coordination and Collaboration for Marine Invasive Species Prevention	-	-	-	-	X	X	X
Marine Protected Species Management										
1:1-2; 3:1-2, 4	MPS-1: Scalloped Hammerhead Shark Survey	61755NR891	Scalloped Hammerhead Shark Survey	X	-	-	-	-	-	-
1:1-2; 3:1-2, 4; 7:3	MPS-2: Sea Turtle Population Protection and Enhancement	61755NR815	Sea Turtle Distribution and Habitat Use	X	X	X	X	X	X	X
1:1-2; 2:1,4; 3:1-2, 4; 4:2	MPS-3: Mariana Islands Training and Testing Implementation of the Biological Opinion	61128NR218	Mariana Islands Training and Testing Implementation of the Biological Opinion	X	X	X	X	X	X	X
Marine Natural Resources Educational Outreach										
1:1-2; 2:4; 3:4; 4:1, 4; 6:1-2; 7:1-2	MEDU-1: ESA-listed Species and Marine Resources Outreach	61755NR306	Listed Species Outreach Materials	X	X	X	X	X	X	X
1:1-2; 2:4; 3:4; 4:1, 4; 6:1-2; 7:1-2	MEDU-1: ESA-listed Species and Marine Resources Outreach	61755NR305	Threatened and Endangered Species Outreach Signage	X	X	X	X	X	X	X
1:1-2; 2:4; 3:4; 4:1, 4; 6:1-2; 7:1-3	MEDU-2: JRM Natural Resources Stewardship Outreach and Public Engagement Program	61128NR962	JRM Natural Resources Stewardship Outreach and Public Engagement Program	X	X	X	X	X	X	X
		61128NR962	Reef-safe Sunscreen Outreach Materials to Protect Marine Resources	-	-	-	-	-	-	-
		61128NR962	Marine Debris Clean-up to Protect Threatened and Endangered Species	-	-	-	-	-	-	-
Marine Natural Resources Law Enforcement										
1:1-3; 2:1-2, 4; 3:4; 6:1-2; 7:1-3	MLAW-1: Conservation Law Enforcement	61755NR009, 61128NR589	Conservation Law Enforcement Program	-	-	-	-	X	X	X
1:1, 3; 2:3-4; 3:4; 6:1-2	MLAW-2: Recreational Access Tracking and Ecological Reserve Area Visitor Use Plan	61755NR175	Management of Ecological Reserve Areas	-	-	-	-	-	-	-
Marine GIS and Data Management										
1:1-2; 2:1-5; 3:1, 4	MGIS-1: Marine Natural Resources GIS and Data Management	61128NR200	GIS Database Management	X	X	X	X	X	X	X

Table 13-8. Planned Implementation Summary of Projects at NMS				**Year Funded**
Goals and Objectives	**INRMP Project Code/Title (Abbreviated)**	**EPR#**	**EPR Project Title**	

Terrestrial Habitat Management				FY18	FY19	FY20	FY21	FY22	FY23	FY24
1:1-2; 2:7-8	THM-1: Watershed Management	61755NR832	Vetiver Grass Planting – Fena Valley Reservoir	X	X	X	X	X	X	X
		61755NR832	Soil and Water Conservation: Stabilization of Eroding Streambanks, Cliffs, and Ravines	X	X	X	X	X	X	X
1:1-2; 2:1-6; 3:1, 4; 4:2	THM-2: Forest Enhancement	61755NR856	Native Forest Habitat Restoration	X	X	X	X	X	X	X
		61128NR210	Monitoring Native Ecosystem Health and Growth	-	-	-	-	-	-	-
		61755NR837	Habitat Monitoring, Long-term Vegetation Surveys for Recovery of Threatened and Endangered Species	-	-	-	-	-	-	-
		61128NR209	Listed Plant Surveys, Propagation, Planting and Establishment in the Wild	X	X	X	X	X	X	X
		61755NR898	Ecological Monitoring and Control in Ungulate Exclusion Plots	X	X	X	X	X	X	X
1:1-2; 2:1-6; 3:1, 4; 4:2	THM-2: Forest Enhancement	61755NR894	Ungulate Fencing	X	X	X	X	X	X	X
		61755NR807	Ungulate Management Population Control	X	X	X	X	X	X	X
		61755NR897	Restore Micronesian Starling to Native Forest Habitats	-	-	-	-	-	-	-
1:1-2; 2:1-8; 3:1-2,4; 5:2; 7:2	THM-3: Managing Wildland Fires	61755NR857	Wildland Fire Management Plan (2015) Implementation through Habitat Management	X	X	X	X	X	X	X
Terrestrial Invasive Species Management										
1:1-2; 2:3-4; 3:1, 4; 4:1-3; 7:3	TIS-1: Brown Treesnake Interdiction	61128NR202	Brown Treesnake Eradication, Control and Adaptive Management to Support Recovery of ESA-listed Species	X	X	X	X	X	X	X
1:1-2; 2:1-4, 6; 3:1, 4; 4:1-3; 7:3	TIS-2: Brown Treesnake Suppression	61128NR202	Brown Treesnake Eradication, Control and Adaptive Management to Support Recovery of ESA-listed Species	X	X	X	X	X	X	X
1:1-2; 2:1-4, 6; 3:1, 4; 4:1-3; 7:3	TIS-2: Brown Treesnake Suppression	61755NR834	Mariana Swiftlet Population Protection: Brown Treesnake Trapping	X	X	X	X	X	X	X
1:1-2; 2:1-4, 6; 3:1, 4; 4:1-3; 7:3	TIS-3: Brown Treesnake Management for the Recovery of Protected Species	61128NR202	Brown Treesnake Eradication, Control and Adaptive Management to Support Recovery of ESA-listed Species	X	X	X	X	X	X	X
1:1-2; 3:1, 4; 4:2	TIS-4: Control Feral Dogs and Cats	61755NR358	Control Feral Dogs and Cats	X	X	X	X	X	X	X
1:1; 2:3; 3:1-2, 4; 4:1-4; 7:1	TIS-5: Implementation of Regional Biosecurity Plan Micronesia and Hawaii	61128NR860	Implementation of Regional Biosecurity Plan Micronesia and Hawaii	X	X	X	X	X	X	X
1:1-2; 2:3, 6; 3:1, 4; 4:1-3	TIS-6: Invasive Species Management	61755NR354	Invasive Species Surveys and Management	X	X	X	X	X	X	X
		61128NR207	Little Fire Ant Surveys and Eradication	X	X	X	X	X	X	X
1:1-2; 2:2-4; 3:1, 4; 4:1-4	TIS-7: Mariana Islands Training and Testing Implementation of the Biological Opinion	61128NR218	Mariana Islands Training and Testing Implementation of the Biological Opinion	X	X	X	X	X	X	X
Terrestrial Protected Species Management										
1:1-2; 2:4; 3:1-4	TPS-1: ESA-listed Species Monitoring	61755NR142	Endangered Species Monitoring	X	X	X	X	X	X	X
		61755NR142	Surveys for ESA-listed Plants, Tree Snails, and Butterflies and Butterfly Host Plants	X	X	X	X	X	X	X
1:1-2; 3:1-2, 4; 4:2	TPS-2: Protection of Listed Invertebrates	61128NR203	Conservation Management of Endangered Guam Tree Snail, Humped Tree Snail and Fragile Tree Snail	X	X	X	X	X	X	X
1:1-2; 3:1-2, 4	TPS-3: Perform Moth Skink and Pacific Slender-toed Gecko Surveys	61128NR204	Perform Moth Skink and Pacific Slender-toed Gecko Surveys	-	-	-	-	-	-	-
1:1-2; 3:1-2, 4; 4:1-2	TPS-4: Monitor and Maintain Mariana Swiftlet Population	61775NR142	Monitor and Maintain Mariana Swiftlet Population on NMS	X	X	X	X	X	X	X
		61775NR854	Mariana Swiftlet Recovery	X	X	X	X	X	X	X
1:1-2; 2:1, 3-6; 3:1-2, 4	TPS-5: Restoration of Mariana Common Moorhen Population	61755NR895	Restoration of Mariana Moorhen at Fena Valley Reservoir	X	X	X	X	X	X	X
1:1-2; 2:4; 3:1-2, 4	TPS-6: Mariana Islands Training and Testing Implementation of the Biological Opinion	61128NR218	Mariana Islands Training and Testing Implementation of the Biological Opinion	X	X	X	X	X	X	X
1:1-2; 2:1, 3-4; 3:1, 4	TPS-7: Mariana Fruit Bat Population Monitoring	61128NRFBM	Mariana Fruit Bat Population Monitoring	-	-	-	X	X	X	X
Migratory Bird Management										
1:1-2; 3:1-2, 4; 6:1	MIG-1: Monitoring of MBTA-listed Bird Species	61128NR142	Conducting Surveys for Migratory Birds							
Terrestrial Natural Resources Educational Outreach										
1:1-2; 2:4; 3:4; 4:1, 4; 6:1; 7:1-2	TEDU-1: ESA-listed Species and Terrestrial Resources Outreach	61755NR306	Listed Species Outreach Materials	X	X	X	X	X	X	X
1:1-2; 2:4; 3:4; 4:1, 4; 6:1; 7:1-3	TEDU-2: JRM Natural Resources Stewardship Outreach and Public Engagement Program	61128NR962	JRM Natural Resources Stewardship Outreach and Public Engagement Program	X	X	X	X	X	X	X
Terrestrial Natural Resources Law Enforcement										
1:1-3; 2:1-2, 4; 3:4; 6:1; 7:1-3	TLAW-1: Conservation Law Enforcement	61755NR009, 61128NR589	Conservation Law Enforcement Program	-	-	-	X	X	X	X
Terrestrial GIS and Data Management										
1:1-2; 2:1-5; 3:1, 4	TGIS-1: Terrestrial Natural Resources GIS and Data Management	61128NR200	GIS Database Management	X	X	X	X	X	X	X

Table 13-9. Planned Implementation Summary of Projects at Apra Heights, Sasa Valley and Tenjo Vista Tank Farms, NCTS Barrigada, Barrigada Transmitter Site, and Andersen South				Year Funded						
Goals and Objectives	**INRMP Project Code/Title (Abbreviated)**	**EPR#**	**EPR Project Title**							
Terrestrial Habitat Management				**FY18**	**FY19**	**FY20**	**FY21**	**FY22**	**FY23**	**FY24**
1:1-2; 2:3, 7-8	THM-1: Watershed Management	61755NR832	Soil and Water Conservation: Stabilization of Eroding Streambanks, Cliffs, and Ravines	X	X	X	X	X	X	X
1:1-2; 2:3, 6; 5:2	THM-2: Fire Prevention and Management	61755NR857	Wildland Fire Management of Savanna Grasslands: Erosion Control to Benefit Apra Harbor (for Sasa Valley and Apra Heights)	X	X	X	X	X	X	X
		61755NR858	Fire Prevention Plantings at Sasa Valley Fuel Farm (USACE Mitigation) (for Sasa Valley)	-	-	-	-	-	-	-
Terrestrial Invasive Species Management										

1:1-2; 2:3-4; 3:1, 4; 4:1-3; 7:3	TIS-1: Brown Treesnake Interdiction	61128NR202	Brown Treesnake Eradication, Control and Adaptive Management to Support Recovery of ESA-listed Species	X	X	X	X	X	X	X
1:1-2; 2:1-4, 6; 3:1, 4; 4:1-3; 7:3	TIS-2: Brown Treesnake Suppression	61128NR202	Brown Treesnake Eradication, Control and Adaptive Management to Support Recovery of ESA-listed Species	X	X	X	X	X	X	X
1:1-2; 2:1-4, 6; 3:1, 4; 4:1-3; 7:3	TIS-3: Brown Treesnake Management for the Recovery of Protected Species	61128NR202	Brown Treesnake Eradication, Control and Adaptive Management to Support Recovery of ESA-listed Species	X	X	X	X	X	X	X
1:1-2; 2:3, 6; 3:1, 4; 4:1-3	TIS-4: Invasive Species Management	61128NR207	Little Fire Ant Surveys and Eradication	X	X	X	X	X	X	X
		NA	Green Waste Management	-	-	-	-	-	-	-
		NA	Hazard Analysis Critical Control Point Program Implementation and Effectiveness Monitoring	-	-	-	-	-	-	-
1:1; 2:3; 3:1-2, 4; 4:1-4; 7:1	TIS-5: Implementation of Regional Biosecurity Plan Micronesia and Hawaii	61128NR860	Implementation of Regional Biosecurity Plan Micronesia and Hawaii	X	X	X	X	X	X	X
1:1-2; 2:2-4; 3:1, 4; 4:1-4	TIS-6: Mariana Islands Training and Testing Implementation of the Biological Opinion	61128NR218	Mariana Islands Training and Testing Implementation of the Biological Opinion	X	X	X	X	X	X	X
1:1-2; 3:1, 4; 4:2	TIS-7: Control Feral Dogs and Cats	61755NR358	Control Feral Dogs and Cats	-	-	-	-	-	-	-
Terrestrial Protected Species Management										
1:1-2; 2:1, 3-4; 3:1-2, 4	TPS-1: ESA-listed Species Monitoring	61755NR142	Endangered Species Monitoring	X	X	X	X	X	X	X
		M5240CN048	Monitoring and Surveys for Listed Tree Snails, Butterflies, and Plants	X	X	X	X	X	X	X
		NA	Pre-construction Surveys for ESA-listed Species	-	-	-	-	-	-	-
1:1-2; 2:1, 3-4; 3:1-2, 4	TPS-1: ESA-listed Species Monitoring	NA	Translocate Listed Tree Snails from Construction Footprint	-	-	-	-	-	-	-
1:1-2; 2:4; 3:1-2, 4	TPS-2: Mariana Islands Training and Testing Implementation of the Biological Opinion	61128NR218	Mariana Islands Training and Testing Implementation of the Biological Opinion	X	X	X	X	X	X	X
1:1-2; 2:1, 3-4; 3:1, 4	TPS-3: Mariana Fruit Bat Population Monitoring	61128NRFBM	Mariana Fruit Bat Population Monitoring	X	X	X	X	X	X	X
Migratory Bird Management										
1:1-2; 3:1-2, 4; 6:1	MIG-1: Monitoring of MBTA-listed Bird Species	61128NR142	Conducting Surveys for Migratory Birds	-	-	-	-	-	-	-
Terrestrial Natural Resources Educational Outreach										
1:1-2; 2:4; 3:4; 4:1, 4; 6:1; 7:1-2	TEDU-1: ESA-listed Species and Terrestrial Resources Outreach	61755NR306	Listed Species Outreach Materials	X	X	X	X	X	X	X
		NA	Contractor Education Program	-	-	-	-	-	-	-
1:1-2; 2:4; 3:4; 4:1, 4; 6:1; 7:1-3	TEDU-2: JRM Natural Resources Stewardship Outreach and Public Engagement Program	61128NR962	JRM Natural Resources Stewardship Outreach and Public Engagement Program	X	X	X	X	X	X	X
Terrestrial Natural Resources Law Enforcement										
1:1-3; 2:1-2, 4; 3:4; 6:1; 7:1-3	TLAW-1: Conservation Law Enforcement	61755NR009, 61128NR589	Conservation Law Enforcement Program	-	-	-	-	X	X	X
Terrestrial GIS and Data Management										
1:1-2; 2:1-5; 3:1, 4	TGIS-1: Terrestrial Natural Resources GIS and Data Management	61128NR200	GIS Database Management	X	X	X	X	X	X	X

Table 13-10. Planned Implementation Summary of Projects at NBG TS				**Year Funded**						
Goals and Objectives	**INRMP Project Code/Title (Abbreviated)**	**EPR#**	**EPR Project Title**							
Terrestrial Habitat Management				**FY18**	**FY19**	**FY20**	**FY21**	**FY22**	**FY23**	**FY24**
1:1-2; 2:7-8	THM-1: Watershed Management	61755NR832	Soil and Water Conservation: Stabilization of Eroding Streambanks, Cliffs, and Ravines (Haputo Ecological Reserve Area)	X	X	X	X	X	X	X
1:1-2; 2:1-4; 3:1, 4; 4:1-2	THM-2: Protection of Ecological Reserve Area	61755NR175	Management of Ecological Reserve Areas	X	X	X	X	X	X	X
		NA	Fence Haputo Ecological Reserve Area	X	X	X	X	X	X	X
1:1-2; 2:1-6; 3:1-4; 4:1-2	THM-3: Forest Enhancement	NA	Ungulate Removal, Native Plant Propagation and Planting and Invasive Plant Species Control	X	X	X	X	X	X	X
		61128NR209	Listed Plant Surveys, Propagation, Planting and Establishment in the Wild	X	X	X	X	X	X	X
		61128NR210	Monitoring Native Ecosystem Health and Growth	-	-	-	-	-	-	-
1:1-2; 2:1-6; 3:1-4; 4:1-2	THM-3: Forest Enhancement	NA	Establish a Native Plant Nursery	-	-	-	-	-	-	-
		61755NR897	Restore Micronesian Starling to Native Forest Habitats	-	-	-	-	-	-	-
Terrestrial Invasive Species Management										
1:1-2; 2:3-4; 3:1, 4; 4:1-3; 7:3	TIS-1: Brown Treesnake Interdiction	61128NR202	Brown Treesnake Eradication, Control and Adaptive Management to Support Recovery of ESA-listed Species	X	X	X	X	X	X	X
1:1-2; 2:1-4, 6; 3:1, 4; 4:1-3; 7:3	TIS-2: Brown Treesnake Suppression	61128NR202	Brown Treesnake Eradication, Control and Adaptive Management to Support Recovery of ESA-listed Species	X	X	X	X	X	X	X
1:1-2; 2:1-4, 6; 3:1, 4; 4:1-3; 7:3	TIS-3: Brown Treesnake Management for the Recovery of Protected Species	61128NR202	Brown Treesnake Eradication, Control and Adaptive Management to Support Recovery of ESA-listed Species	X	X	X	X	X	X	X
1:1; 2:3; 3:1-2, 4; 4:1-4; 7:1	TIS-4: Implementation of Regional Biosecurity Plan Micronesia and Hawaii	61128NR860	Implementation of Regional Biosecurity Plan Micronesia and Hawaii	X	X	X	X	X	X	X
1:1-2; 2:2-4; 3:1, 4; 4:1-4	TIS-5: Mariana Islands Training and Testing Implementation of the Biological Opinion	61128NR218	Mariana Islands Training and Testing Implementation of the Biological Opinion	X	X	X	X	X	X	X
1:1-2; 2:3, 6; 3:1, 4; 4:1-3	TIS-6: Invasive Species Management	NA	Green Waste Management	-	-	-	-	-	-	-
		NA	Hazard Analysis Critical Control Point Program Implementation and Effectiveness Monitoring	-	-	-	-	-	-	-
		61128NR207	Little Fire Ant Surveys and Eradication	X	X	X	X	X	X	X
1:1-2; 3:1, 4; 4:2	TIS-7: Control Feral Dogs and Cats	61755NR358	Control Feral Dogs and Cats	X	X	X	X	X	X	X
Terrestrial Protected Species Management										
1:1-2; 2:1, 3-4; 3:1-2, 4	TPS-1: ESA-listed Species Monitoring	61755NR142	Endangered Species Monitoring	X	X	X	X	X	X	X
1:1-2; 2:1, 3-4; 3:1, 4	TPS-2: Conservation of Listed Species	NA	Pre-construction Surveys for ESA-listed Species at Finegayan, NBG	X	X	X	X	X	X	X

1:1-2; 2:4; 3:1-2, 4	TPS-3: Mariana Islands Training and Testing Implementation of the Biological Opinion	61128NR218	Mariana Islands Training and Testing Implementation of the Biological Opinion	X	X	X	X	X	X	X
1:1-2; 2:1, 3-4; 3:1, 4	TPS-4: Mariana Fruit Bat Population Monitoring	61123NRFBM	Mariana Fruit Bat Population Monitoring	-	-	-	X	X	X	X
Migratory Bird Management										
1:1-2; 3:1-2, 4; 6:1	MIG-1: Monitoring of MBTA-listed Bird Species	61128NR142	Conducting Surveys of Migratory Birds	X	X	X	X	X	X	X
Terrestrial Natural Resources Educational Outreach										
1:1-2; 2:4; 3:4; 4:1, 4; 6:1-2; 7:1-2	TEDU-1:ESA-listed Species and Terrestrial Resources Outreach	61755NR305	Threatened and Endangered Species Outreach Signage	X	X	X	X	X	X	X
1:1-2; 2:4; 3:4; 4:1, 4; 6:1-2; 7:1-2	TEDU-1:ESA-listed Species and Terrestrial Resources Outreach	NA	Contractor Education Program on ESA-listed and Invasive species	-	-	-	-	-	-	-
		61755NR306	Listed Species Outreach Materials	X	X	X	X	X	X	X
1:1-2; 2:4; 3:4; 4:1, 4; 6:1-2; 7:1-3	TEDU-2: JRM Natural Resources Stewardship Outreach and Public Engagement Program	61128NR962	JRM Natural Resources Stewardship Outreach and Public Engagement Program	X	X	X	X	X	X	X
		61128NR962	Reef-safe Sunscreen Outreach Materials to Protect Marine Resources	-	-	-	-	-	-	-
1:1-2; 2:4; 3:4; 4:1, 4; 6:1-2; 7:1-3	TEDU-2: JRM Natural Resources Stewardship Outreach and Public Engagement Program	61128NR962	Marine Debris Clean-up to Protect Threatened and Endangered Species	-	-	-	-	-	-	-
Terrestrial Natural Resources Law Enforcement										
1:1-3; 2:1-2, 4; 3:4; 6:1-2; 7:1-3	TLAW-1: Conservation Law Enforcement	61755NR009, 61128NR589	Conservation Law Enforcement Program	-	-	-	-	X	X	X
Terrestrial GIS and Data Management										
1:1-2; 2:1-5; 3:1, 4	TGIS-1: Terrestrial Natural Resources GIS and Data Management	61128NR200	GIS Database Management	X	X	X	X	X	X	X
Marine Habitat Management										
1:1-2; 2:1, 3-6; 3:1-2, 4; 5:1-2	MHM-1: Coral Habitat Enhancement	61755NR168	Ecosystem Monitoring and Coral Reef Indicators	-	-	-	-	-	-	-
1:1-2; 2:1, 3-6; 3:1-2, 4; 5:1-2	MHM-1: Coral Habitat Enhancement	61128CN222	Monitoring and Control of Acute Impacts on Coral Reefs (Crown-of-Thorn Seastar and Coral Bleaching)	-	-	-	-	-	-	-
		61128NR214	Coral Nursery and Outplanting for Reef Restoration and Resilience	-	-	-	-	-	-	-
1:1; 2:1, 3-4; 3:4; 7:3	MHM-2: Marine Resources Data Analysis and Coordination	61128NR742	Mariana Archipelago Reef Assessment and Monitoring Program Data Analysis and Coordination	-	-	-	-	-	-	-
1:1; 2:1, 3-5; 3:1, 4; 5:1; 7:3	MHM-3: Marine Habitat Mapping Efforts	61755NR818	Benthic Habitat and Coral Mapping and Management	-	-	-	-	-	-	-
1:1; 2:1, 3-5; 3:1, 4; 5:1; 7:3	MHM-3: Marine Habitat Mapping Efforts	61128NR212	Marine Bathymetric Mapping Survey	X	X	X	X	X	X	X
1:1, 2; 2:4; 3:4; 7:3	MHM-4: U.S. Navy Diver Training for Submerged Natural Resources Management	61128NR716	U.S. Navy Diver Training for Submerged Natural Resources Management	X	X	X	X	X	X	X
Marine Invasive Species Management										
1:1; 2:3; 3:1-2, 4; 4:1-4; 7:1	MIS-1: Implementation of Regional Biosecurity Plan Micronesia and Hawaii	61128NR860	Implementation of Regional Biosecurity Plan Micronesia and Hawaii	X	X	X	X	X	X	X
1:1; 2:4; 4:4; 7:3	MIS-2: Federal and Territorial Coordination and Collaboration for Marine Invasive Species Prevention	61128NR860	Federal and Territorial Coordination and Collaboration for Marine Invasive Species Prevention	-	-	-	-	X	X	X
Marine Protected Species Management										
1:1-2; 3:1-2, 4	MPS-1: Scalloped Hammerhead Shark Survey	61755NR891	Scalloped Hammerhead Shark Survey	-	-	-	-	-	-	-
1:1-2; 3:1-2, 4; 7:3	MPS-2: Sea Turtle Population Protection and Enhancement	61755NR815	Sea Turtle Distribution and Habitat Use	X	X	X	X	X	X	X
Marine Natural Resources Educational Outreach										
1:1-2; 2:4; 3:4; 4:1, 4; 6:1-2; 7:1-2	MEDU-1: ESA-listed Species and Marine Resources Outreach	61755NR306	Listed Species Outreach Materials	X	X	X	X	X	X	X
		61755NR305	Threatened and Endangered Species Outreach Signage	X	X	X	X	X	X	X
1:1-2; 2:4; 3:4; 4:1, 4; 6:1-2; 7:1-3	MEDU-2: JRM Natural Resources Stewardship Outreach and Public Engagement Program	61128NR962	JRM Natural Resources Stewardship Outreach and Public Engagement Program	X	X	X	X	X	X	X
		61128NR962	Reef-safe Sunscreen Outreach Materials to Protect Marine Resources	-	-	-	-	-	-	-
		61128NR962	Marine Debris Clean-up to Protect Threatened and Endangered Species	-	-	-	-	-	-	-
Marine Natural Resources Law Enforcement										
1:1-3; 2:1-2, 4; 3:4; 6:1-2; 7:1-3	MLAW-1: Conservation Law Enforcement	61755NR009, 61128NR589	Conservation Law Enforcement Program	-	-	-	X	X	X	X
Marine GIS and Data Management										
1:1-2; 2:1-5; 3:1, 4	MGIS-1: Marine Natural Resources GIS and Data Management	61128NR200	GIS Database Management	X	X	X	X	X	X	X

Table 13-11. Planned Implementation Summary of Projects at Andersen AFB

Goals and Objectives	INRMP Project Code/Title (Abbreviated)	EPR#	EPR Project Title	Year Funded						
Terrestrial Habitat Management				**FY18**	**FY19**	**FY20**	**FY21**	**FY22**	**FY23**	**FY24**
1:1-2; 2:1-6; 3:1, 4; 4:2	THM-1: Forest Enhancement	M5240NR067	Native Forest Habitat Restoration	X	X	X	X	X	X	X
		61128NR209	Listed Plant Surveys, Propagation, Planting and Establishment in the Wild	X	X	X	X	X	X	X
		61128NR210	Monitoring Native Ecosystem Health and Growth	-	-	-	-	-	-	-
		M524010004	Native Plant Propagation and Outplanting for Habitat Improvement in the Habitat Management Unit	X	X	X	X	X	X	X
		M524010005	Non-native Plant Removal and Control in the Habitat Management Unit	X	X	X	X	X	X	X
		M524010013	Invasive Plant Species Monitoring and Control on Andersen AFB	X	X	X	X	X	X	X
1:1-2; 2:1-6; 3:1, 4; 4:2	THM-1: Forest Enhancement	M524010011	Vegetation Monitoring in Ungulate Management Areas	X	X	X	X	X	X	X
		M5240NR069	Ungulate Eradication and Control	X	X	X	X	X	X	X
		NA	Install and Maintain Ungulate Fence at Northwest Field	-	-	-	-	-	-	-
		NA	Ungulate Control at Northwest Field	-	-	-	-	-	-	-
		M5240CN056	Ungulate Control Outside of Fenced Areas	-	-	-	-	-	-	-
		M5240NR043	Ungulate Fencing, Inspection, and Maintenance	X	X	X	X	X	X	X

1:1-2; 2:1-6; 3:1, 4; 4:2	THM-1: Forest Enhancement	NA	Maintenance of Ritidian Ungulate Exclosure	-	-	-	-	-	-	-
		M524010000	Barrier Maintenance for the Habitat Management Unit	X	X	X	X	X	X	X
1:1-2; 2:1-4, 6; 3:1, 4; 4:2	THM-2: Establish Forage Plots for ESA-listed Bats and Crows	M5240NR046	Establish Forage Plots for ESA-listed Bats and Crows	X	X	X	-	-	-	-
1:1; 2:3, 6	THM-3: Urban Forestry Data Base, Maintenance, and Replacement of Trees	M5240NR066	Urban Forestry Data Base, Maintenance, and Replacement of Trees	-	-	-	-	-	-	-
Terrestrial Invasive Species Management										
1:1-2; 2:3-4; 3:1, 4; 4:1-3; 7:3	TIS-1: Brown Treesnake Interdiction	61128NR202	Brown Treesnake Eradication, Control and Adaptive Management to Support Recovery of ESA-listed Species	X	X	X	X	X	X	X
		M5240CN042	Survivorship of Mariana Fruit Bat to Support Guam Intelligence, Surveillance, and Reconnaissance Strike Requirements	-	-	-	-	-	-	-
1:1-2; 2:1-4, 6; 3:1, 4; 4:1-3; 7:3	TIS-2: Brown Treesnake Suppression	61128NR202	Brown Treesnake Eradication, Control and Adaptive Management to Support Recovery of ESA-listed Species	X	X	X	X	X	X	X
		NA	Trial Eradication of Brown Treesnake in the U.S. Geological Survey Closed Population Facility via Aerial Toxicants, Phases I and II	-	-	-	-	-	-	-
		M5240CN042, M524010001	Planning and Preparation to Implement Landscape Level Brown Treesnake suppression on JRM-administered lands on Guam – Phases I and II: Commencement of Aerial Brown Treesnake Suppression Actions in the Habitat Management Unit	X	X	X	X	X	X	X
		M5240CN042	Expanded Evaluation of Brown Treesnake Aerial Toxicant Delivery System	X	X	X	X	X	X	X
1:1-2; 2:1-4, 6; 3:1, 4; 4:1-3; 7:3	TIS-3: Brown Treesnake Management for the Recovery of Protected Species	61128NR202	Brown Treesnake Eradication, Control and Adaptive Management to Support Recovery of ESA-listed Species	X	X	X	X	X	X	X
		M524010001	Brown Treesnake Monitoring and Control in the Habitat Management Unit	X	X	X	X	X	X	X
1:1-2; 2:3-4; 3:4; 4:2; 7:3	TIS-4: Wildlife Management Biologist	M5240NR068	Wildlife Management Biologist: Ungulate Eradication for Endangered Species Habitat	X	X	X	X	-	-	-
1:1-2; 2:2-4; 3:1, 4; 4:1-3	TIS-5: Invasive Species Management	M524010002	Feral Cat, Monitor Lizard, and Rodent Management in the Habitat Management Unit	-	-	-	X	X	X	X
		M5240NR063	Invasive Species Monitoring and Control Including Cycas micronesica Protection	X	X	X	X	X	X	X
		NA	Hazard Analysis Critical Control Point Program Implementation and Effectiveness Monitoring	-	-	-	-	-	-	-
1:1-2; 2:2-4; 3:1, 4; 4:1-3	TIS-5: Invasive Species Management	61128NR207	Little Fire Ant Surveys and Eradication	X	X	X	X	X	X	X
1:1; 2:3; 3:1-2, 4; 4:1-4; 7:1	TIS-6: Implementation of Regional Biosecurity Plan for Micronesia and Hawaii	61128NR860	Implementation of Regional Biosecurity Plan for Micronesia and Hawaii	X	X	X	X	X	X	X
1:1-2; 2:2-4; 3:1, 4; 4:1-4	TIS-7: Mariana Islands Training and Testing Implementation of the Biological Opinion	61128NR218	Mariana Islands Training and Testing Implementation of the Biological Opinion	X	X	X	X	X	X	X
1:1-2; 3:1, 4; 4:2	TIS-8: Control Feral Dogs and Cats	61755NR358	Control Feral Dogs and Cats	-	-	-	-	-	-	-
Terrestrial Protected Species Management										
1:1-2; 2:1-5; 3:1-2, 4; 4:2; 6:1-2; 7:1-2	TPS-1: Sea Turtle Population Protection and Enhancement	M5240CN037	Sea Turtle Monitoring, Protection and Educational Outreach	X	X	X	X	X	X	X
1:1-2; 2:1, 3-4; 3:1, 4	TPS-2: Mariana Fruit Bat Population Protection and Enhancement	M5240CN041	Mariana Fruit Bat Monitoring	X	X	X	X	X	X	X
1:1-2; 2:1, 3-4; 3:1, 4	TPS-2: Mariana Fruit Bat Population Protection and Enhancement	M5240NR155	Fruit Bat Demography and Population Estimation	X	X	X	X	X	X	X
1:1-2; 3:1, 4	TPS-3: Moth Skink and Pacific Slender-toed Gecko Surveys	61128NR204	Moth Skink and Pacific Slender-toed Gecko Surveys	-	-	-	-	-	-	-
1:1-2; 2:1, 3-6; 3:1-2, 4	TPS-4: Protection of Listed Invertebrates	M5240CN048	Monitoring and Surveys for Listed Tree Snails, Butterflies, and Plants	X	X	X	X	X	X	X
		NA	Translocate Listed Butterflies from Construction Footprints at Northwest Field		-	-	-	-	-	-
		NA	Plant Host Plants for Mariana Eight-spot Butterfly	-	-	-	-	-	-	-
		61128NR203	Conservation Management of Endangered Mariana Eight-spot Butterfly, Guam Tree Snail, Humped Tree Snail, and Fragile Tree Snail	X	X	X	X	X	X	X
1:1-2; 2:1-6; 3:1-2, 4; 4:2	TPS-5: Conservation of Listed Plant Species	M5240CN039	Serianthes nelsonii Monitoring and Management	X	X	X	X	X	X	X
		M5240NR061	Conservation of Cycas micronesica	X	X	X	X	X	X	X
		NA	Pre-construction Surveys for ESA-listed Species within Construction Footprints at Northwest Field, Andersen AFB	-	-	-	-	-	-	-
1:1; 2:3; 3:1-4	TPS-6: Support Recovery Planning Using Surrogate Native Species	M5240CN018	Micronesian Starling Monitoring and Protection	-	-	-	-	-	-	-
		61128NR202	Field Assessment of a Predator-resistant Nest Box for Micronesian Starlings with Application to Endangered Guam Micronesian Kingfishers	X	X	X	X	X	X	X
1:1-2; 2:4; 3:1-2, 4	TPS-7: Mariana Islands Training and Testing Implementation of the Biological Opinion	61128NR218	Mariana Islands Training and Testing Implementation of the Biological Opinion	X	X	X	X	X	X	X
Migratory Bird Management										
1:1-2; 3:1-2, 4; 6:1	MIG-1: Conservation Measures for Migratory Birds	NA	Prepare a Migratory Bird Inventory	-	-	-	-	-	-	-
		NA	Describe Priority Migratory Bird Conservation Measures	-	-	-	-	-	-	-
		NA	Detail the Bird Aircraft Strike Hazard Program	-	-	-	-	-	-	-
Terrestrial Natural Resources Educational Outreach										
1:1-2; 2:4; 3:4; 4:1, 4; 6:1-2; 7:1-2	TEDU-1: ESA-listed Species and Terrestrial Resources Outreach	61755NR306	Listed Species Outreach Materials	X	X	X	X	X	X	X
		M5240CN005	Environmental Education Outreach and Awareness	X	X	X	X	X	X	X
		NA	Contractor Education Program on ESA-listed and Invasive Species	-	-	-	-	-	-	-
1:1-2; 2:4; 3:4; 4:1, 4; 6:1-2; 7:1-3	TEDU-2: JRM Natural Resources Stewardship Outreach and Public Engagement Program	61128NR962	JRM Natural Resources Stewardship Outreach and Public Engagement Program	X	X	X	X	X	X	X
		61128NR962	Reef-safe Sunscreen Outreach Materials to Protect Marine Resources	-	-	-	-	-	-	-
		61128NR962	Marine Debris Clean-up to Protect Threatened and Endangered Species	-	-	-	-	-	-	-
Terrestrial Natural Resources Law Enforcement										

1:1-3; 2:1-2, 4; 3:4; 6:1-2; 7:1-3	TLAW-1: Conservation Law Enforcement	61755NR009, 61128NR589	Conservation Law Enforcement Program	-	-	-	-	X	X	X
Terrestrial GIS and Data Management										
1:1-2; 2:1-5; 3:1, 4	TGIS-1: Terrestrial Natural Resources GIS and Data Management	61128NR200	GIS Database Management	X	X	X	X	X	X	X
Marine Habitat Management										
1:1-2; 2:1, 3-5; 3:1-2, 4; 5:1-2	MHM-1: Coral Habitat Enhancement	61755NR168	Ecosystem Monitoring and Coral Reef Indicators	-	-	-	-	-	-	-
		61128CN222	Monitoring and Control of Acute Impacts on Coral Reefs (Crown-of-Thorns Seastar and Coral Bleaching)	-	-	-	-	-	-	-
1:1; 2:1, 3-4; 3:4; 7:3	MHM-2: Marine Resources Data Analysis and Coordination	61128NR742	Mariana Archipelago Reef Assessment and Monitoring Program Data Analysis and Coordination	-	-	-	-	-	-	-
1:1; 2:1, 3-5; 3:1, 4; 5:1; 7:3	MHM-3: Marine Habitat Mapping Efforts	61128NR212	Marine Bathymetric Mapping Survey	X	X	X	X	X	X	X
Marine Invasive Species Management										
1:1; 2:3; 3:1-2, 4; 4:1-4; 7:1	MIS-1: Implementation of Regional Biosecurity Plan Micronesia and Hawaii	61128NR860	Implementation of Regional Biosecurity Plan Micronesia and Hawaii	X	X	X	X	X	X	X
1:1; 2:4; 4:4; 7:3	MIS-2: Federal and Territorial Coordination and Collaboration for Marine Invasive Species Prevention	61128NR860	Federal and Territorial Coordination and Collaboration for Marine Invasive Species Prevention	-	-	-	-	X	X	X
Marine Protected Species Management										
1:1-2; 3:1-2, 4	MPS-1: Scalloped Hammerhead Shark Survey	61755NR891	Scalloped Hammerhead Shark Survey	-	-	-	-	-	-	-
1:1-2; 3:1-2, 4; 7:3	MPS-2: Sea Turtle Population Protection and Enhancement	M5240CN037	Sea Turtle Monitoring, Protection and Educational Outreach	X	X	X	X	X	X	X
Marine Natural Resources Educational Outreach										
1:1-2; 2:4; 3:4; 4:1, 4; 6:1-2; 7:1-2	MEDU-1: ESA-listed Species and Marine Resources Outreach	M5240CN005	Environmental Education Outreach and Awareness	-	-	-	-	-	-	-
1:1-2; 2:4; 3:4; 4:1, 4; 6:1-2; 7:1-3	MEDU-2: JRM Natural Resources Stewardship Outreach and Public Engagement Program	61128NR962	JRM Natural Resources Stewardship Outreach and Public Engagement Program	X	X	X	X	X	X	X
		61128NR962	Reef-safe Sunscreen Outreach Materials to Protect Marine Resources	-	-	-	-	-	-	-
		61128NR962	Marine Debris Clean-up to Protect Threatened and Endangered Species	-	-	-	-	-	-	-
Marine Natural Resources Law Enforcement										
1:1-3; 2:1-2, 4; 3:4; 6:1-2; 7:1-3	MLAW-1: Conservation Law Enforcement	61755NR009, 61128NR589	Conservation Law Enforcement Program	-	-	-	-	X	X	X
Marine GIS and Data Management										
1:1-2; 2:1-5; 3:1, 4	MGIS-1: Marine Natural Resources GIS and Data Management	61128NR200	GIS Database Management	X	X	X	X	X	X	X

Table 13-12. Planned Implementation Summary of Projects on Tinian

Goals and Objectives	INRMP Project Code/Title (Abbreviated)	EPR#	EPR Project Title	Year Funded						
Terrestrial Habitat Management				**FY18**	**FY19**	**FY20**	**FY21**	**FY22**	**FY23**	**FY24**
1:1-2; 2:1, 3-6; 3:1-2, 4	THM-1: Forest Enhancement	61755NR839	Tinian Native Forest Enhancement for Listed Species	X	X	X	X	X	X	X
Terrestrial Invasive Species Management										
1:1; 2:3; 3:1-2, 4; 4:1-4; 7:1	TIS-1: Implementation of Regional Biosecurity Plan Micronesia and Hawaii	61128NR860	Implementation of Regional Biosecurity Plan Micronesia and Hawaii	X	X	X	X	X	X	X
1:1-2; 2:2-4; 3:1, 4; 4:1-4	TIS-2: Mariana Islands Training and Testing Implementation of the Biological Opinion	61128NR218	Mariana Islands Training and Testing Implementation of the Biological Opinion	X	X	X	X	X	X	X
Terrestrial Protected Species Management										
1:1; 2; 1, 3-6; 3:1-2, 4; 4:2-3	TPS-1: Conservation Management of Tinian Cycas micronesica Plantings	61128NR162	Conservation Management of Tinian Cycas micronesica Plantings	X	X	X	X	X	X	X
1:1-2; 2:1-6; 3:1-2, 4; 4:2; 6:1	TPS-2: Sea Turtle Population Protection and Enhancement	61128NR211	Monitoring of Sea Turtle Nesting	X	X	X	X	X	X	X
		61128NR211	Barriers for Sea Turtle Nesting Protection	X	X	X	X	X	X	X
		6128NR211	Beach Marine Debris and Trash Removal for Sea Turtle Nesting Habitat Enhancement	X	X	X	X	X	X	X
1:1-2; 2:1, 3-6; 3:1-2, 4	TPS-3: Conservation of Mariana Common Moorhen	61128NR211	Mariana Common Moorhen Monitoring	X	X	X	X	X	X	X
1:1-2; 3:1-2, 4	TPS-4: Conservation of Forest Birds	61755NR303	Tinian Forest Bird Monitoring	X	X	X	X	X	X	X
		61755NR303	Tinian Monarch Basic Natural History Information	X	X	X	X	X	X	X
1:1-2; 3:1-2, 4	TPS-5: Protection of Listed Invertebrates	61755NR839	Protection of Partula gibba	-	-	-	-	-	-	-
1:1-2; 2:4; 3:1-2, 4	TPS-6: Mariana Islands Training and Testing Implementation of the Biological Opinion	61128NR218	Mariana Islands Training and Testing Implementation of the Biological Opinion	X	X	X	X	X	X	X
1:1-2; 2:1, 3-4; 3:1, 4	TPS-7: Mariana Fruit Bat Population Monitoring	61128NRFBM	Mariana Fruit Bat Population Monitoring	-	-	-	X	X	X	X
Migratory Bird Management										
1:1-2; 3:1-2, 4; 6:1	MIG-1: Management of MBTA-listed Bird Species	61128NR211	Conducting Surveys for Migratory Birds	X	X	X	X	X	X	X
Terrestrial Natural Resources Educational Outreach										
1:1-2; 2:4; 3:4; 4:1, 4; 6:1; 7:1-3	TEDU-1: JRM Natural Resources Stewardship Outreach and Public Engagement Program	61128NR962	JRM Natural Resources Stewardship Outreach and Public Engagement Program	X	X	X	X	X	X	X
1:1-2; 2:4; 3:4; 4:1, 4; 6:1; 7:1-3	TEDU-1: JRM Natural Resources Stewardship Outreach and Public Engagement Program	61128NR962	Marine Debris Clean-up to Protect Threatened and Endangered Species	X	X	X	X	X	X	X
Terrestrial Natural Resources Law Enforcement										
1:1-3; 2:1-2, 4; 3:4; 6:1; 7:1-3	TLAW-1: Conservation Law Enforcement	61755NR009, 61128NR589	Conservation Law Enforcement Program	-	-	-	-	X	X	X
Terrestrial GIS and Data Management										
1:1-2; 2:1-5; 3:1, 4	TGIS-1: Terrestrial Natural Resources GIS and Data Management	61128NR200	GIS Database Management	X	X	X	X	X	X	X
Marine Habitat Management										

1:1-2; 2:1, 3-5; 3:1-2, 4; 5:1-2	MHM-1: Coral Habitat Enhancement	61128CN222	Monitoring and Control of Acute Impacts on Coral Reefs (Crown-of-Thorns Seastar and Coral Bleaching)	X	X	X	X	X	X	X
1:1; 2:1, 3-4; 3:4; 7:3	MHM-2: Marine Resources Data Analysis and Coordination	61128NR742	Mariana Archipelago Reef Assessment and Monitoring Program Data Analysis and Coordination	-	-	-	-	-	-	-
1:1; 2:1, 3-5; 3:1	MHM-3: Marine Flora Management	61755NR804	Green and Hawksbill Sea Turtle Habitat – Sea Grass Survey	-	-	-	-	-	-	-
Marine Invasive Species Management										
1:1; 2:3; 3:1-2, 4; 4:1-4; 7:1	MIS-1: Implementation of Regional Biosecurity Plan for Micronesia and Hawaii	61128NR860	Implementation of Regional Biosecurity Plan for Micronesia and Hawaii	X	X	X	X	X	X	X
1:1; 2:4; 4:4; 7:3	MIS-2: Federal and Territorial Coordination and Collaboration for Marine Invasive Species Prevention	61128NR860	Federal and Territorial Coordination and Collaboration for Marine Invasive Species Prevention	-	-	-	-	X	X	X
Marine Protected Species Management										
1:1-2; 3:1-2, 4; 7:3	MPS-1: Sea Turtle Population Protection and Enhancement	61755NR815	Sea Turtle Distribution and Habitat Use	X	X	X	X	X	X	X
1:1-2; 2:4; 3:4; 6:1	MPS-2: Recreational Use Survey	NA	Recreational Use Survey	-	-	-	-	-	-	-
1:1-2; 2:1,4; 3:1-2, 4; 4:2	MPS-3: Mariana Islands Training and Testing Implementation of the Biological Opinion	61128NR218	Mariana Islands Training and Testing Implementation of the Biological Opinion	X	X	X	X	X	X	X
Marine Natural Resources Educational Outreach										
1:1-2; 2:4; 3:4; 4:1, 4; 6:1; 7:1-3	MEDU-1: JRM Natural Resources Stewardship Outreach and Public Engagement Program	61128NR962	JRM Natural Resources Stewardship Outreach and Public Engagement Program	X	X	X	X	X	X	X
1:1-2; 2:4; 3:4; 4:1, 4; 6:1; 7:1-3	MEDU-1: JRM Natural Resources Stewardship Outreach and Public Engagement Program	61128NR962	Marine Debris Clean-up to Protect Threatened and Endangered Species	X	X	X	X	X	X	X
Marine Natural Resources Law Enforcement										
1:1-3; 2:1-2, 4; 3:4; 6:1; 7:1-3	MLAW-1: Conservation Law Enforcement	61755NR009, 61128NR589	Conservation Law Enforcement Program	-	-	-	-	X	X	X
Marine GIS and Data Management										
1:1-2; 2:1-5; 3:1, 4	MGIS-1: Marine Natural Resources GIS and Data Management	61128NR200	GIS Database Management	X	X	X	X	X	X	X

Table 13-13. Planned Implementation Summary of Projects on FDM

Goals and Objectives	INRMP Project Code/Title (Abbreviated)	EPR#	EPR Project Title	Year Funded						
Terrestrial Invasive Species Management				**FY18**	**FY19**	**FY20**	**FY21**	**FY22**	**FY23**	**FY24**
1:1; 2:3; 3:1-2, 4; 4:1-4; 7:1	TIS-1: Implementation of Regional Biosecurity Plan Micronesia and Hawaii	61128NR860	Implementation of Regional Biosecurity Plan Micronesia and Hawaii	X	X	X	X	X	X	X
1:1-2; 2:2-4; 3:1, 4; 4:1-4	TIS-2: Mariana Islands Training and Testing Implementation of the Biological Opinion	61128NR218	Mariana Islands Training and Testing Implementation of the Biological Opinion	X	X	X	X	X	X	X
Terrestrial Protected Species Management										
1:1-2; 2:1, 3-4; 3:1, 4	TPS-1: Monitoring for Micronesian Megapodes and Mariana Fruit Bats	61128NR211	Monitoring for Micronesian Megapodes	X	X	X	X	X	X	X
1:1-2; 2:4; 3:1-2, 4	TPS-2: Mariana Islands Training and Testing Implementation of the Biological Opinion	61128NR218	Mariana Islands Training and Testing Implementation of the Biological Opinion	X	X	X	X	X	X	X
Migratory Bird Management										
1:1-2; 3:1-2, 4; 6:1	MIG-1: Monitoring of MBTA-listed Bird Species	61128NR211	Migratory Bird Monitoring	X	X	X	X	X	X	X
Terrestrial Natural Resources Educational Outreach										
1:1-2; 2:4; 3:4; 4:1, 4; 6:1; 7:1-3	TEDU-1: JRM Natural Resources Stewardship Outreach and Public Engagement Program	61128NR962	JRM Natural Resources Stewardship Outreach and Public Engagement Program	X	X	X	X	X	X	X
Terrestrial GIS and Data Management										
1:1-2; 2:1-5; 3:1, 4	TGIS-1: Terrestrial Natural Resources GIS and Data Management	61128NR200	GIS Database Management	X	X	X	X	X	X	X
Marine Habitat Management										
1:1-2; 3:1, 4; 7:3	MHM-1: Fish, Coral, and Marine Flora Surveys	NA	Fish Surveys	-	-	-	-	-	-	-
1:1; 2:1, 3-5; 3:1, 4; 5:1; 7:3	MHM-2: Marine Habitat Mapping Efforts	61128NR212	Marine Bathymetric Mapping Survey	X	X	X	X	X	X	X
Marine Protected Species Management										
1:1-2; 3:1-2, 4; 7:3	MPS-1: Sea Turtle Population Protection and Enhancement	61755NR815	Sea Turtle Distribution and Habitat Use	X	X	X	X	X	X	X
1:1-2; 2:1, 4; 3:1, 4	MPS-2: Assess ESA-listed Scleractinian Corals	NA	NA	-	-	-	-	-	-	-
Marine Natural Resources Educational Outreach										
1:1-2; 2:4; 3:4; 4:1, 4; 6:1; 7:1-3	MEDU-1:	61128NR962	JRM Natural Resources Stewardship Outreach and Public Engagement Program	X	X	X	X	X	X	X
	CNMI Fishing Community Outreach			-	-	-	-	-	-	-
Marine Natural Resources Law Enforcement										
1:1-3; 2:1-2, 4; 3:4; 6:1; 7:1-3	MLAW-1: Monitoring, Control, and Surveillance Plan	61128NR589	Conservation Law Enforcement Program	-	-	-	-	-	-	-
Marine GIS and Data Management										
1:1-2; 2:1-5; 3:1, 4	MGIS-1: Marine Natural Resources GIS and Data Management	61128NR200	GIS Database Management	X	X	X	X	X	X	X

Appendix D
Integrated Natural Resources Management Plan Annual Reports

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D1 2019 Annual Reports

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DEPARTMENT OF THE NAVY
JOINT REGION MARIANAS
PSC 455 BOX 211
FPO AP 96540-1000

5090
Ser J4/ 0036
4 Feb 20

From: Commander, Joint Region Marianas

Subj: FISCAL YEAR 2019 NATURAL RESOURCES/INTEGRATED NATURAL RESOURCES MANAGEMENT PLAN METRICS SUMMARY REPORT

Ref: (a) OPNAVINST 5090.1D

Encl: (1) FY 2019 Natural Resources INRMP Metrics Results
(2) JRM INRMP Summary of FY19 Projects
(3) FY 2019 Natural Resources INRMP Metrics Invitation and Attendee List

1. In accordance with reference (a), Navy installations are required to submit an annual report summarizing the recent Natural Resources/Integrated Natural Resources Management Plan (INRMP) Metrics meeting and status of the INRMP.

2. The Fiscal Year (FY) 2019 Joint Region Marianas (JRM) Natural Resources/INRMP Metrics meeting for Guam resource partners was held on October 16-17, 2019 at the Outrigger Hotel in Tumon, Guam. The JRM INRMP Metrics meeting for Commonwealth of the Northern Mariana Islands (CNMI) resource partners was held on November 7, 2019 at the Hyatt Regency in Saipan. The FY19 Natural Resources (INRMP) Metrics results and summary FY19 JRM INRMP Projects is enclosed. The JRM INRMP Summary of FY19 Projects presents outcomes and benefits of INRMP projects implemented in FY19 and their direct and indirect benefits to listed species. Also enclosed are the metrics, meeting invitations, and lists of those who participated. It should be noted that although the CNMI Metrics meeting was postponed due to inclement weather, CNMI resource partners were provided an opportunity to comment on the FY19 INRMP Metrics; however, no comments were received.

3. The Final 2019 JRM INRMP was finalized and signed by partner agencies (U.S. Fish and Wildlife Service, National Marine Fisheries Service, Guam Department of Agriculture, and CNMI Department of Land and Natural Resources –Division of Fish and Wildlife) June - August 2019. An annual update will be conducted in calendar year 2020 and a 5-year review will be conducted in 2024 per OPNAVINST 5090.1D, reference (b), sections 670a-f.

4. Thank you for your participation in our Natural Resources/INRMP Metrics meeting and for your support of the JRM Natural Resources Program. If you have any questions, please contact Jennifer Horeg, Conservation Resources Program Manager, at jennifer.horeg@fe.navy.mil or 671-339-7348.

J. V. MENONI
Rear Admiral, U.S. Navy
Commander, Joint Region Marianas

Distribution:

Ms. Katherine Mullet
Field Supervisor
U.S. Department of the Interior
U.S. Fish and Wildlife Service
Pacific Islands Fish and Wildlife Office
300 Ala Moana Boulevard, Room 3-122 Box 5008
Honolulu, HI 96816

Mr. Michael Tosatto
Regional Administrator
National Marine Fisheries Service
Pacific Islands Regional Office
1845 Wasp Blvd., Bldg 176
Honolulu, Hawaii 96818

Ms. Chelsa Muna-Brecht
Director
Guam Department of Agriculture
163 Dairy Road
Mangilao, Guam 96913

Mr. Anthony Benavente
Director
CNMI Department of Land and Natural Resources
P.O. Box 10007
Saipan, MP 96950

Subj: FISCAL YEAR 2019 NATURAL RESOURCES/INTEGRATED NATURAL RESOURCES MANAGEMENT PLAN METRICS SUMMARY REPORT

Blind copy to: (w/encls)

Programmatic Division U.S. Fish and Wildlife Service
Pacific Islands Fish and Wildlife Office
Marianas Office, U.S. Fish and Wildlife Service, Pacific Islands Fish and Wildlife Office
300 Ala Moana Boulevard, Room 3-122 Box 5008
Honolulu, HI 96816

Mariana Islands Refuges and Monument Complex
P.O. Box 8134, MOU-3
Dededo, Guam 96912

U.S. Fish and Wildlife Service
Ecological Services
P.O. Box BT
Hagatna, Guam 96932

CNIC Washington DC (N45) NAVFACENGCOM Washington DC (EV2)

FY 2019 Natural Resources/INRMP Metrics Results

2019 Natural Resources Annual Report: NSA ANDERSEN

Summary Score

Focus Area	Score
1 - Natural Resources Management	0.70
2 - Listed Species Critical Habitat	0.67
3 - Recreation Use and Access	0.95
4 - Sikes Act Cooperation	0.86
5 - Team Adequacy	0.52
6 - INRMP Implementation	0.86
7 - Support of Installation Mission	0.90
NSA ANDERSEN - Overall Score	0.78

2019 Natural Resources Annual Report: NB Guam

Summary Score

Focus Area	Score
1 - Natural Resources Management	0.71
2 - Listed Species Critical Habitat	0.81
3 - Recreation Use and Access	0.95
4 - Sikes Act Cooperation	0.89
5 - Team Adequacy	0.77
6 - INRMP Implementation	0.84
7 - Support of Installation Mission	0.64
NB Guam - Overall Score	0.80

Encl (1)

FY 2019 Natural Resources/INRMP Metrics Results

2019 Natural Resources Annual Report: Tinian MLA

Summary Score

Focus Area	Score
1 - Natural Resources Management	0.54
2 - Listed Species Critical Habitat	0.53
3 - Recreation Use and Access	0.83
4 - Sikes Act Cooperation	0.77
5 - Team Adequacy	0.80
6 - INRMP Implementation	0.86
7 - Support of Installation Mission	0.68
Tinian MLA - Overall Score	0.72

2019 Natural Resources Annual Report: Farrallon de Medinilla FDM

Summary Score

Focus Area	Score
1 - Natural Resources Management	0.65
2 - Listed Species Critical Habitat	0.30
3 - Recreation Use and Access	0.00
4 - Sikes Act Cooperation	0.66
5 - Team Adequacy	0.80
6 - INRMP Implementation	0.80
7 - Support of Installation Mission	0.57
Farrallon de Medinilla FDM - Overall Score	0.63

2019

Joint Region Marianas Integrated Natural Resources Management Plan Summary of FY2019 Projects

OCTOBER 2019

NAVFAC Naval Facilities Engineering Command

COMMANDER JOINT REGION MARIANAS
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Joint Region Marianas
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Acronyms and Abbreviations

AAFB	Andersen Air Force Base
ADS	Automated Delivery System
AOR	Area of Responsibility
BO	Biological Opinion
BTS	Brown Treesnake
CESU	Cooperative Ecosystem Studies Units Network
CEMML	Center for Environmental Management of Military Lands
CIS	Center for Island Sustainability
CNMI	Commonwealth of the Northern Mariana Islands
COMPACFLT	Commander, U.S. Pacific Fleet
CP	Closed Population
CRB	Coconut Rhinoceros Beetle
CRU	Cooperative Research Unit
CSU	Colorado State University
DNM	Dead Neonatal Mice
DoD	Department of Defense
EOD	Explosive Ordnance Disposal
ERA	Ecological Reserve Area
ESA	Endangered Species Act
FDM	Farallon de Medinilla
ft	foot/feet
FY	Fiscal Year
GIS	Geographic Information System
GMK	Guam Micronesian Kingfisher
GNWR	Guam National Wildlife Refuge
GPEPP	Guam Plant Extinction and Prevention Program
GDOAg	Guam Department of Agriculture
ha	hectare(s)
HACCP	Hazard Analysis and Critical Control Points
HMU	Habitat Management Unit
ISU	Iowa State University
INRMP	Integrated Natural Resources Management Plan
IRP	Installation Restoration Program
JRM	Joint Region Marianas
LFA	Little fire ant
LFTRC	Live Fire Training Range Complex

Acronyms and Abbreviations

m	meter(s)
MCAG	Marine Corps Activity Guam
MCB	Marine Corps Base
MIRC	Mariana Islands Range Complex
MITT	Mariana Islands Training and Testing
MLA	Military Lease Area
MOA	Memorandum of Agreement
MSA	Munitions Storage Area
NAVFAC	Naval Facilities Engineering Command
NBG	Naval Base Guam
NBGTS	Naval Base Telecommunications Site
NMS	Naval Base Guam Naval Munitions Site
NNE	Non-Nesting Emergence
NWF	Northwest Field
NWRC	National Wildlife Research Center
PACOM	Pacific Command
PIERC	Pacific Island Ecosystems Research Center
QA/QC	Quality Assurance/Quality Control
RFMP	Range Fire Management Plan
RBP	Regional Biosecurity Plan for Micronesia and Hawaii
UOG	University of Guam
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
USDA-WS	United States Department of Agriculture- Wildlife Services

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Terrestrial Habitat Management

Listed Plant and Invertebrate Surveys

Location: JRM **Period of Performance:** SEPT2014 – SEPT2019

Project Objective

This purpose of this project is to conduct plant surveys and to implement management techniques to provide a conservation benefit to federally-listed threatened and endangered species under the Endangered Species Act (ESA).

Conservation Benefit

Identifying locations of ESA-listed plant and invertebrate species will allow for management actions to reduce habitat fragmentation, enhance and restore habitat, buffer protected areas, and implement new conservation strategies.

FY19 Status

- FY19 surveys were focused on NMS and Andersen Air Force Base (AAFB). This period of performance for this cooperative agreement ended September 2019.
- Transect surveys (5-10 m) for listed plants were conducted over 919 acres in NMS. Plants found are listed in Table 1 and depicted on Figure 1.
- In February 2019, plant surveys were conducted on AAFB in specified areas (Fig 2-4). Surveys were conducted at Northwest Field, Red Horse quarry, Tarague. Results are listed in Table 2.
- A new cooperative agreement was awarded through the Cooperative Ecosystem Studies Units (CESU) Network to University of Guam (UOG) in August of 2019 through August 2020 to conduct surveys for plant and invertebrate surveys on all JRM lands and other lands on Guam and the Commonwealth of the Northern Mariana Islands (CNMI).

EPR: Listed plant surveys, Propagation, planting, and Establishment in the Wild; 61128NR209 and 1 S JRM AAFB - Monitoring and Surveys for Listed Tree Snails, Butterfly, Plants; M5240CN048

2019 JRM INRMP Reference: THM-2; 6-39, TPS-5; 9-77

Table 1. Number of ESA-listed plants found in NMS by species each month from October 2018 – July 2019.

Species	Oct	Nov	Dec	Jan	Mar	Apr	May	Jun	Jul	Total
Bulbophyllum guamense	424	990	73	1	1581	907	628	1386	930	6920
Cycas micronesica	21	118	17	77	46	22	16	56	20	393
Dendrobium guamense	467	1779	256	87	533	1755	648	2007	766	8298
Nervilia jacksoniae	0	0	103	81	0	0	0	0	0	184
Tabernaemontana rotensis	0	0	0	11	0	0	0	0	1	12
Tuberolabium guamense	1202	118	1957	404	50	2	23	291	45	4092
Phyllanthus saffordii	0	0	0	0	0	42	0	0	0	42

Table 2. Number of ESA-listed Species found by location on AAFB during February 2019.

Location	*Cycas micronesica*	*Tuberolabium guamense*
Northwest Field	14	0
Red Horse	5	44
Tarague	1039	0

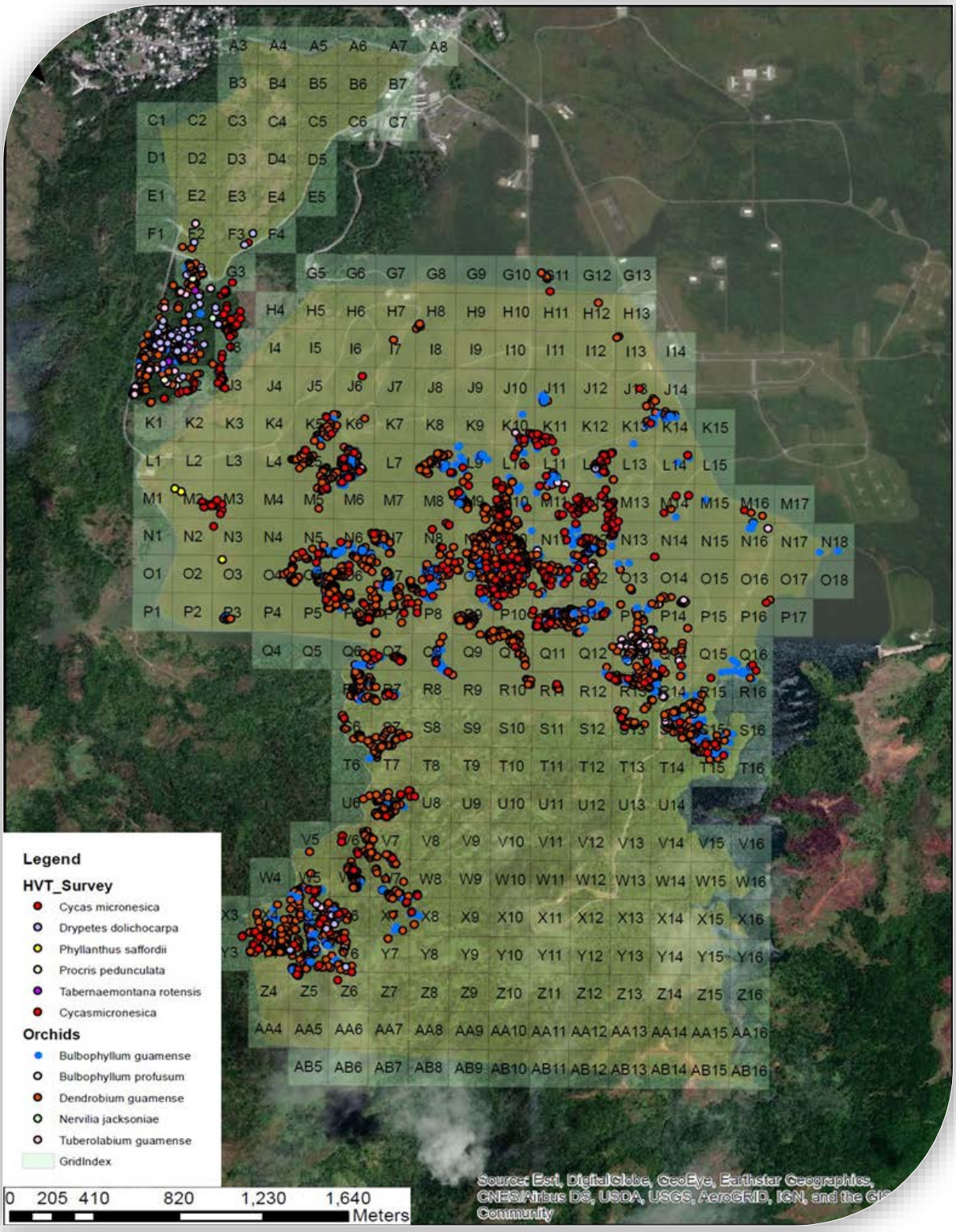


Figure 1. ESA-listed plants found in NMS through the month of July 2019.



Figure 2. *Cycas micronesica* found along the two forested areas near the runways in NWF, AAFB.



Figure 3. *Cycas micronesica* found in the priority area in Tarague, AAFB.

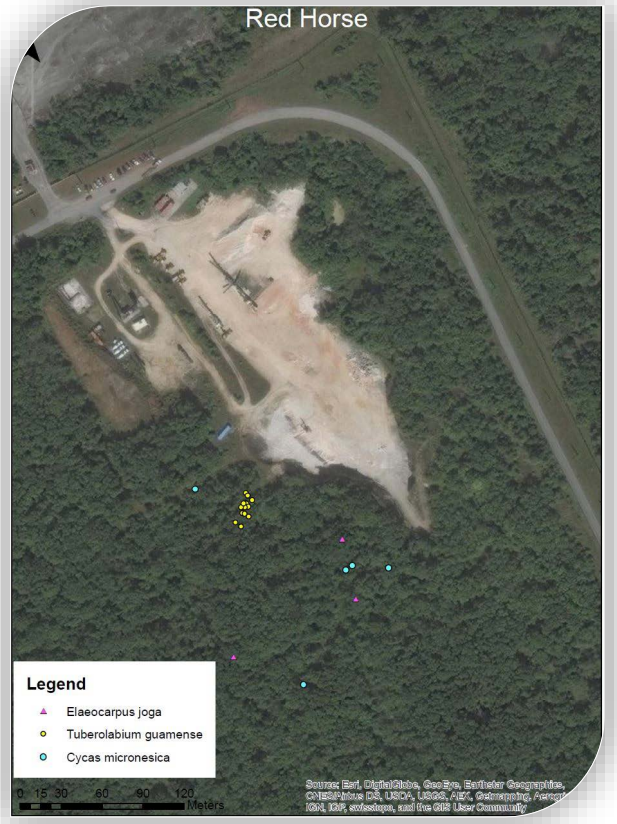


Figure 4. ESA-listed plants found behind the Red Horse quarry, AAFB.

Threatened and Endangered Species Preconstruction Surveys

Location: JRM **Period of Performance:** N/A

Project Objective

Conduct preconstruction surveys prior to vegetation clearing and grubbing for construction and design related activities.

Conservation Benefit

To minimize impacts to specific listed species due to construction and design related activities.

FY19 Status

- Preconstruction fruit bat surveys ongoing for the following construction projects: J-001B, P-102, P-103, P250/P260, and P-715 (Figure 5).
- Preconstruction fruit bat surveys conducted for design-related project P-735.
- Preconstruction ESA listed snail surveys ongoing for J-755.
- Preconstruction ESA listed species surveys completed for J-001B, J-006, J-007, J-755 (except snails), P-102, P-103, P-290, P-295, P-296, P-608, P-715, P-735, P-103, and Haputo fence line.
- Preconstruction ESA listed species survey completed for J-001B Forest Enhancement Fence Phase I.

EPR: DPRI: Marine Corps Relocation 2017/2018 amendment to 2015 BO, Conservation Measures to Contribute to the Recovery of Listed Species.

2019 JRM INRMP Reference: THM-2; 6-39, TPS-5; 9-77

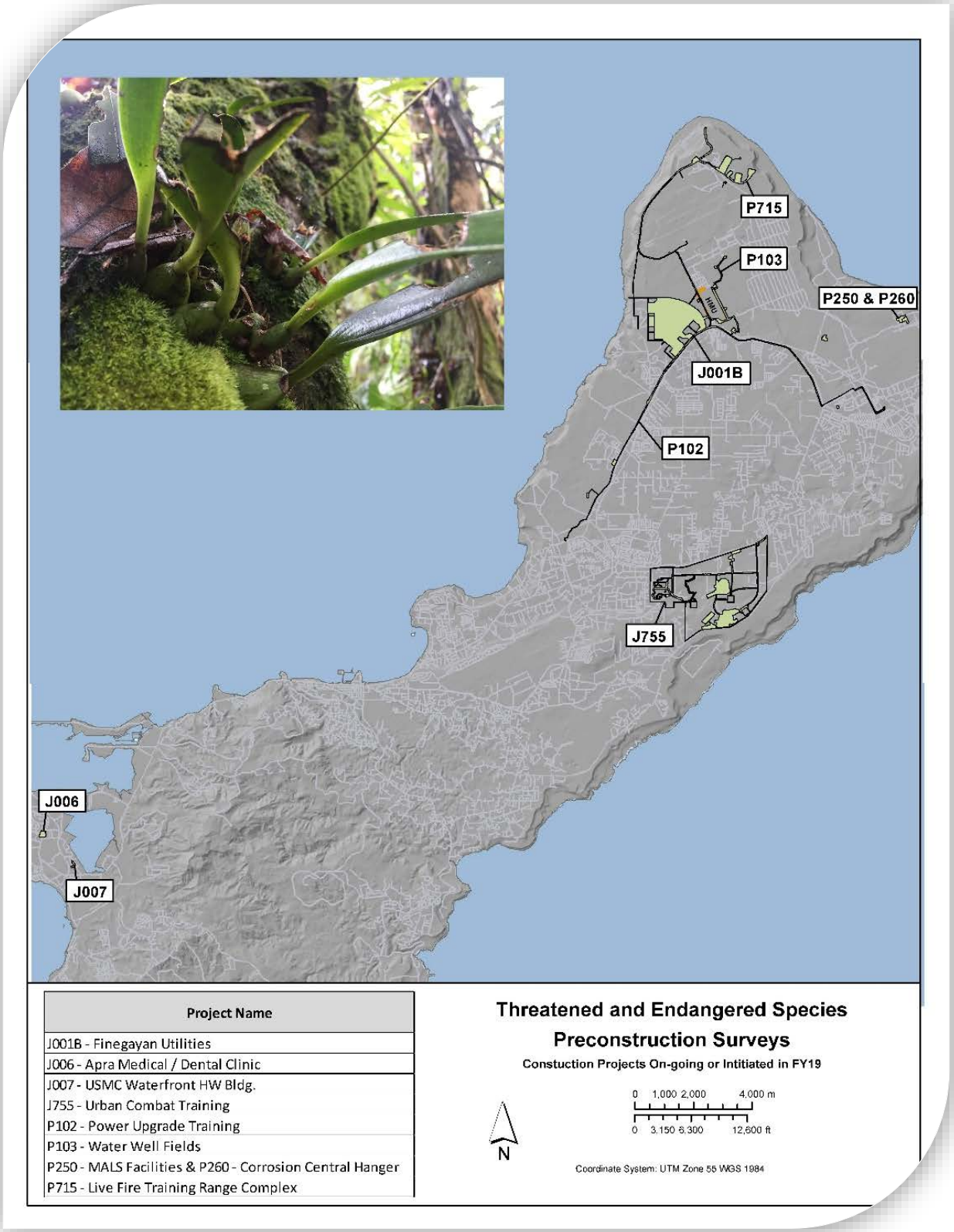


Figure 5: Map of threatened and endangered species preconstruction surveys and consolidated project locations.

Forest Restoration Plan Implementation – NBG

Location: NMS **Period of Performance:** SEP2017 – DEC2019

Project Objective

- Restore native forest ecosystems within fenced areas where feral pigs, deer and carabao have been removed on the NMS.
- Propagate and plant and/or use direct seed techniques for reforestation following the recommendations of the Naval Base Guam (NBG) Forest Restoration Plan and the Conceptual Limestone Forest Restoration and Enhancement Plan (NAVFAC PAC 2018).
- Manage new plantings for a minimum of three years to ensure establishment.

Conservation Benefit

Increasing native forest habitats would improve species survival, particularly threatened and endangered species enhance native habitat for listed animals, increase the biodiversity of native species, and contributes to the connectivity with surrounding communities in ways that support improved ecosystem functionality. It also contributes to the goals of the Guam NWR as an overlay unit the NMS.

FY19 Status

- Twenty research plots have been established in the NMS. Ten of the plots are within an ungulate exclosure area (Labeled 1 in Figure 6). Ten of the plots are in a control area where ungulates have access to them for comparison.
- Ground vegetation and tree surveys have taken place in all plots to set the baseline.
- Vitex trees (*Vitex parviflora*), which are the most common aggressive invasive tree in the research area will be removed in the dry season of 2020.
- Removal of vitex trees are pending finalization of Section 7 consultation with USFWS.

EPR: 1 CP MAR NBG Native Forest Habitat Restoration; 61755NR856

2019 JRM INRMP Reference: THM-2; 6-39

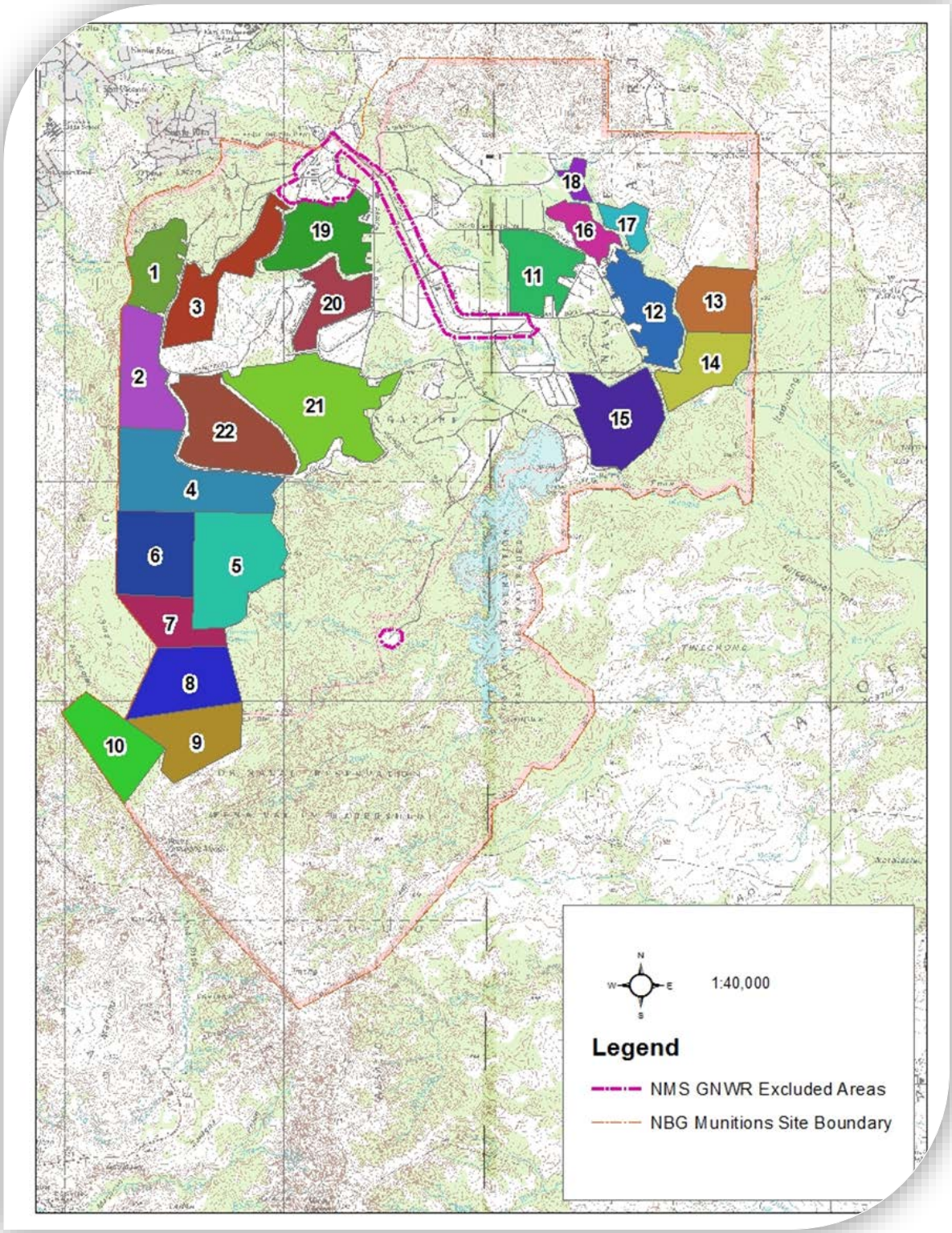


Figure 6: Map depicting location of the fenced and proposed fenced units within NMS. The Plots within the fenced area are located in Site 1.

Ungulate Fencing – NBG

Location: NMS **Period of Performance:** OCT2016 – MAR2020

Project Objective

Construction and maintenance of ungulate fencing on the Naval Munitions Site (NMS) to facilitate eradication of feral pigs, Philippine deer, and carabao and to prevent immigration into the fenced areas. The objective is to fence off native limestone forest on NMS and eradicate ungulates inside the fenced areas (Figure 7).

Conservation Benefit

Will allow native forest regeneration and recovery.

FY 19 Status

- Contract awarded to Sundance EA Inc. in FY2018 to construct second fence.
- An 80-acre fence (#1 in Figure 7) was constructed Jun 2017-February 2018.
- Construction of a second fence (#2 in Figure 7) began in August 2019 and is expected to be completed in October 2019.

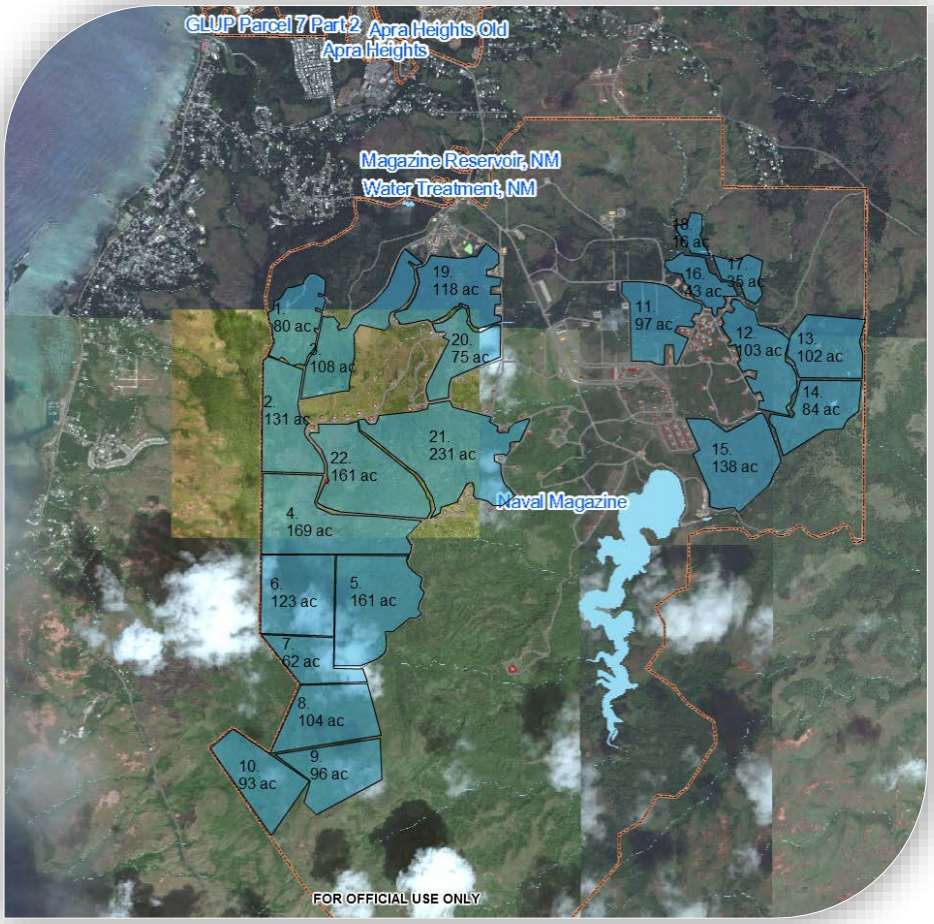


Figure 7. Map depicting areas that may be fenced on NMS. The section labeled "1. 80 ac." was fenced in FY18.

EPR: 1 RP MAR NBG Ungulate Fencing; 61755NR894

2019 JRM INRMP Reference: THM-2; 6-39

Firebreak Management Plan Implementation – NBG

Location: NMS **Period of Performance** AUG2018 – AUG2020

Project Objective

To implement the NBG Wildland Fire Management Plan. Specifically, to treat problem fuels (e.g. swordgrass (*Miscanthus floridulus*)) in strategic locations to disrupt the spread of wildland fires in savannah/ grasslands on NBG land.

The long-term goal is to have less flammable vegetation to allow uninterrupted land use that meets the military mission requirements. This project will implement specific management actions for Fire Management by planting and/or direct seeding of trees to create shaded fuel breaks and annual management of forested fuel breaks by mowing and chemical treatments of high-fuel load grasses.

Areas in Sasa Valley have previously been planted with acacia trees. Those areas will be under-planted with native species which will eventually replace the acacia.

Conservation Benefit: Protect native ecosystems that might otherwise be susceptible to wildfire damage. Protect against soil erosion which causes further damage. Over time the project will protect natural resources and listed species by reducing soil erosion which causes siltation of Guam's coral reefs.

FY19 Status

- This project was awarded as a contract in October 2018.
- The first round of tree planting has taken place in both the NMS and in Sasa Valley.
- A second round of planting will take place during the rainy season in 2020.
- The firebreak plantings will be completed in two separate areas. One planting is taking place in the Naval Magazine site along Firebreak 3, the other area is in the Sasa Valley Fuel Farm. The plantings are structured so that low lying vegetation such as *Scaevola sericea*, which is a shrub will be planted closest to any roadways or firelanes, followed by a medium height tree *Hibiscus tiliaceus*, the third tier will be native trees from the list above which will be planted behind the hibiscus.
- Tree plantings in Sasa Valley will take place in areas that were previously planted with acacia. The acacia will be thinned slightly, such that some trees will be removed to increase light infiltration. Eventually all acacia will be removed and

native species will be planted (Table 3). The areas to be planted are shown in Figures 8 and 9.

EPR: 1 RP MAR NBG Wildland Fire Management Plan (2015) Implementation through Habitat Management; 61755NR857

2019 JRM INRMP Reference: THM-3; 6-41

Table 3. Native tree species to be outplanted in the firebreak areas:

Plant Name	
Da'ok	*Calophyllum inophyllum*
Pågu	*Hibiscus tiliaceus*
Nanåsu	*Scaevola sericea*
Dokdok	*Artocarpus mariannensis*
Lalåha	*Pouteria obovata*
Ladda	*Morinda citrifolia*
Kaffo'	*Pandanus tectorius*
Påhong	*Pandanus dubius*
Åhgao	*Premna serratifolia*
Nonak	*Hernandia sonora*
Faia	*Tristiropsis obtusangula*
Binålo	*Thespesia populnea*
Ifit	*Intsia bijuga*
Niyoron	*Cordia subcordata*
Sayåfe	*Melochia vellosissima*
Talisai	*Terminalia catappa*
Nunu	*Ficus prolixa*
Chosgu	*Glochidion marianum*
Gågu	*Casuarina equisetifolia*
Chi'ute	*Cerbera dilatate*
Langiti	*Ochrosia mariannensis*
Nonak	*Hernandia labyrinthic*

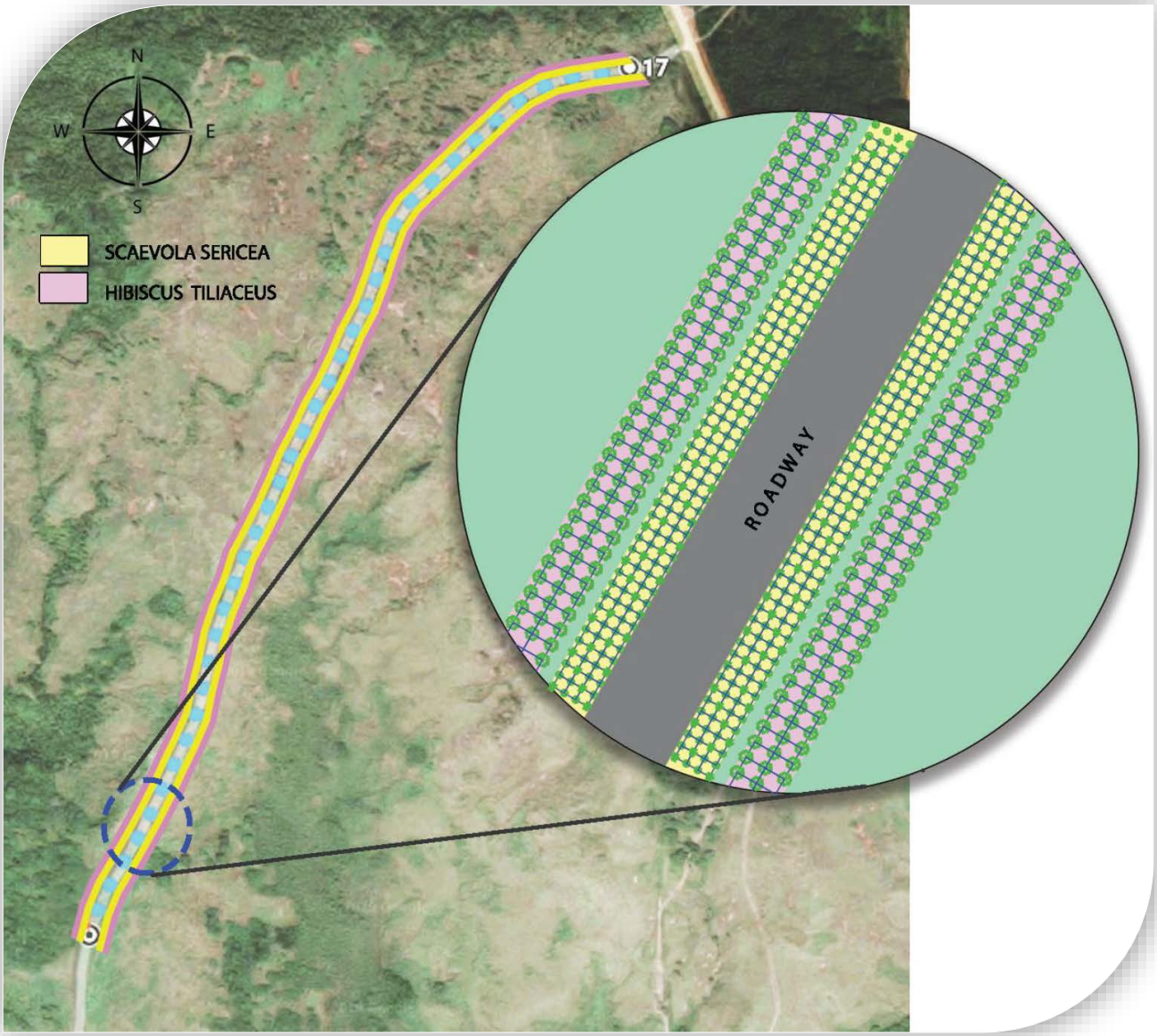


Figure 8. Map depicting the planned tree plantings in the Naval Magazine along Firebreak 3.

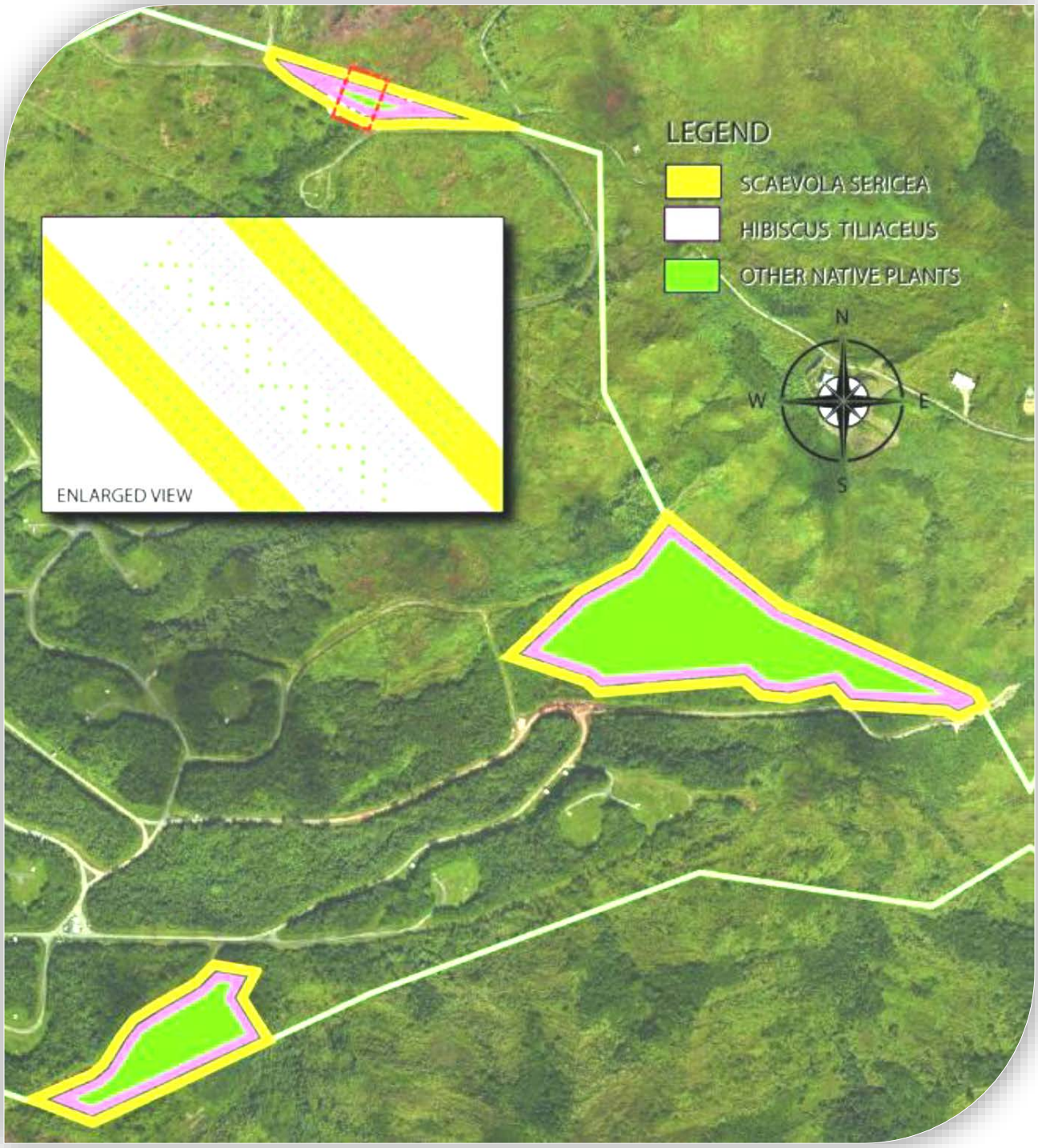


Figure 9. Map depicting areas within Sasa Valley that will be planted in native trees as a firebreak.

Range Fire Management Plan for Marine Corps Ranges on Guam

Location: NWF, AAFB **Period of Performance:** SEP2017 - SEP2020

Project Objective

The overall objective is to create a Range Fire Management Plan (RFMP) to reduce range wildfire potential, protect and enhance valuable natural and cultural resources, integrate applicable state and local permit and reporting requirements, and implement ecosystem management goals, sustainable training, and objectives already supported on existing Marine Corps installations.

The RFMP shall focus on the areas that will encompass and surround the Marine Corps ranges at Northwest Field and Anderson South.

Conservation Benefit

Provide plan to reduce the effects of fires by limiting their frequency, size, and severity to avoid or minimize impacts to listed species or recovery habitat while still allowing the USMC to maintain a high level of combat readiness.

FY19 Status

- Draft Guam fire management plan submittal reviewed by the government. Comments discussed with cooperator and revised draft is anticipated by end of October 2019.
- After resolution of comments, final draft will be submitted to USFWS for a 30-day review.

EPR: DPRI: Marine Corps Relocation 2017/2018 amendment to 2015 BO, Conservation Measures to Minimize the Effects of Fire.

Cetti Bay Watershed Terrestrial Monitoring

Location: Cetti Bay Watershed **Period of Performance:** SEP2017 - MAR2020

Project Objective

MILCON P-502 required compensatory mitigation for the unavoidable loss of coral reef functions and values for the construction of the Kilo Wharf expansion site at Naval Base Guam. The Cetti Bay reforestation project was negotiated as the compensatory mitigation for P-502. Roughly 300 acres were planted with Acacia trees for erosion and sediment load control. The plantings took place each year starting in 2007 and continuing until 2016 (Figure 10). The acacia trees at Cetti are at various stages of growth. This project is monitoring tree survivorship, erosion control and sediment loads in the reforestation site.

Fires have occurred annually in Cetti Bay throughout the lifetime of this project, the effects of which is reducing ground cover plants that normally control soil erosion, increasing deposition of eroded soil into Cetti Bay which harms corals, and threatening the survival of newly planted acacia trees which are more vulnerable when they are small in trunk diameter.

The project objective is to gage the efficacy of the acacia plantings in reducing the effects of fires in Cetti Bay and reducing the amount of soil that settles into Cetti Bay. The measures involved in addressing the project objective include survival and growth rates of the acacia trees, tree survival rates after a fire, and the amount of sediment reaching the bay from the two rivers that drain the Cetti watershed into the Bay.

Conservation Benefit

The project will establish how effective the acacia tree plantings are in improving Cetti Bay aquatic resources, given the environment and site history of annual fires.

FY 2019 Status

- Awarded as a cooperative agreement through the CESU network to UOG in September of 2017.
- Establish Trimble data library so that information can be directly downloaded into Navy GeoReadiness maps.
- 30 plots were selected for monitoring within the forested area.

- All 30 plots have been monitored. Data was collected on tree survivorship and growth. Vegetation structure was also recorded. Data collection is complete, but not yet submitted. Total amount of acres planted will also be tabulated.
- Turbidity probes were installed. One probe went into the watershed and two probes went into the bay. These probes will provide the baseline data set for runoff conditions before the trees have had a chance to mature (Figure 11).
- 2018 and 2019 fires within the restored/monitored area were recorded, tree survivorship in relation to size in burned areas was recorded.
- Turbidity data shows an average turbidity during the rainy season as 22 NTU (nephelometric turbidity units). Nephelometric is an instrument for measuring the concentration of suspended particulates in a liquid. This NTU results will be used as a baseline against future results.
- Tree growth data was collected to be used as a baseline for tree growth rate over time.
- Trees have an 80% survival rate in unburned areas.
- In burned areas from 2018 all trees with a diameter over one inch survived. Among trees with a diameter less than one inch only 50% of trees survived the fires.

EPR: USACE Permit, NBG Reforestation Site, Cetti Bay; 61755NR896

2019 JRM INRMP Reference: THM-2; 7-50

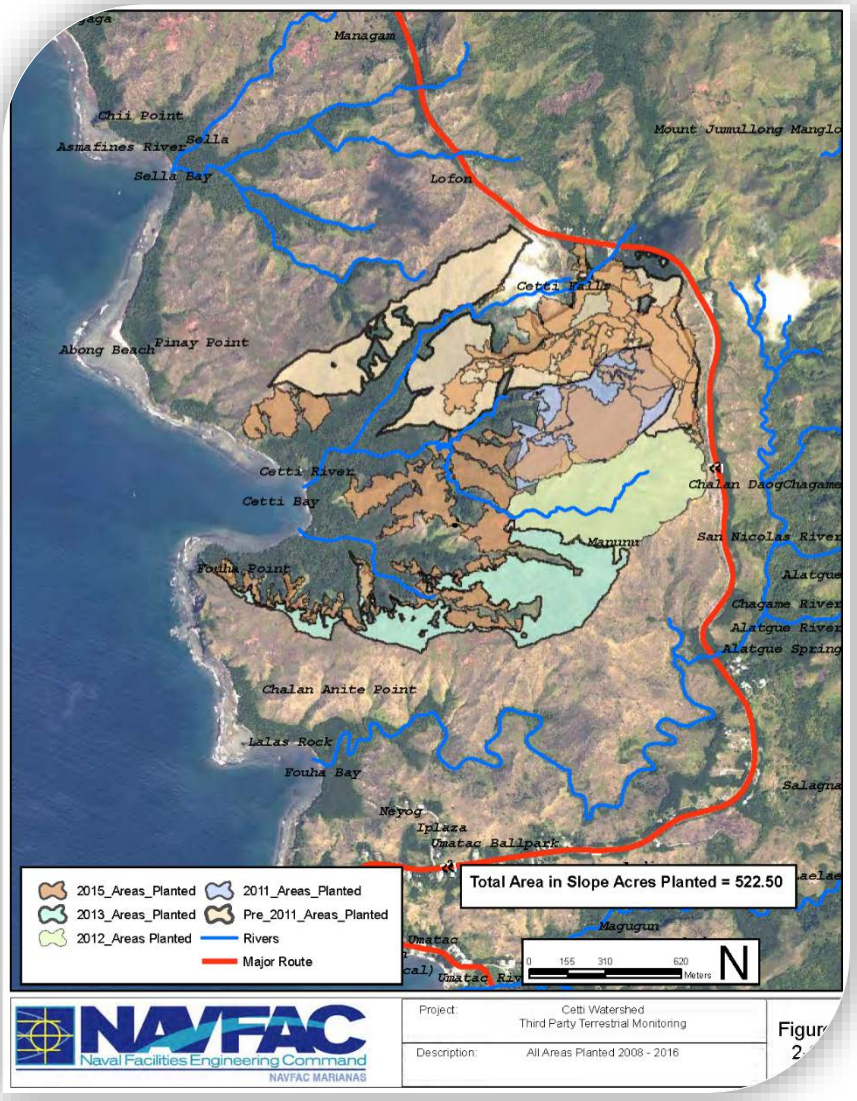


Figure 10. Map depicting the location of Cetti Bay Watershed and acacia plantings by year.

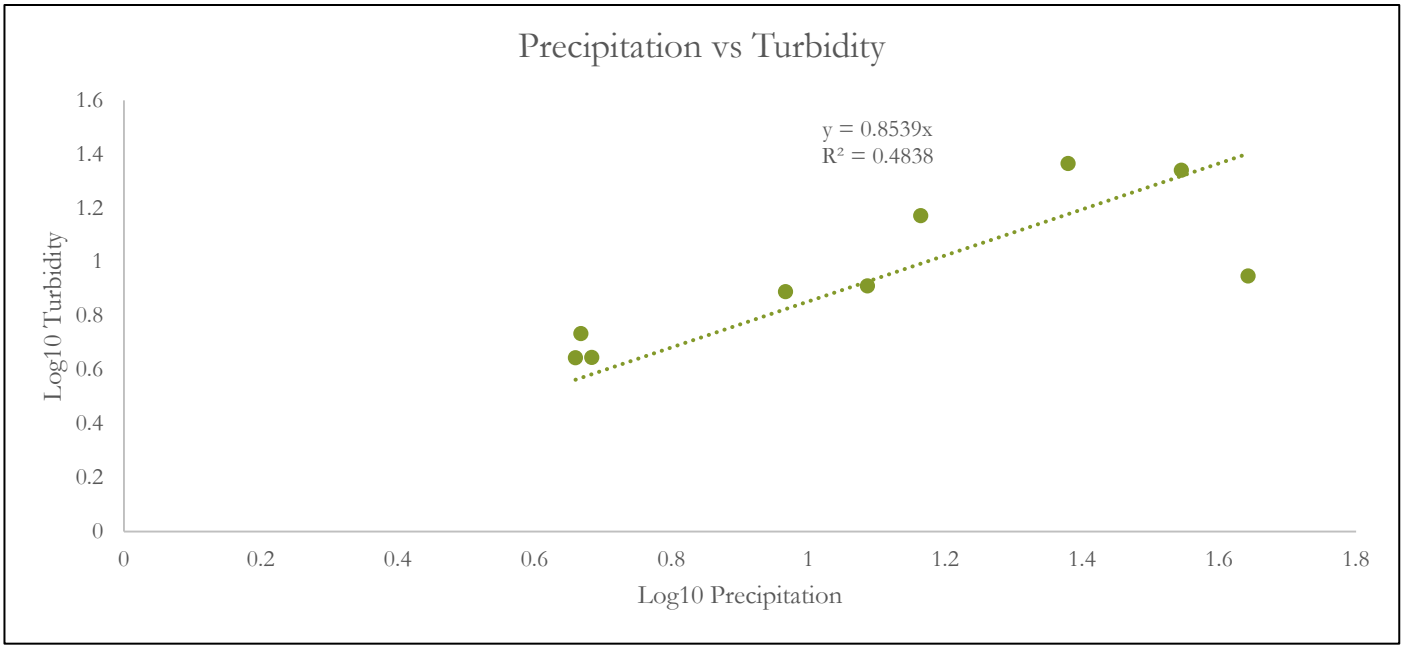


Figure 11. Graph depicting linear regression model demonstrating the relationship between turbidity and precipitation.

Seed Collection from *Heritiera longipetiolata* and *Tabernaemontana rotensis*

Location: AAFB **Period of Performance:** OCT2018 - OCT2021

Project Objective

To collect seeds from federally endangered *Heritiera longipetiolata* and threatened *Tabernaemontana rotensis* identified within construction footprints associated with the Marine Corps Relocation.

Conservation Benefit

To minimize impacts of military construction activities to native ecosystems by collecting seeds from as many mature individuals as possible to preserve the genetic diversity of the species.

FY19 Status

- One (1) *Heritiera longipetiolata* is located within project footprints. It is a mature, seed-producing adult, and seeds have been collected from it.
- 214 *Tabernaemontana rotensis* are located within project footprints.

- Approximately 2/3 of the trees are mature and have the potential to seed.
- To date, approximately 25 individuals have produced seeds during the collection time (seeds collected from the ground are assigned to the nearest seed-producing tree, so an exact number cannot be determined).

EPR: DPRI: Marine Corps Relocation 2017/2018 amendment to 2015 BO, Conservation Measures to Contribute to the Recovery of Listed Species.

2019 JRM INRMP Reference: THM-3; 8-49

Forest Restoration in Area - Achae Point

Location: AAFB **Period of Performance:** SEP2017 – SEP2019

Project Objective

Restore native vegetation as a component to limestone forest rehabilitation and enhancement.

Background

The Achae Point Reforestation Project at Ritidian Point was started as collaborative effort between the AAFB and the US Fish and Wildlife Service (USFWS), Guam National Wildlife Refuge (GNWR). This Reforestation project was a multi-year project that included 1) constructing an ungulate proof fence, 2) collecting and growing native plant seeds, and 3) planting native trees important for endangered species recovery, specifically the Mariana fruit bat. In 2011, a chain link fence was constructed around a 1.5 acre Installation Restoration Program (IRP) site to exclude deer and feral pigs (Figure 12). Native tree seedlings were outplanted in November 2013, with a final count of 1,086 native trees outplanted in April of 2014.

In June of 2016 a brush fire occurred in and around the reforestation site and destroyed numerous trees within approximately one acre of the fenced area. An additional 860 native plants were planted in September 2016 within the fenced area in open burned areas.

Conservation Benefit

Enhance and restore habitats, reduce habitat fragmentation, increase populations of native species, and buffer protected areas.

FY19 Status

- A contract was awarded in 2017 to maintain the trees, weed, fertilize, and maintain the grass-free buffer around the fence line.
- A total of 75 native trees were outplanted in the summer of 2019. Currently there are 782 native plants within the site.
- A draft final report was submitted and will be finalized at the end of September.
- The maintenance of the Achae Point reforestation area was awarded to UOG as a Cooperative Agreement through the CESU network was awarded.
- In October 2019 management of the area will be turned over to UOG, Guam Plant Extinction Prevention Program (GPEPP) to include planting and maintaining listed plant species such as *Serianthes nelsonii* and *Heritiera longipetiolata*.

EPR: 1 CR MAR AFB Native Forest Habitat Restoration; M5240NR067

2019 JRM INRMP Reference: THM-1; 9-68



Figure 12. Location of the Achae Reforestation Site on Route 3A.

Vegetation Restoration for the HMU

Location: AAFB **Period of Performance:** AUG2016 – DEC2019

Project Objective
Implement vegetation restoration within the Habitat Management Unit (HMU) utilizing the 2017 HMU Vegetation Restoration Plan.

Conservation Benefit
Enhance and restore habitat and maintain or increase populations of threatened and endangered species, including those extirpated from Guam and potentially reintroduced within the HMU.

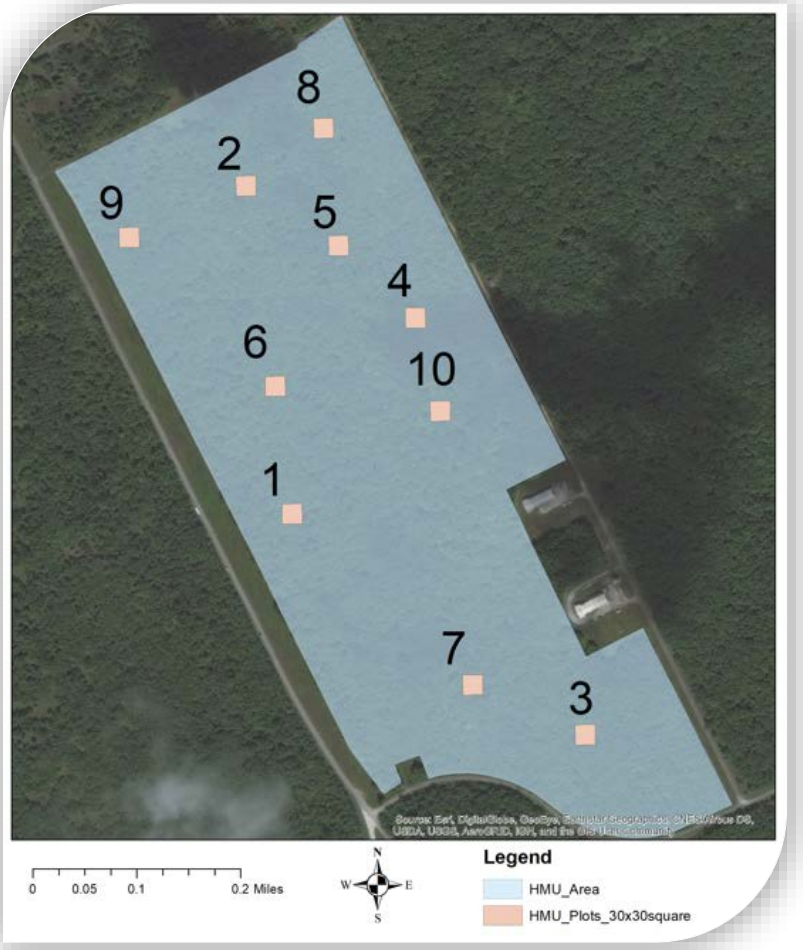


Figure 13. Proposed locations of experimental plots in the HMU.

FY19 Status

- Ten plots were established, including five (5) experimental and five (5) control plots, per the HMU Management Plan (Figure 13). Evaluation of plot size indicated 30 x 30 m plots needed (vs 50 x50 m plots).
- Mapping of vegetation within plots completed. Mapping of edge vegetation initiated.
- Greenhouse was established and native plants for restoration are growing in the greenhouse.
- Treatment of *Vitex parviflora* pending Section 7 consultation with USFWS.

EPR: 1 CR MAR AFB Native Forest Habitat Restoration; M5240NR067

2019 JRM INRMP Reference: THM-1; 9-68

Maintenance of Ungulate Exclosure – AAFB

Location: AAFB **Period of Performance:** OCT2018 – SEP2019

Project Objective

Annual fence line maintenance and repairs to maintain the efficacy of AAFB ungulate-free exclosures. This project includes 1) monthly inspections, which involves walking the fence-line encompassing multiple ungulate exclosures and conducting any repairs and 2) cutting and trimming the vegetation within 3 feet of each side of the fence monthly to reduce any damage to the fence.

Conservation Benefit

The routine maintenance and repair of ungulate exclosures will enhance the longevity of the ungulate barrier. Regular fence monitoring and repair also has the benefit of early detection to any possible immigration of ungulate into fenced eradicated areas. Monitoring, maintenance and repair all support the purpose of facilitating ungulate-free areas to enhance native forest ecosystem regeneration.

FY19 Status

- No new fences were constructed in FY19. The existing fence at Ritidian was removed/reconfigured under Live Fire Training Range Complex (LFTRC) requirements.
- "Tarague Triangle" ungulate exclosure was awarded in September 2019.

EPR: 2 BO MAR AAFB Maintenance of Ungulate Exclosure; M5240NR045

2019 JRM INRMP Reference: THM-1; 9-68

Northwest Field Ungulate Control Area Fencing and Eradication

Location: AAFB **Period of Performance:** SEP2019 – JUL2021

Project Objective

The project will install ungulate-proof fencing around the limestone plateau in the vicinity of the Live Fire Training Range Complex.

Conservation Benefit

Feral pigs and deer are among the most significant threats to sensitive limestone forests; ungulate removal will promote growth of native species and increased survival of threatened and endangered species.

FY19 Status

- Installation approval and cultural resource consultation completed in 2019.
- The Northwest Field exclosure (Figure 14) will be completed by July 2021.
- The contract for ungulate eradication for the Northwest Field (NWF) ungulate control area is expected to be awarded in FY21.

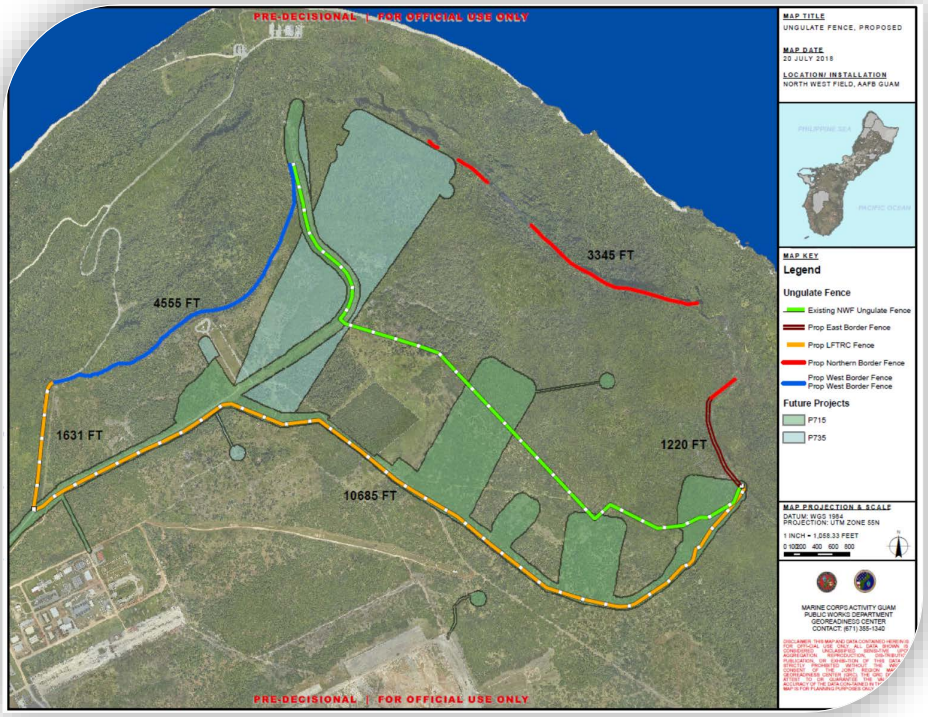


Figure 14. Location of Ungulate Exclusion Fence (Yellow/Blue/Red) Targeted for ungulate eradication at future USMC LFTRC at NWF, AAFB (Gaps are Sheer Cliff Areas).

EPR: DPRI: Marine Corps Relocation 2017/2018 amendment to 2015 BO, Conservation Measures to Minimize the Effects of Invasive Species.

2019 JRM INRMP Reference:

THM-1; 9-68

Ungulate Fencing – AAFB

Location: AAFB **Period of Performance:** OCT2018 – SEP2019

Project Objective

Construct ungulate fencing on AAFB to facilitate eradication of feral pigs and Philippine deer as well as prevent immigration of ungulates within fenced areas.

Conservation Benefit

Supports ungulate eradication goals within fenced areas of AAFB (Figure 15). Ungulate eradication facilitates the revitalization of native habitat that supports viable populations of native species, increases the biodiversity of native species, and contributes to the connectivity with surrounding communities in ways that support improved ecosystem functionality. Contributes to the goals of the Guam NWR as an overlay unit on AAFB.

FY19 Status

- Informal Section 7 Consultation for "Tarague Triangle" area was completed in May 2019.
- Tarague Triangle fence contract awarded in September 2019. Tarague Triangle ungulate fence will fence approximately 80 Acres within Tarague Basin of AAFB (Figure 19).

EPR: 1 RP MAR AAFB Ungulate Fencing; M5240NR043

2019 JRM INRMP Reference: THM-1; 9-68

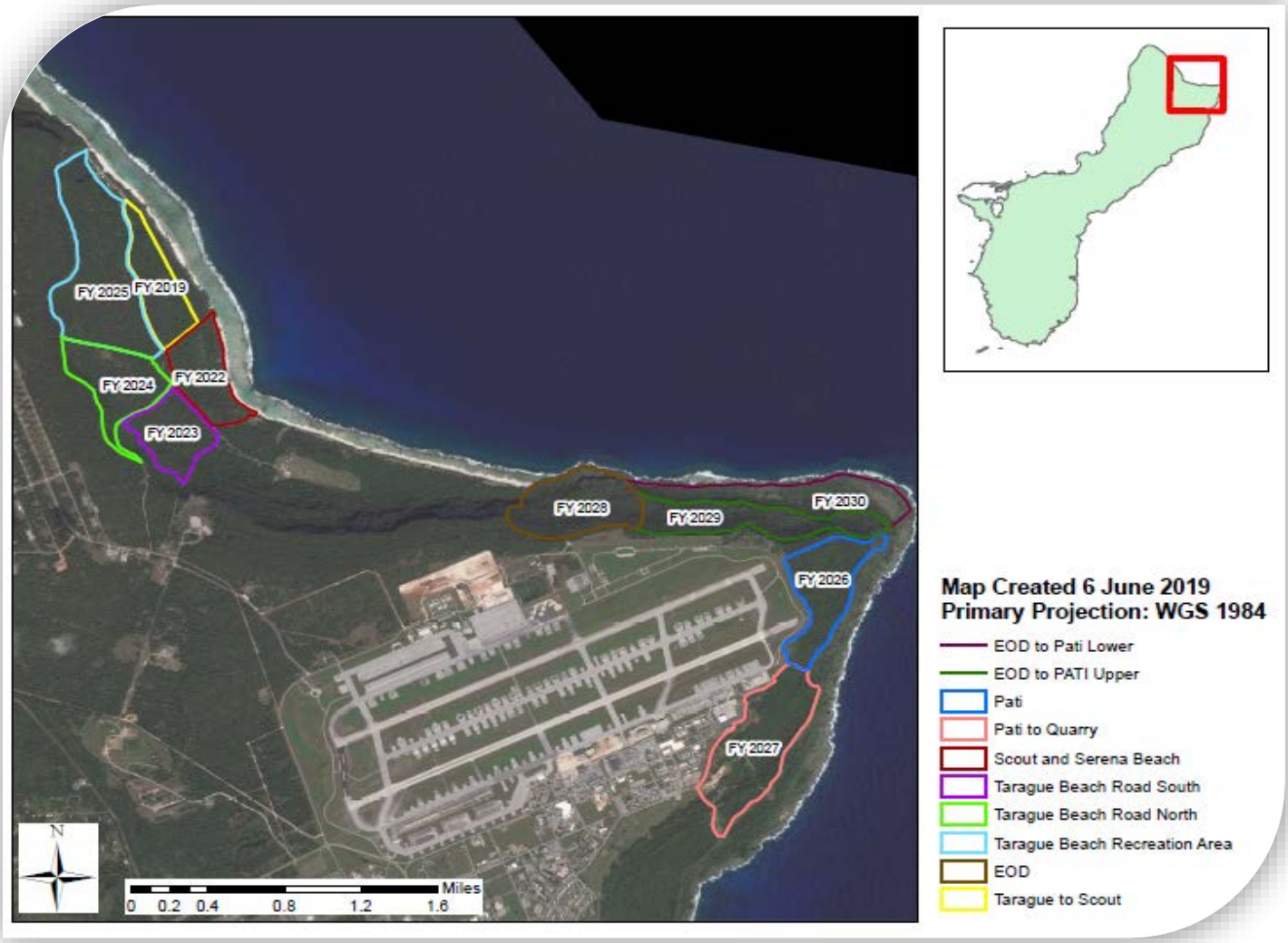


Figure 15. Map depicting areas of anticipated ungulate fencing at AAFB.

Ungulate Eradication and Control – AAFB

Location: AAFB **Period of Performance:** SEP2018 – SEP2019

Project Objective

Removal of feral pigs and Philippine deer from AAFB to protect and enhance native species and associated habitat.

Conservation Benefit

Enhance and restore habitats to increase populations of native species, particularly threatened and endangered species, as well as promote biodiversity of native plants.

Reduce ground disturbance from ungulates to improve soil stabilization, and reduce suitability of invasive plant species.

FY19 Status

- Coordinated with AAFB Volunteer Conservation Officer Program. As of September 2019 a total of 288 deer and 41 pigs were removed from AAFB (Figure 16).
- A Cooperative Agreement was awarded to White Buffalo Inc. in September 2019 for the collaring and tracking of 18 ungulates (9 deer, 9 pigs) on AAFB.
    - Data collected will be used to conduct spatial analysis for home range, pathways, and habitat selection and use, increasing effectiveness and efficiency of future ungulate control activities.
- Conducted 73 depredation events to support conservation as well as human health and safety on AAFB.
- Completed revisions to the AAFB Depredation SOP

EPR: 1 CP MAR AAFB Ungulate Eradication and Control; M5240NR069

2019 JRM INRMP Reference: THM-1; 9-68

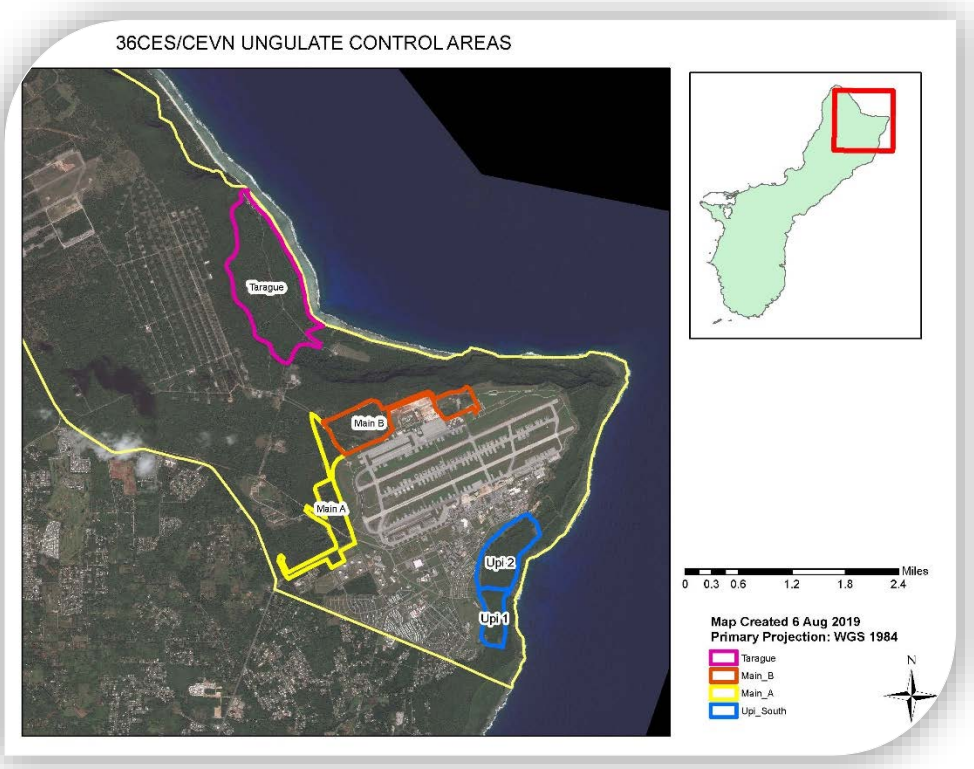


Figure 16. AAFB Depredation Areas Current as of 30 September 2019.

Salvage and Transplantation of ESA-listed Orchids – NBG TS and AAFB

Location: NBG TS; AAFB **Period of Performance:** 2017 - 2021

Project Objective

To salvage and transplant federally threatened *Bulbophyllum guamense*, *Dendrobium guamense*, and *Tuberolabium guamense* identified within construction footprints associated with the Guam Relocation.

Conservation Benefit

To minimize impacts of military construction activities to native ecosystems by salvaging as many healthy individuals as possible and preserving the genetic diversity of each species.

FY19 Status

- *Bulbophyllum guamense*
  - 71 individuals have been identified, salvaged, and transplanted to the Forest Enhancement Area from project footprints on Finegayan.
  - 71 individuals survived at least 1 year after transplantation.
  - One individual was identified in AAFB in July 2019. It was salvaged and translocated to the Government nursery in September 2019.
- *Dendrobium guamense*
  - 21 individuals have been identified, salvaged, and transplanted to the Forest Enhancement Area from project footprints on Finegayan and Andersen South since 2017.
  - 18 individuals survived at least 1 year after transplantation.
- *Tuberolabium guamense*
  - 15,385 individuals have been identified in NBG Telecommunications Site and throughout AAFB since 2017.
  - 6,357 individuals have been salvaged and transplanted to the Forest Enhancement Area (Figure 17).

  - 4,826 individuals survived at least 1 year after transplantation.
- Survival criteria:
  - 2017 through 2019: New root growth
  - 2019 and all future projects: New root growth and root attachment to the new host tree

EPR: DPRI: Marine Corps Relocation 2017/2018 amendment to 2015 BO, Conservation Measures to Contribute to the Recovery of Listed Species.

2019 JRM INRMP Reference: THM-3; 8-49



Figure 17. Surviving adult *Tuberolabium guamense* fruiting after salvage and transplantation to the Forest Enhancement Area.

Salvage and Transplantation of *Cycas micronesica* – NBG TS and AAFB

Location: NBG TS; AAFB **Period of Performance:** JUL2017 - JUL2021

Project Objective

To salvage and transplant federally threatened *Cycas micronesica* identified within construction footprints associated with the Guam Relocation.

Conservation Benefit

To minimize impacts of military construction activities to native ecosystems by salvaging as many healthy individuals as possible and preserving the genetic diversity of the species.

FY19 Status

- NBG Telecommunications Site
  - Cycads salvage was completed on 03 October 2018
  - Eight (8) cycads were identified within the construction area, but only six

(6) were considered healthy enough to potentially survive transplantation (Figure 20).
    - Six adult cycads were salvaged and transplanted to an area of the Forest Enhancement Area. Salvage and transplantation was completed on 03 October 2018. The cycads received maintenance and monitoring for 1 year until 03 October 2019.
    - Four (4) of the six are alive
        - Three are healthy
        - One has scale, but it is being treated with BioAdvance and is expected to survive. This individual is three trunks grafted together and actually produced a cone.
    - One of the six is confirmed dead.
    - One of the six is in very poor health and is not expected to survive despite efforts to fight off pests.
- Northwest Field, AAFB
    - Pup salvage was completed on 01 August 2019. 1,411 pups were salvaged (Figure 18).
    - Direct salvage and outplanting of 28 cycad trees is scheduled to occur place between 23 and 27 September 2019.
- Munitions Storage Area (MSA), AAFB
    - Five cycads were identified within the construction area, viability assessment pending.
    - A work plan to salvage the cycads is currently being drafted.
    - Pups and/or stem cuttings will be salvaged from viable cycads as soon as a work plan is approved. Pups and/or stem cuttings will receive maintenance and monitoring in a Government-approved nursery before being outplanted into the Forest Enhancement Area.
- Andersen South, AAFB
    - 27 cycads were identified within the construction area, but only eight were considered healthy enough to potentially survive transplantation.
    - Pups and stem cuttings were salvaged from eight cycads and transplanted to pots within a Government-approved nursery in September 2019 (Figure 19). Pups and/or stem cuttings will receive maintenance and monitoring in a Government-approved nursery before being outplanted into the Forest Enhancement Area.

EPR: DPRI: Marine Corps Relocation 2017/2018 amendment to 2015 BO, Conservation

Measures to Contribute to the Recovery of Listed Species.

2019 JRM INRMP Reference: THM-3; 8-49



Figure 18. *Cycas micronesica* Pups Salvaged from Northwest Field and Transplanted in a Nursery.



Figure 19. *Cycas micronesica* Apical Stems Salvaged from Andersen South and Transplanted in a Nursery.



Figure 20. Adult *Cycas micronesica* salvaged from NBG Telecommunications Site and directly transplanted into the Forest Enhancement Area.

Invasive Plant Control – NBG TS and AAFB

Location: NBG TS; AAFB **Period of Performance:** OCT2019 – OCT2020

Project Objective

This project intends to eradicate limited infestations of *Antigonon leptopus* and *Mimosa diplotricha* in the North Finegayan and Finegayan Forest Enhancement Sites.

Conservation Benefit

Invasive plants can outcompete native vegetation and interfere with restoration efforts for threatened and endangered species. Removal of invasive plants, particularly in new or smaller infestations where it may be possible to eradicate the invasive species from sensitive areas, will improve survivorship and growth of native plant species during future restoration efforts.

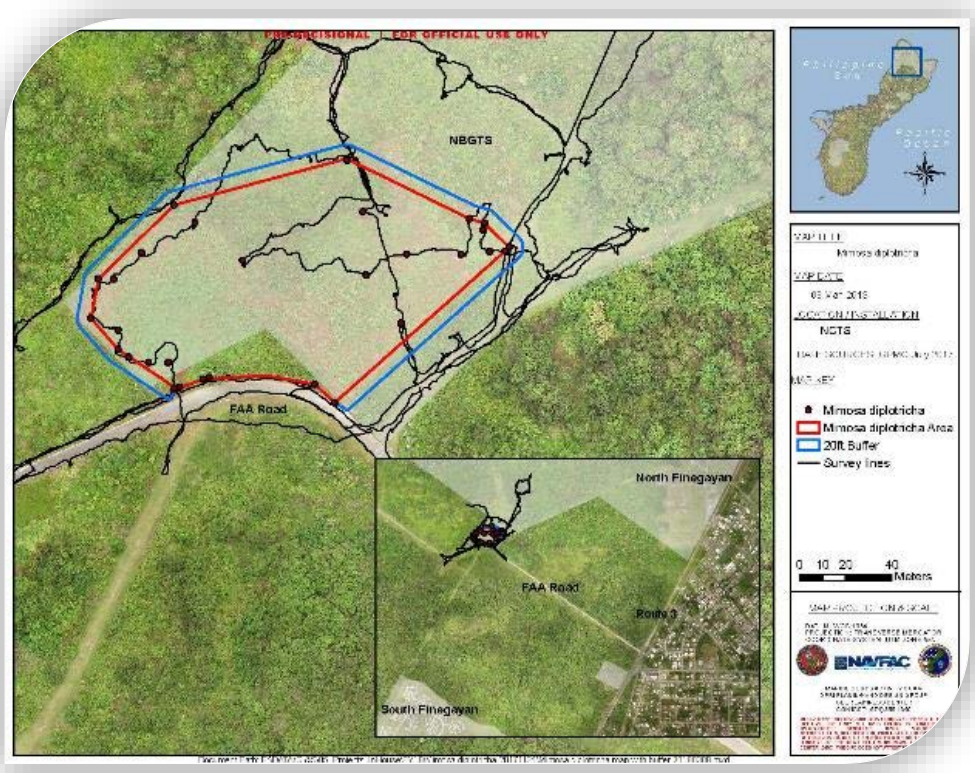


Figure 21. *Mimosa diplotricha* infestation site.

FY19 Status

- A request for proposal for this project was issued in September 2019. An award is expected in the first quarter of FY2020.

EPR: DPRI: Marine Corps Relocation 2017/2018 amendment to 2015 BO, Conservation Measures to Minimize the Effects of Invasive Species.

2019 JRM INRMP Reference: THM-3; 8-49, TIS-1; 8-52, THM-1; 9-68

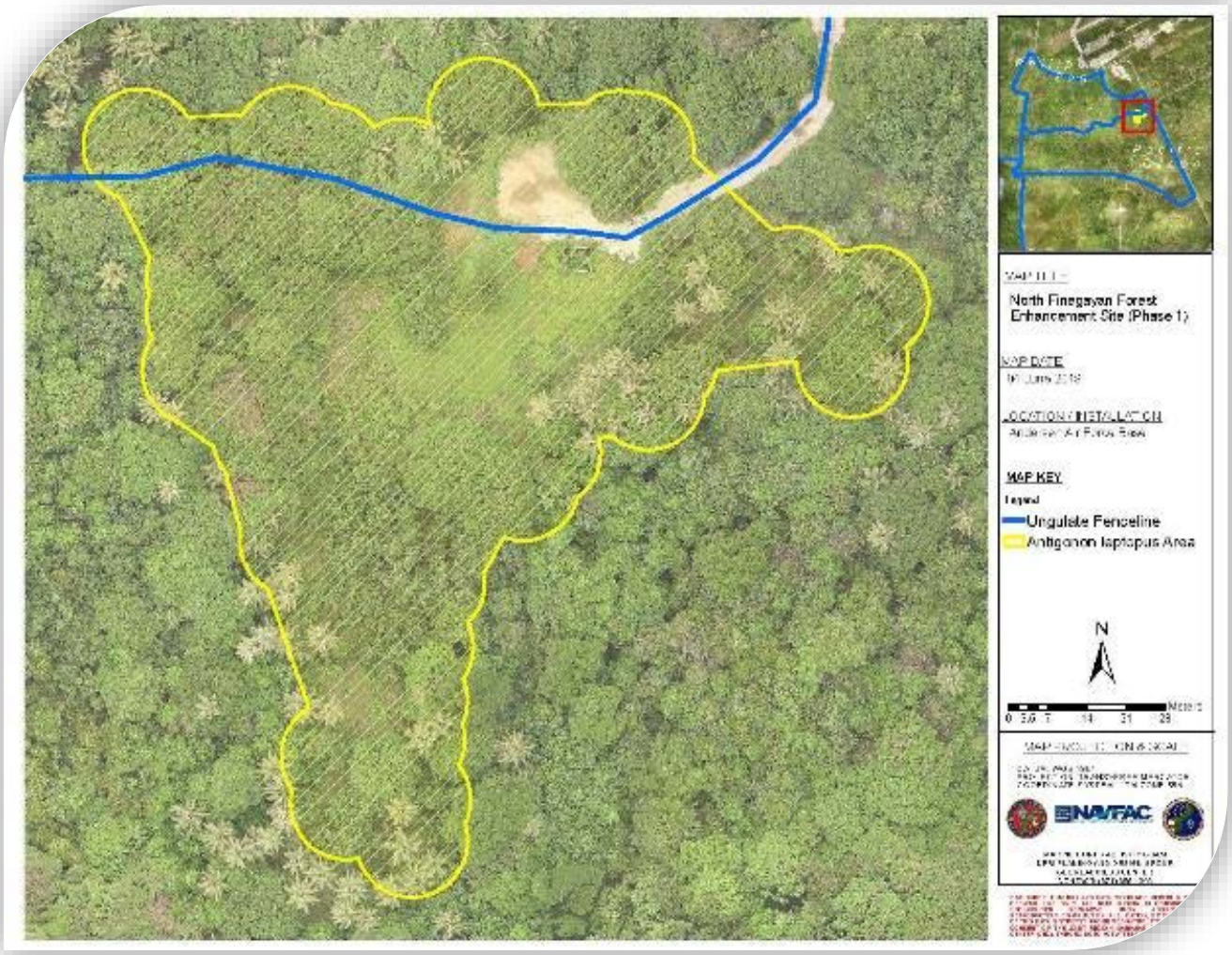


Figure 22. *Antigonon leptopus* infestation area within Phase I, North Finegayan Forest Enhancement Site.

North Finegayan Forest Enhancement Site Ungulate Fencing and Eradication

Location: NBG TS; AAFB **Period of Performance:** SEP2019 – SEP2020

Project Objective

The project will install ungulate-proof fencing around the North Finegayan Forest Enhancement Site (NFFES) in 2 phases: the 407-acre Phase 1 and 272-acres in Phase 2.

Conservation Benefit

Feral pigs and deer are among the most significant threats to sensitive limestone forests; ungulate removal will promote growth of native species and increased survival of threatened and endangered species.

FY19 Status

- The North Finegayan FES Phase 1 exclosure (Figure 23) will be completed by October 2019.
- The contract for ungulate eradication in Phase 1 is expected to be awarded in the first quarter of FY20.
- The North Finegayan FES Phase 2 fencing project has been awarded and will begin in November 2019. Ungulate eradication timeline will depend on the duration of fence installation.



Figure 23. Construction of ungulate control fence at Phase I Ungulate Control Area.

EPR: DPRI: Marine Corps Relocation 2017/2018 amendment to 2015 BO, Conservation Measures to Minimize the Effects of Invasive Species.

2019 JRM INRMP Reference: THM-33; 8-49



Figure 24. Location of Targeted Ungulate Eradication Areas of the North Finegayan Forest Enhancement Site.

North Haputo Ecological Reserve Area Ungulate Fencing

Location: NBG TS **Period of Performance:** AUG2019 – FEB2021

Project Objective

Approximately 165 acres of the Haputo Ecological Reserve Area (ERA) will be fenced to exclude deer and pigs that are damaging sensitive limestone forest habitats.

Conservation Benefit

The ungulate fence (Figure 25) will exclude deer and pigs that destroy native vegetation and contribute to erosion that harms nearshore reefs. Ungulate removal will promote growth of native species and increase survival of threatened and endangered species.

FY19 Status

- Contract was awarded in August 2019 to SRGI, Inc.

EPR: DPRI: 2015 Navy-USFWS Guam Micronesia Kingfisher MOA.

2019 JRM INRMP Reference: THM-2; 8-48



Figure 25. Map depicting North Haputo Fence Line.

Implementation Plan for Phase I of the North Finegayan Forest Enhancement Site

Location: NBG TS; AAFB **Period of Performance:** JUL2019 – JUL2020

Project Objective

The project will develop a site-specific plan for Phase 1 of the North Finegayan Forest Enhancement Site (Figure 26) to address regulatory compliance, infrastructure needs, invasive plant removal options, and sequencing for native species outplanting.

Conservation Benefit

Forest enhancement efforts will improve habitat for native species, including threatened and endangered plants and animals.

FY19 Status

- CESU awarded to UOG in July 2019.
- Final Implementation Plan expected in July 2020.

EPR: DPRI: Marine Corps Relocation 2017/2018 amendment to 2015 BO, Conservation Measures to Contribute to the Recovery of Listed Species.

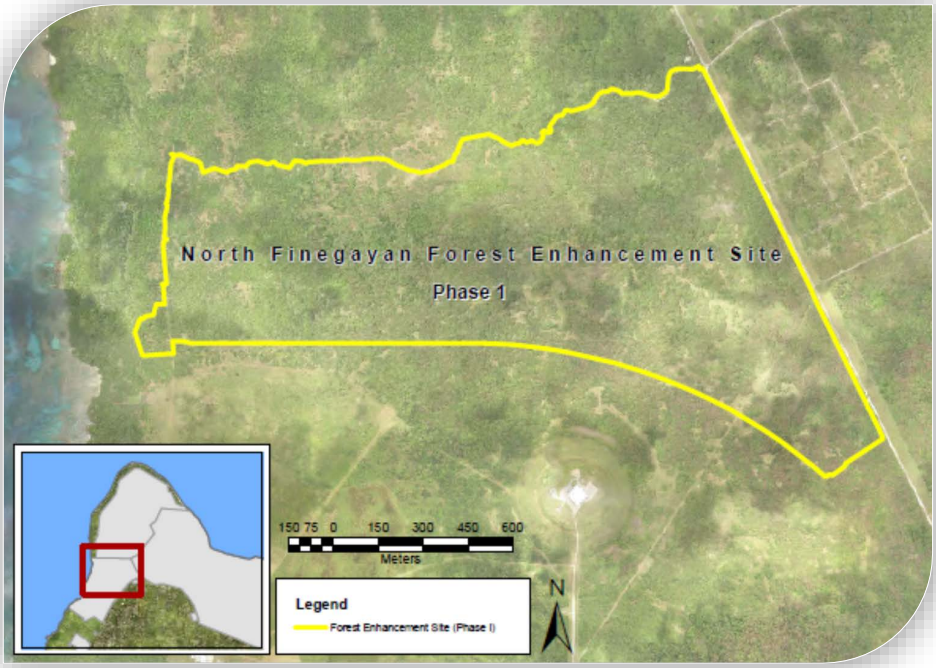


Figure 26. Map depicting North Finegayan Forest Enhancement Site Phase 1.

2019 JRM INRMP Reference: THM-1; 9-68

Terrestrial Exotic and Invasive Species Management

Developing a Framework for Coordinated Management of Vertebrate Restoration and Brown Treesnake Control on Guam

Location: JRM **Period of Performance:** SEP2019 – MAR2021

Project Objective

This project will consist of developing a decision-analytic framework to guide coordinated brown treesnake (BTS) control and vertebrate species restoration on Guam. The intent is to establish a collaborative process involving management agencies, stakeholders, and scientific experts and use a workshop model to bring these groups together for the purpose of framework development.

Conservation Benefit

This is an indirect way towards operational management decisions through a decision analysis process to engage in a more robust planning phase. This can include prioritization, management application, and collaboration to manage long-tern, costly complex conservation problems.

FY19 Status

- New funded project through an Interagency Agreement with United States Geological Survey (USGS) – Cooperative Research Unit (CRU): Washington University Extension starting in FY2019
- Project in early phases

EPR: 1 RP JRM Brown Tree Snake Eradication and Control to Support Recovery of ESA-Listed Birds; 61128NR202

2019 JRM INRMP Reference: TIS-3; 9-72

Review, Evaluation, and Assessment of Reintroduction Programs as Related to Reintroduction of Guam Micronesian Kingfisher on Joint Region Marianas Lands

Location: JRM **Period of Performance:** JUL2019 – JAN2021

Project Objective

The Guam Micronesian Kingfisher (GMK) Reintroduction evaluation CESU will provide the following: 1) evaluation of reintroduction of GMK within limited (unbounded) BTS-controlled areas of Joint Region Marianas (JRM) lands, 2) review and evaluate other reintroduction programs on Department of Defense (DoD) lands to identify mission compatibility successes, and 3) evaluate reintroduction performance utilized within other reintroduction programs and provide recommendations for JRM performance criteria for future reintroduction programs with an emphasis on mission compatibility.

Conservation Benefit

The collation of success and failures of reintroduction programs, an assessment of JRM preparedness and capabilities will be vital to reducing risk and increasing success when considering reintroducing avian species in the future. This review, evaluation, and assessment will help to minimize the learning curve, improve reintroduction outcomes, and provide JRM guidance in planning its' conservation goals.

FY19 Status

- Awarded as a cooperative agreement through the CESU network to the University of Tennessee starting in FY2019
- Project in early phases of

EPR: 1 RP JRM Brown Tree Snake Eradication and Control to Support Recovery of ESA-Listed Birds; 61128NR202

2019 JRM INRMP Reference: TIS-3; 9-72

Implementation of the Regional Biosecurity Plan of Micronesia and Hawaii

Location: JRM **Period of Performance:** JUL2017 – SEP2019

Project Objective

Update Attachment M (DoD Biosecurity Recommendations) of the Regional Biosecurity Plan for Micronesia and Hawaii (hereafter: RBP), and implement various actions identified within the RBP aimed at: preventing the spread of invasive species into/out of JRM AOR; controlling, managing, and eradicating invasive and nuisance species on DoD lands within the JRM AOR; providing outreach and awareness to military personnel, contractors, and their respective dependents; and increasing coordination and collaboration with regional partners and DoD stakeholders regarding biosecurity and invasive species management.

Conservation Benefit

Protect native species, particularly those that are threatened and endangered from the threat of invasive species within the JRM AOR.

FY19 Status

- Attachment M of the RBP was coordinated and developed in FY19. In addition, a review of the document was completed for DoD across JRM AOR, Hawaii, DoD stakeholders in the Pacific, and PACOM.
- Aug 2018: Awarded contract modification to remove dead coconut trees and green waste piles in support of bio-sanitation mitigation measures against Coconut Rhinoceros Beetles (CRB) for NBG and AAFB.
- Delimitation surveys for LFA at Haputo Trailhead and planning for eradication in FY20. First treatment of pesticides administered in September of FY19.
- Purchasing of CRB sentinel traps and planning for placement across AAFB and NBG in FY20.
- Implementation of Quality Assurance/Quality Control (QA/QC) bio-sanitation inspections of military equipment and cargo (and non-military cargo moved on military conveyances) utilized via the Defense Support of Civil Authorities in support of emergency relief efforts for areas within the CNMI affected by Super Typhoon Yutu.
- Continued interagency coordination and consultation regarding invasive species

management and biosecurity concerns within the region.

EPR: CHS NISA MAR JRM Implementation of the Regional Biosecurity Plan; 61128NR860

2019 JRM INRMP Reference: TIS-4; 5-85, TIS-5; 6-44, TIS-5; 7-53, TIS-4; 8-51, TIS-6; 9-73, TIS-1; 11-61, TIS-1; 12-32, MIS-1; 5-102, MIS-1; 8-64, MIS-1; 9-87, MIS-1; 11-74, MIS-2; 11-74



Figure 27. Bio-sanitation QA/QC overseeing wash-down of military equipment retrograde in support of emergency relief efforts for Super Typhoon Yutu.

Monitoring to Evaluate Effectiveness of HACCP Plan Implementation at Construction Sites

Location: JRM **Period of Performance:** N/A

Project Objective

Long-term monitoring program for terrestrial vegetation to aid in evaluating the success of implemented Hazard Analysis and Critical Control Points (HACCP) plans.

Conservation Benefit

To minimize the spread and effects of invasive plant species due to construction activities.

FY19 Status

- Ongoing previous FY contract awards for construction activities:
  - J-001B Finegayan Utilities and Site Improvements Phase 1
  - J-006 Apra Medical Clinic
  - J-007 Waterfront Head Quarters
  - J-200 IV Utilities
  - J-755 Urban Combat Training
  - P-102 Power Upgrade-Harmon.
  - P-103 Water Phase 2
  - P-295 Ordnance Ops.
  - P-715 Live-Fire Training Range Complex Known Distance Ranges
- Final Reports:
  - J-001B Finegayan Utilities and Site Improvements Phase 1 HACCP Baseline Survey Report
  - J-006 Apra Medical Clinic HACCP Baseline Survey Report
  - J-007 Waterfront Head Quarters HACCP Baseline Survey Report
  - P-102 Power Upgrade-Harmon HACCP Baseline Survey Report
  - P-715 Live-Fire Training Range Complex Known Distance Ranges HACCP Baseline Survey Report

EPR: DPRI: Marine Corps Relocation 2017/2018 amendment to 2015 BO, Conservation Measures to Contribute to the Recovery of Listed Species.

2019 JRM INRMP Reference: TIS-4; 7-53

Little Fire Ant (LFA), *Wasmannia auropunctata*, Surveys, Eradication, and Monitoring

Location: AAFB; NMS **Period of Performance:** SEP2017 – SEP2020

Project Objective

To eradicate LFA within Andersen South and the NMS to reduce impacts to native ecosystems and military readiness activities.

Conservation Benefit

Enhance and restore habitats by prevention of the spread of the invasive LFA.

FY19 Status

- CESU awarded in FY17 to University of Guam
- FY19 surveys for LFA conducted throughout AAFB Annex, with no positive detections (Figure 28).
- In FY19, LFA delimitation in the infested area of the NMS was completed (Figure 29).
- As of August 2019, two (2) of eight (8) scheduled treatments for LFA have been administered at NMS resulting in a decrease in LFA (Figure 30).
- Eradication of LFA at NMS is being closely coordinated with our resource partners at GovGuam Biosecurity, who are jointly treating the adjacent acacia forest and engaging the adjacent neighborhood with plans to commence treatment soon.

EPR: DPRI: Marine Corps Relocation 2017 amendment to 2015 BO, Conservation Measures to Minimize the Effects of Invasive Species; CHS EO 13751 MAR Little Fire Ant Surveys and Eradication; 61128NR207

2019 JRM INRMP Reference: TIS-5; 5-86, TIS-5; 9-72



Figure 28. Results of delimiting survey for LFA at the Andersen South Annex conducted Oct 2018-Aug 2019. Green dots indicate the location where LFA were detected.

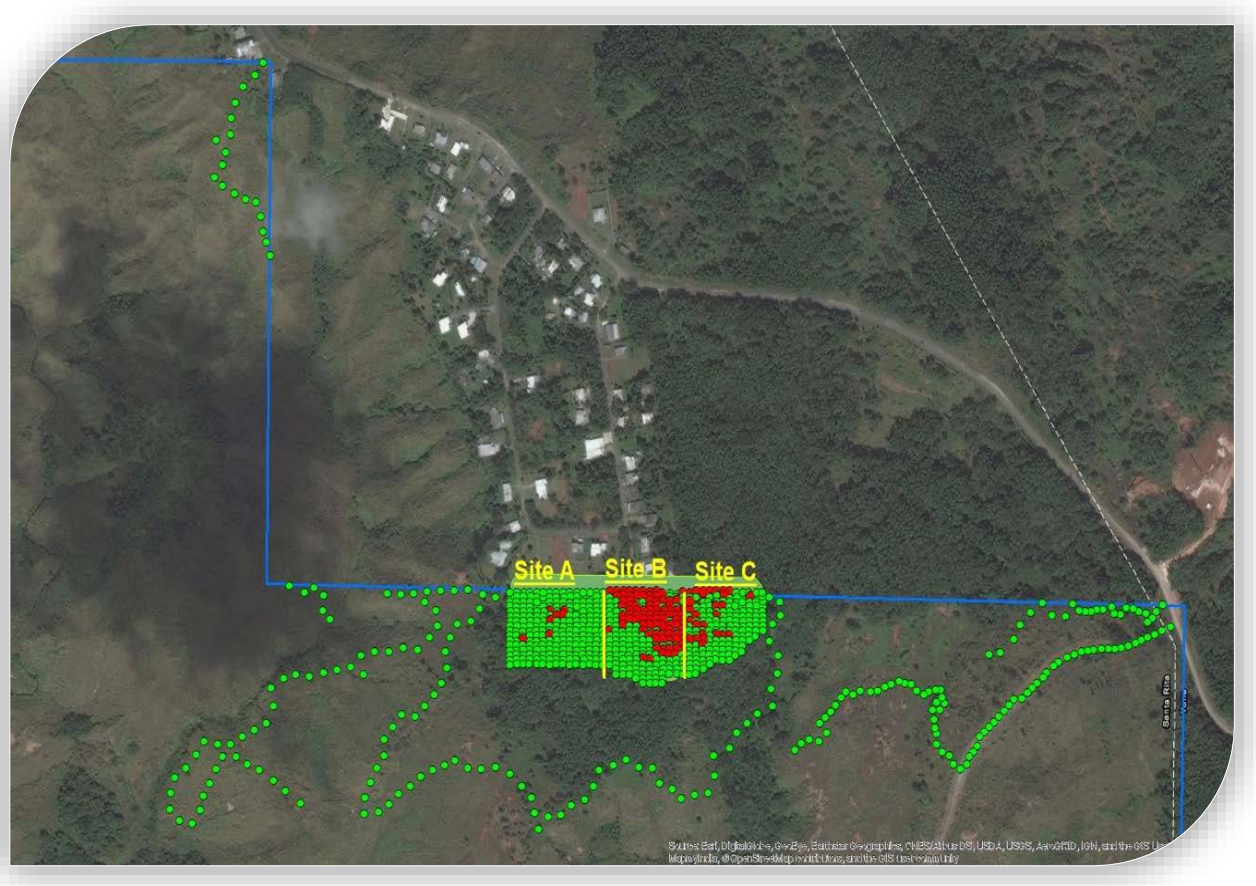


Figure 29. Detail of the delimiting survey of the LFA infestation at NMS conducted as of Aug 2019. Green dots show sample sites where no LFA were collected, and red dots indicate sites where LFA was collected. The green shaded area indicates a tentative 20m wide buffer zone that will be treated along with the LFA infested areas in the interior of the sampling sites once the delimiting survey is completed.

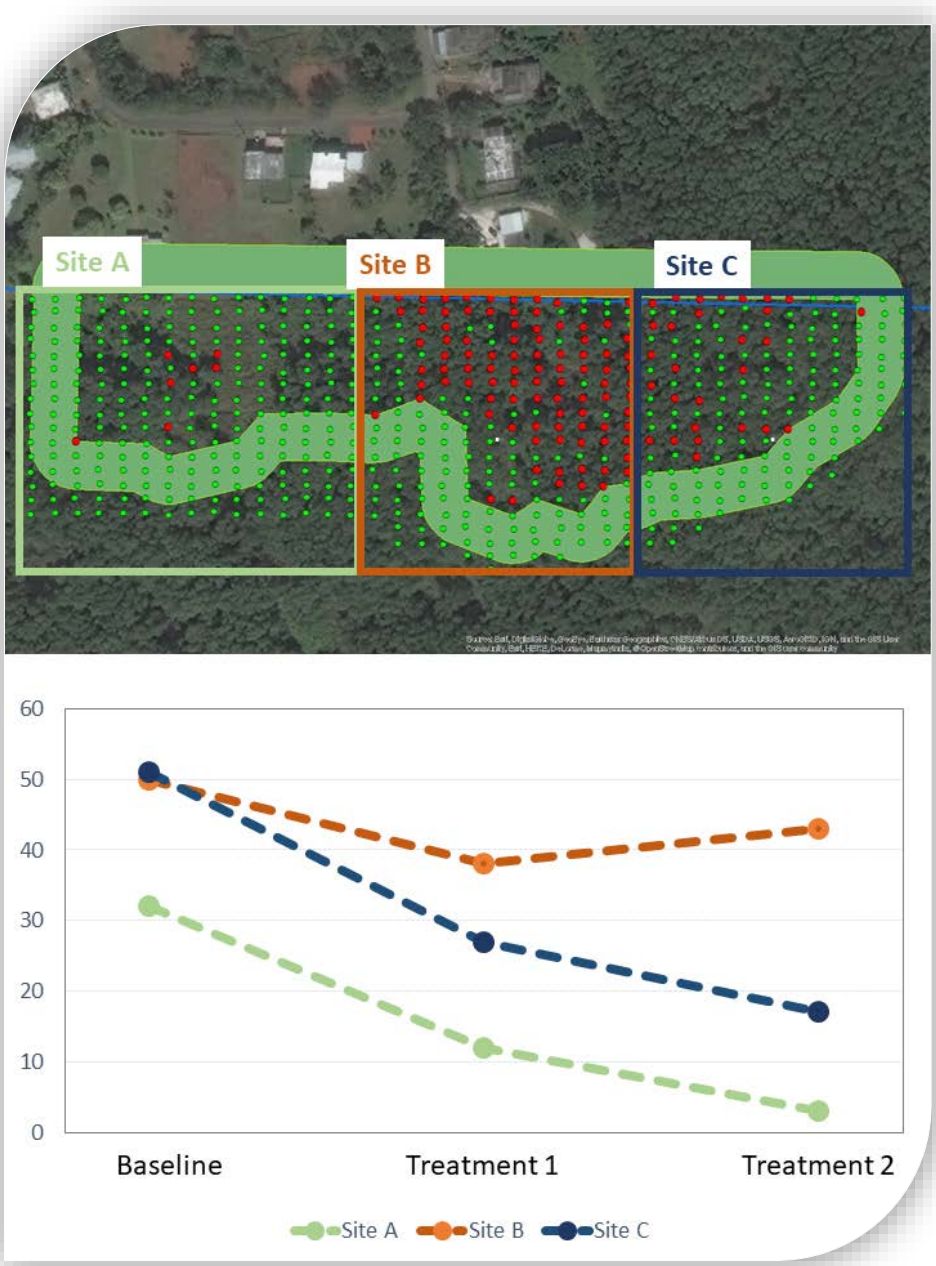


Figure 30. Detail of the survey results of the first two treatments of LFA infestation at NMS conducted as of Aug 2019. Green dots show sample sites where no LFA were collected, and red dots indicate sites where LFA was collected. The green shaded area indicates a 20m wide buffer zone that will be treated along with the LFA infested areas in the interior of the sampling sites once the eradication effort is completed.

Invasive Species Management within the Joint Region Marianas Area of Responsibility

Location: JRM **Period of Performance:** SEP2016 – JUN2020

Project Objective

In support of Mariana Islands Training & Testing (MITT) activities, conduct baseline inventory of non-native species at training and cargo staging locations within the JRM AOR (Guam and Tinian); develop and implement long-term monitoring protocols for non-native species; develop and implement invasive species rapid response protocols; and develop and implement standard operating procedures for: the control and removal of high-risk invasive species; rapidly responding to the identification of invasive species; bio-sanitation standards along with quality assurance/quality control standards; and development of a programmatic pathway risk analysis for the movement of equipment and personnel between islands within the JRM AOR.

Conservation Benefit

Prevent the movement of invasive species into and out of Guam and the CNMI during training exercises.

FY19 Status

- June 2019: Option Year 2 (June 2019 – July 2020) cooperative agreement awarded to Colorado State University (CSU), Center for Environmental Management of Military Lands (CEMML).
- FY19: Bio-sanitation Quality Assurance/Quality Control (QA/QC) inspections conducted for invasive species on military training equipment departing Guam as part of two (2) major military training events and three (3) unit-level training events.
- July 2018: Option Year 1 staff which included a Project Manager, five (5) Field Biologists, one (1) Supervisory Entomologist, augmented in June 2019 to include five (5) Field Technicians and one (1) Crew Leader.
- Final Report for Base Year (September 2016 – June 2018) expected 30 November 2019.
- Final Report for Option Year 1 (June 2018 – June 2019) expected 15 December 2019.

EPR: 2 BO MAR Mariana Islands Training and Testing (MITT) Implementation; 61128NR218 CHS EO 13751 MAR Little Fire Ant Surveys and Eradication; 61128NR207
1 CR MAR AAFB BTS Barrier Maintenance in HMU; M524010000 CHS NISA MAR JRM Implementation of the Regional Biosecurity Plan; 61128NR860

2019 JRM INRMP Reference: TIS-6; 5-86, TIS-5; 6-44, TIS-5; 7-53, TIS-4; 8-51, TIS-6; 9-73, TIS-1; 11-62, TIS-1; 12-32



Figure 31. Bio-sanitation QA/QC inspections during Cope North 2019 on Tinian.



Figure 32. Red-backed spider (*Latrodectus hasseltii*) intercepted at AAFB during Cope North 2019.

BTS Control at Mariana Swiftlet Caves

Location: NBG; NMS **Period of Performance:** OCT2018 – Ongoing

Project Objective

Ongoing long-term BTS protection of the Mariana Swiftlet (*Aerodramus bartschi*). Protection consists of oral toxicants for BTS around the areas surrounding Mahlac, Fachi, and Maemong caves, NMS.

Conservation Benefit

Maintain or increase swiftlet population and enhance or restore habitat by reducing predation by BTS.

FY19 Status

- Ongoing project with United States Department of Agriculture- Wildlife Services (USDA-WS) and CSU.
- Service providers switched April 1, 2019 from USDA/WS to CEMML- CSU CEMML.
- Switched from a mix of BTS traps and toxicant bait tubes to 100% bait tubes.

EPR: 1 MAR NBG Mariana Swiftlet Population Protection: BTS Trapping; 61755NR834

2019 JRM INRMP Reference: TIS-2; 6-43

Table 4. BTS Control at Swiftlet Caves, NMS by USDA/WS (01JUN18 – 31MAR19).

Cave	# Traps	# BTS	# Bait	# Bait
Fachi	25	34	25	112
Maemong	29	54	29	132
Mahlac	40	61	36	165
Total	**94**	**149**	**90**	**409**

Table 5. BTS Control at Swiftlet Caves, NMS by CEMML (01APR19 – 29AUG19).

Cave	# Bait	# Bait
Fachi	30	49
Maemong	33	52
Mahlac	42	81
Total	**105**	**182**

*# Bait Taken does not mean taken by a BTS as other animals may take the bait.
[$]USDA/WS Deployed 3510 baits; CEMML has deployed 1647 baits

Evaluation of Brown Treesnake control to improve management of Guam's remnant Mariana Swiftlet population

Location: NMS **Period of Performance:** SEP2018 – MAR2020

Project Objective

Estimate Mariana swiftlet (*Aerodramus bartschi*) population size derived from thermal videography recordings coupled with estimates of movement patterns in and out of the caves. Evaluate the effect of bait type (bird/mammal) on targeting snakes entering swiftlet caves to help inform capture efficacy and management strategies.

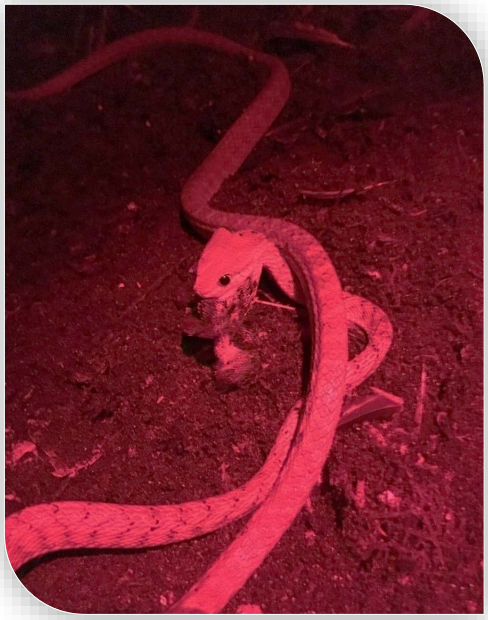


Figure 33: Female BTS consuming swiflet fledging on the ground in Mahlac Cave.

Conservation Benefit

As one of two remaining forest birds on Guam, protection of Mariana Swiftlets is an import conservation goal for JRM. Data gathered from the study will help in designing different methods or strategies for reducing BTS populations in and around occupied and unoccupied caves. Accurate counts of swiftlets will help improve reporting and understanding population dynamics to develop/refine management goals.

FY19 Status

- Bait preference trials are ongoing with inconclusive data at this time.
- Five visual searches yielded three (3) in cave BTS (Average SVL: 905mm).
- Thermal camera data has been collected; analysis is ongoing.
- Project is conducted through an Interagency Agreement with USGS – Fort Collins and USGS – Pacific Island Ecosystems Research Center (PIERC).

EPR: 1 RP JRM Brown Tree Snake Eradication and Control to Support Recovery of ESA-Listed Birds; 61128NR202

2019 JRM INRMP Reference: TIS-3; 6-43

Feral Pig Control – NBG

Location: NBG **Period of Performance:** OCT2015 – OCT2019

Project Objective

Eradicate feral pigs on NBG Main Base to protect habitat, particularly in sensitive areas of Orote Peninsula, the Camp Covington wetlands, and sea turtle nesting sites at Spanish Steps.

Conservation Benefit

Enhance and restore native habitats and increase populations of native species, particularly threatened and endangered species.

FY19 Status

- From 2013-2019, a total of 1432 pigs have been removed (see Table 6).
- A Cooperative Agreement was awarded to White Buffalo Inc. for pig eradication on NBG Main Base. Base year work commenced in November 2017 and finished in May 2018. A total of 467 pigs were removed.
- In 2019, an additional 26 pigs were removed from NBG Main Base.
- There are gaps between the ground and the security fence that allow pig immigration. These will be repaired in FY20.

EPR: 1 RP MAR NBG Ungulate Management Population Control; 61755NR807

2019 JRM INRMP Reference: TIS-6; 6-44

Table 6. Removal of feral pigs from NBG Main Base by fiscal year (FY2013-FY2019).

Fiscal Year	2013	2014	2015	2016	2017	2018	2019	Total
Pigs Removed	82	226	287	344	278	189	26	1432

Feral Dog and Cat Control and Management – NBG

Location: NBG; NMS **Period of Performance:** SEP2018 – SEP2020

Project Objective

Determine the population numbers of feral dogs and cats on the NMS and NBG Main Base. Trail cameras are utilized for a mark/re-sight methodology to estimate the feral dog and cat populations. Development of a management plan for the best method for feral dog and cat control, and implementation of that plan in the coming years.

Conservation Benefit

Control invasive species that directly or indirectly impact native species.

FY 19 Status

- NMS camera surveys completed by Sundance EA Inc. in FY2019.
- A total of 60 cameras were placed in NMS for surveys (see Figure 34).
- Feral dog population estimate is 58 dogs (95% confidence interval 53-74)
- Feral cat estimate is 13 cats (95% confidence interval 10-22).
- Contract awarded to Sundance EA Inc. for surveys on NBG Main Base for FY20. Surveys on NBG Main Base will be performed December 2019-March 2020.

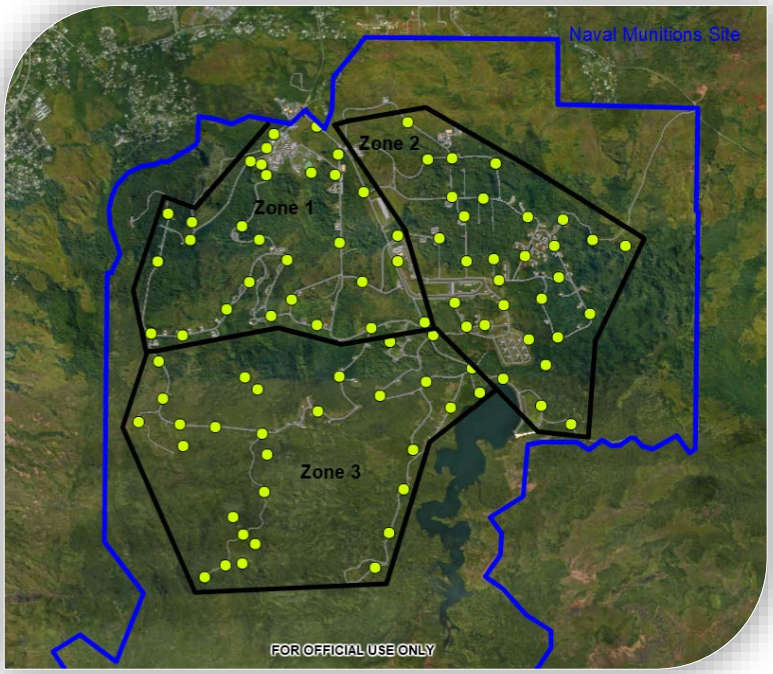


Figure 34. Locations (yellow dots) where trail cameras monitored for feral cats and dogs on the NMS during FY19

EPR: CHS MAR NBG Feral Dog and Cat Control and Management; 61755NR358

2019 JRM INRMP Reference: TIS-4; 6-43

Ungulate Management Population Control – NBG

Location: NBG; NMS; NBG TS **Period of Performance:** Recurring Annually

Project Objective

Conduct population surveys of the Guam Navy lands to determine locations and estimate numbers of feral animals, review accepted control measures Control ungulates in fenced and unfenced areas.

Conservation Benefit

Enhance and restore native habitats and increase populations of native species, particularly threatened and endangered species.

FY 19 Status

- Deer (22) and pigs (5) were removed by White Buffalo Inc. through a Cooperative Agreement from inside the first 80-acre fenced area on NMS in May 2018.
- Fence construction on the second fence in NMS is in progress, expected by Nov 2019; ungulate eradication will begin in early FY20.
- As part of ungulate control, approximately 30 male carabao were sterilized in 2018 and 2019.
- A total of 142 pigs were removed from NBG TS in March of 2019.

EPR: 1 RP MAR NBG Ungulate Management Population Control; 61755NR807

2019 JRM INRMP Reference: TIS-6; 6-44

Artificial Toxic Bait for Landscape-scale BTS Suppression – AAFB

Location: AAFB **Period of Performance:** JUL2018 – DEC2019

Project Objective

To further the development an artificial bait matrix that will have the same level of impact as dead neo-natal mice and deployable by aerial delivery. There is a transfer of pilot-scale bait production knowledge and capacity to National Wildlife Research Center (NWRC) facilities in Hilo, HI. Second, collaborate with USDA-Agricultural Research Service-Eastern Regional Research Center (USDA-ARS-ERRC) to refine the bait formulation to permit attachment of the artificial bait to the Automated Delivery System

(ADS) cartridge.

Conservation Benefit

Development of artificial bait to replace dead neo-natal mice is viewed as technological goal to help reduce overall cost and maintain the same level of impact to BTS populations. If costs to the bait component of the aerial delivery system can be achieve, cost saving could be used to expand the amount of landscape covered by toxicants. It has the potential for management actions to enhance and restore habitat, and to assist in potential reintroduction of kingfishers and other listed species to the wild on Guam.



Figure 35. Loss of fats from bait matrix.

FY19 Status

- Project conducted through an Interagency Agreement with USDA –NWRC
- Evaluation of adhesives is in progress
- Evaluating the impact of reducing amount of pork fat in the formulation
- Evaluating the acceptance of baits prepared with cheaper, natural triglyceride sources
- Field trials conducted in September 2019

EPR: No EPR - funded under the Guam Micronesian Kingfisher MOA.

2019 JRM INRMP Reference: TIS-2; 9-71

Evaluating Statistical Methods for Estimating Density of Invasive BTS from Camera Trapping Data – AAFB

Location: AAFB **Period of Performance:** SEP2018 – MAR2020

Project Objective

This project will evaluate several published models for their ability to provide robust estimates of BTS density by comparing know BTS populations numbers from Closed Population to results from analysis with the models. Data from 2015 will be used.

Conservation Benefit
Developing more robust monitoring is an important goal to help increase confidence in outcomes for landscape scale management for BTS. The ability to monitor suppressed BTS populations will be critical in determining success for reintroduction of avian populations. Low cost monitoring or robust population models can reduce costs and improve outcomes for propose reintroduction programs.

FY19 Status

- Project ongoing
- One of three test models demonstrates reasonable potential for evaluation
- No publishable data or information available at this time
- Project conducted through an Interagency Agreement with USGS –CRU: Washington University Extension

EPR: 1 RP JRM Brown Tree Snake Eradication and Control to Support Recovery of ESA-Listed Birds; 61128NR202

2019 JRM INRMP Reference: TIS-2; 9-71



Figure 36. A selected nocturnal digital image of a mouse-baited trap contact by a BTS that failed to result in a snake capture. The individual depicted stayed at the trap for 33 minutes before leaving the field of view for the camera trap.

Long-term known fate monitoring of large snakes in conjunction with Closed Population Eradication – AAFB

Location: AAFB **Period of Performance:** SEP2018 – MAR2020

Project Objective

Identify effective supplementary control tools for large snakes that are refractory to ADS treatments; genetically identify which snakes are producing offspring during ADS suppression; assist with snake collection (via visual surveys or trapping) for snake Known Fate research.

Conservation Benefit

It is known that very small and very large BTS are not as susceptible to current mouse baits. This project seeks to collect data to in Increase effectiveness of large BTS control that currently have limited susceptibility to aerial bait application. Collecting genetic data will help with population demography. The ability to target large BTS is a critical goal to enhance and restore habitat, and to assist in potential reintroduction of ESA listed species to the wild on Guam.

FY19 Status

- Data collection is ongoing
- 11/30 (37%) large BTS impacted by aerial drops post June 2019 drops
- No data or information available at this time for genetic component
- Project conducted through an Interagency Agreement with USGS – Fort Collins

EPR: 1 RP JRM Brown Tree Snake Eradication and Control to Support Recovery of ESA-Listed Birds; 61128NR202

2019 JRM INRMP Reference: TIS-2; 9-71

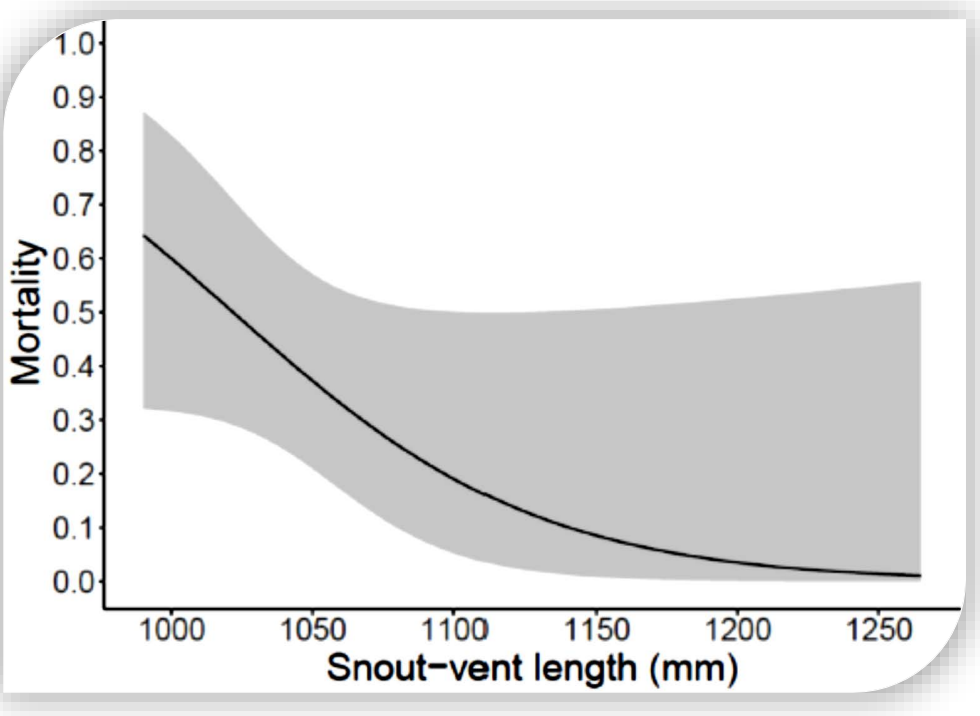


Figure 37. The effect of SVL on mortality probabilities during the two-week treatment period. The gray band represents the 95% confidence intervals.

Monitoring of Reduction in Brown Treesnake Abundance during Eradication Activities in the Habitat Management Unit and Evaluation of Alternative Ground Baits for Large Brown Treesnakes

Location: AAFB **Period of Performance:** APR2018 – SEP2019

Project Objective

To evaluate BTS population levels after a series of eight aerial baiting within the HMU and continue monitoring populations before, during, and after the next proposed series of drops. Abundance of BTS will be measured through analysis of non-toxic bait, camera work, and analysis of the data. Additionally, a known-fate component will be conducted; BTS captured in the HMU will be radio-tagged and tracked. A bait trial for large BTS will be conducted to help assess the need for alternative baits for BTS not attracted by standard baits.

Conservation Benefit

To increase effectiveness of large BTS control that currently have limited susceptibility to aerial bait application to enhance and restore habitat, and to assist in potential reintroduction of ESA listed species to the wild on Guam. Determining the level of impact from landscape scale BTS control is an essential requirement to evaluate success and future investment when considering species restoration on Guam.

FY19 Status

- New agreement signed: September 2019 – March 2021 through an Interagency Agreement with USDA –NWRC.
- Cameras tested in August 2019; field deployment expected in October 2019.
- Large dose trials show large BTS can survive an initial dose of 80mg tablet but succumb to second dose on week later (Figure 38).
- Monitoring indicates an 80% reduce in BTS abundance after 8 drops (52,000 baits/55ha).

EPR: No EPR - funded under the Guam Micronesian Kingfisher MOA.

2019 JRM INRMP Reference: TIS-2; 9-71

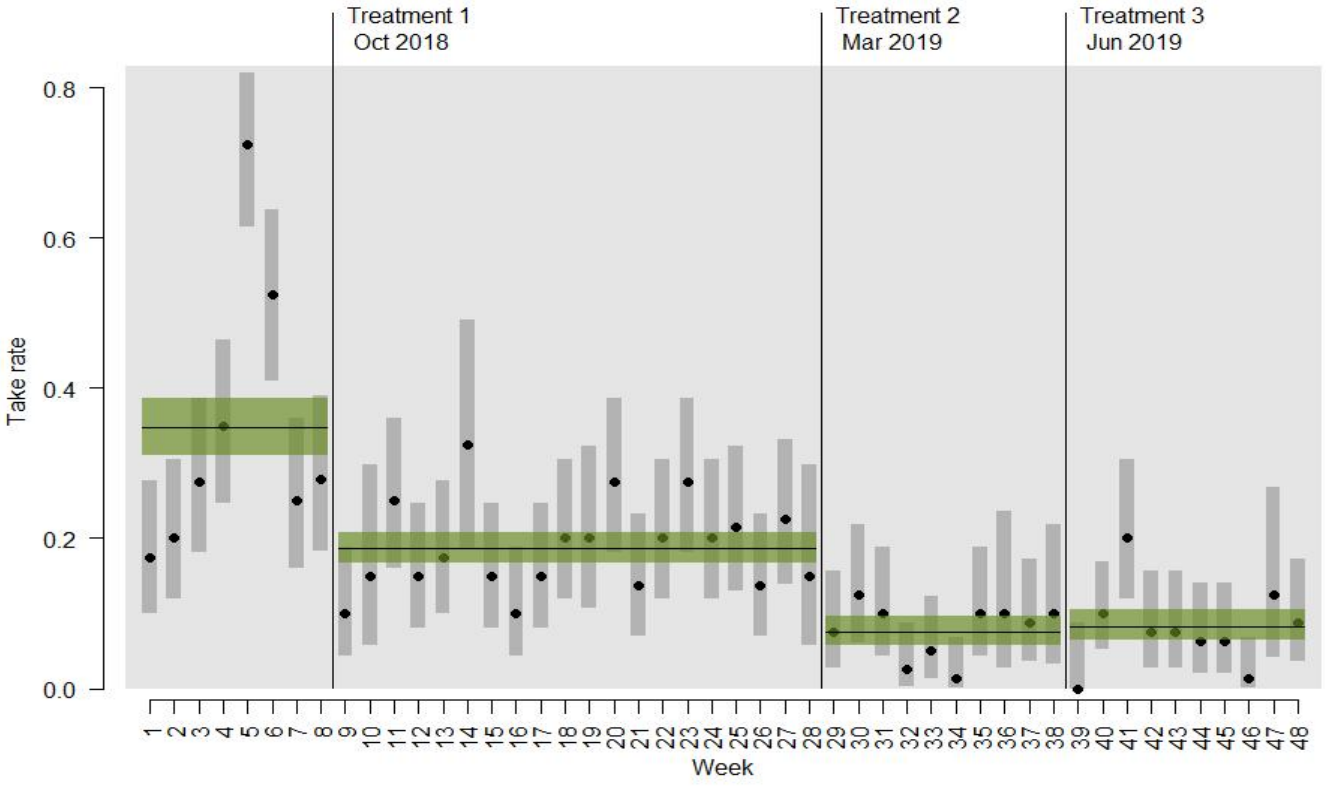


Figure 38. Weekly bait take rates before and following three bait application treatments. Grey bars are the 95% confidence intervals around the weekly estimates (points). Horizontal lines are the period averages, with 95% confidence intervals represented by the green shaded areas.

Trial Eradication of BTS in the USGS Closed Population Facility (CPF) via Aerial Toxicants, Phases I and II

Location: AAFB **Period of Performance:** SEP2017 – MAR2019

Project Objective

Continue from Phase One monitoring BTS population structure and eradication efforts in Closed Population (CP); improve cost-efficacy of tools used to monitor rodent populations in conjunction with BTS population suppression; identify water sources that produce large biomass of invasive frog species on AAFB and reduce or eliminate their use for reproduction.

Conservation Benefit
As a small-scale experimental version of the HMU, CP aerial delivery project is collecting refined data and impacts to BTS to help inform impacts at the landscape level. The ability to identify refractory and emergent BTS is a critical goal to enhance and restore habitat, and to assist in potential reintroduction of ESA listed species to the wild on Guam. Monitoring prey populations will help devise better management strategies in support species recovery.

FY19 Status
- Project conducted through an Interagency Agreement with USGS – Fort Collins
- Phase I conclusions: aerial baiting may be more effective in dry season. CP BTS suppressed by 50% with BTS >1150 less susceptible.
- Approximately 37% (41/111) of the original CP BTS population remained after multiple applications of bait through Phase II
- Some recruitment of juveniles
- Limited to no rodent recovery observed
- Phase II report due end of 2019

EPR: No EPR - funded under the Guam Micronesian Kingfisher MOA.

2019 JRM INRMP Reference: TIS-2; 9-71

Estimation of Brown Treesnake Predation Threat Thresholds for Persistence of Reintroduced Birds on Guam – AAFB

Location: AAFB **Period of Performance:** SEP2019 – MAR2021

Project Objective
To evaluate the levels of snake suppression that might enable persistence of reintroduced birds under some acceptable level of BTS predation. It is unknown what snake density is tolerable when considering the reintroduction of avian species. The project will simulate nest contact rates with cameras and model the levels of nestling mortality that can be sustained while maintaining a stable or growing population of birds.

Conservation Benefit
It is widely recognized that eradication of BTS from Guam is not currently achievable, however, severe suppression is viewed favorably. Through considering avian species persistence in the presence of a suppressed BTS population it may help facilitate reintroductions in areas where management can be sustained and supported allowing for limited recovery of extirpated species.

FY19 Status
- New funded project through an Interagency Agreement with USDA –NWRC starting in FY19
- Project in early phases

EPR: No EPR - funded under the Guam Micronesian Kingfisher MOA.

2019 JRM INRMP Reference: TIS-3; 9-72

Habitat Management Unit Biomonitor Support and ESA Listed Species Identification Training

Location: AAFB **Period of Performance:** SEP2018 – JUN2019

Project Objective
To provide biomonitor support during aerial baiting project by the ADS, to observe for presence of Mariana Fruit Bat (*Pteropus mariannus mariannus*, Fanihi) and observe for take.

Conservation Benefit
Allow for the continuance of the ADS project while monitoring for the presence of fanihi per requirements of the USFWS.

FY19 Status
- HMU Biomonitor support ended June; last aerial baiting drops for fiscal year.
- 11 bats observed during September/October schedule drops, not interactions with helicopter occurred – all transient flights over the HMU.
- This project was conducted through a cooperative agreement with UOG – Center for Island Sustainability (CIS).

EPR: 1 RP JRM Brown Tree Snake Eradication and Control to Support Recovery of ESA-Listed Birds; 61128NR202

2019 JRM INRMP Reference: TIS-3; 9-72

Using BTS Behavior and Movement to Refine Control on AAFB & for Improved Management of Native Forest Birds

Location: AAFB **Period of Performance:** SEP2019 – MAR2021

Project Objective

The goals of this project are to identify movement pathways used by BTS on AAFB, as well as estimate abundance of BTS in relation to resources important to birds. Better understanding of hotspots of BTS activity, travel pathways, and decision-making during foraging are critical to improve the coverage and efficacy of BTS control in a cost-effective manner.

Conservation Benefit

This project is one of four projects that will, collectively, further develop information on BTS behaviors related to predation and movement in the presence of abundant avian species. Additionally, population demographics that could be useful for supporting future avian restoration projects and controlling BTS in low density with competing food sources in the presence of control regimes.

FY19 Status

- New funded project through an Interagency Agreement with USGS – Fort Collins starting in FY2019
- Project in early phases

EPR: No EPR - funded under the Guam Micronesian Kingfisher MOA.

2019 JRM INRMP Reference: TIS-3; 9-72

Guam Micronesian Kingfisher MOA Program and Project Execution

Location: AAFB, NBG TS **Period of Performance:** JUN2015 - JUN2025

Project Objective

In order to secure and enhance durable habitat for future reintroduction efforts of kingfishers, the U.S. Department of the Navy (DON) and U.S. Fish and Wildlife Service (USFWS) entered into a Memorandum of Agreement (MOA) signed in 2015 that conserves and manages habitat suitable for the recovery of the Guam kingfisher.

Specifically, under the 2015 MOA, the DON agreed to designate 2,118 hectares (5,234 acres) to a status that will provide durable habitat protection needed to support native habitat restoration and land management for the survival and recovery of the kingfisher.

The DON analyzed a number of potential courses of action to implement the 2015 MOA, and selected a course of action to guide funding allocations as to direct positive, verifiable, and sustainable gains in terms of the condition of durable habitat.

Conservation Benefit

Durable habitat protection for 5,234 acres in northern Guam to benefit the survival and recovery of the kingfisher.

In addition, projects for active conservation will be implemented and integrated with JRM INRMP. Focal areas for projects include (with priority on focal area 2 and 3):

1. BTS control and suppression to facilitate the larger goal of suppressing snake population levels that will ultimately support kingfisher survival and recovery;
2. Support for BTS control and eradication methods development, focusing on tools and techniques needed for landscape level survival and recovery of the kingfisher;
3. Ungulate fencing and eradication;
4. Control or small mammalian predators;
5. Invasive plant control and eradication;
6. Native plant restoration;
7. Localized control of introduced invertebrates that may negatively impact kingfisher nesting/fledging.

FY19 Status

- Activities conducted/supported to date:
  - Development of three courses of action (COA), selection of a COA for further development of Draft 10 year plan.
  - Draft 10 year plan reviewed by DON.
  - Trial eradication within CP facility yields suppression models, but suggest need for long-term trial at scale (e.g. HMU) and optimization of monitoring tools.
  - ADS at operational level and additional ABMS winder increased bait production capacity
  - Artificial toxic bait field trials continue, seeking cheaper/reduced fat and better adhesive
  - Haputo T/E listed species survey, Haputo cultural resource surveys and base approvals completed for proposed North Haputo ERA ungulate control barrier.
- FY19 Projects awarded:
  - Focal Area 2:
    - USDA WS: Follow-on FY19 ADS bait application at HMU (completed June 2019) (Figure 39).
    - USGS: Optimizing Monitoring of Brown Treesnakes
    - USDA NWRC: Estimation of Brown Treesnake Predation Threat Thresholds for Persistence of Reintroduced Birds on Guam
    - USDA NWRC: Continuation of HMU Monitoring and Eradication Evaluation
  - Focal Area 3:
    - MCAG: North Haputo ERA Ungulate Control Barrier Construction (see standalone description)
- Next step: Plan development workshop in FY20 and project implementation.

EPR: DPRI: 2015 Navy-USFWS Guam Micronesia Kingfisher MOA.

2019 JRM INRMP Reference: TIS-3; 9-72



Figure 39. GMK MOA-funded application of bait via ADS at HMU, AAFB.

Little Fire Ant (*Wasmannia auropunctata*) Surveys, Eradication, and Monitoring – AAFB

Location: AAFB **Period of Performance:** SEP2017 – SEP2020

Project Objective

Eradicate LFA within Andersen South to reduce impacts to native ecosystems and military readiness activities.

Conservation Benefit

Enhance and restore habitats by prevention of the spread of the invasive LFA.

FY19 Status

- Andersen South:
  - Total of six positive LFA site delineated.
  - Four sites eradication completed
  - Two sites awaiting eradication treatment
- Final Reports: Pending completion of work.

EPR: DPRI: Marine Corps Relocation 2017/2018 amendment to 2015 BO, Conservation Measures to Minimize the Effects of Invasive Species

2019 JRM INRMP Reference: TIS-5; 9-72

Evaluate visual searching versus bait tubes and camera surveillance as a low-density monitoring tool for BTS – AAFB and Rota, CNMI

Location: AAFB; Rota, CNMI **Period of Performance:** MAY2018 – NOV2019

Project Objective

Evaluate visual searching along minimally cleared transects versus trackless areas; evaluate visual searching versus bait tubes and camera surveillance as a low density monitoring tool for BTS (compare with USDA/NWRC); improve cost-efficacy of tools used to monitor small mammal populations in conjunction with BTS population suppression.

Conservation Benefit

This will assess specific monitoring tools inform current structures of BTS populations and their small mammal prey, improved demographic inform and levels of suppression will inform future conservation efforts. Rodent prey have been determined to have strong effects on efficacy of snake suppression; monitoring their populations is likely to improve efficacy



Figure 40. Evidence of rat from a chew card deployed in a high density rat area Rota, CNMI.

of individual landscape scale level applications. This project provide data to enhance and restore habitat, and to assist in potential reintroduction of ESA listed species to the wild on Guam.

FY19 Status

- Transect data collection on going; low numbers of BTS detected post aerial baiting
- Second season of small mammal monitoring in Rota
- Final report due JAN/FEB 2020

EPR: 1 RP JRM Brown Tree Snake Eradication and Control to Support Recovery of ESA-Listed Birds; 61128NR202; Guam Micronesian Kingfisher MOA

2019 JRM INRMP Reference: TIS-2; 9-71

Multi-species Barrier Development Phase I – NBG TS

Location: NBG TS **Period of Performance:** APR2018 – OCT2019

Project Objective

The primary objective of this project is to develop and evaluate a multispecies barrier fence, estimate and itemize annual and long-term maintenance methods and costs and provide recommendations for multispecies barrier based on a review of the existing literature, visiting other sites with vertebrate barriers, testing results, and cost analysis.

Conservation Benefit

Closed Population has demonstrated that BTS can be effectively excluded using barrier fences, with the caveat that these require significant labor for maintenance Little research has been undertaken to promote creation of areas free of multiple species of invasive or predatory vertebrates that would be suitable for reintroduction or recovery of Guam's native fauna and flora.

FY19 Status

- Activities conducted to date:
    - Review of the existing literature
    - Visited other sites (New Zealand) with vertebrate barriers

- Lab testing results

EPR: DPRI: Marine Corps Relocation 2017/2018 amendment to 2015 BO, Conservation Measures Brown Treesnake Control and Suppression.

2019 JRM INRMP Reference: TIS-3; 9-72



Figure 41. MSB Prototype at USGS Facility, AAFB.

Table 7. Summary table of brown treesnake arena trials.

Size class	Number of individuals	Number of trials	Number of Breaches	Number of breach attempts and height achieved on exclusion prototype wall			
				50cm	100cm	150cm	200cm
Large	19	25	0	402	50	0	0
Med-Lrg	25	25	0	484	0	0	0
Medium	26	26	0	368	0	0	0
Small	25	25	0	98	0	0	0
Small	16†	33	0	N/A	N/A	N/A	N/A

†Four of these individuals were previously trialed in the full-scale arena.

Mariana Islands Training & Testing Biological Opinion Terms & Conditions 1.1 Compliance – CNMI

Location: CNMI **Period of Performance:** AUG2018 – SEP2022

Project Objective

To comply with the Mariana Islands Training & Testing (MITT) Biological Opinion (BO) Incidental Take Statement Terms and Conditions 1.1 (as amended 28 FEB 2016) to provide funding to the U.S. Fish & Wildlife Service for invasive vertebrate pest control to minimize the effect of take on the Micronesian megapode (*Megapodius laperouse*). DoD is not responsible for project implementation or the results thereof, per the MITT Biological Opinion (BO) amended Terms and Conditions 1.1.

Conservation Benefit

To ensure compliance with the Incidental Take Statement of the 2015 MITT BO to minimize the effect of take on the Micronesian megapode.

FY19 Status

- Interagency Agreement between Joint Region Marianas and the U.S. Fish & Wildlife Service established in August 2018.
- U.S Fish & Wildlife Service project currently in planning phase to implement Micronesian megapode habitat restoration on Aguiguan.

EPR: 2 BO MAR Mariana Islands Training and Testing (MITT) Implementation; 61128NR218

2019 JRM INRMP Reference: TIS-5; 9-72

Terrestrial Protected Species Management

Conservation Management of Listed Invertebrates

Location: JRM **Period of Performance:** JUL2018-DEC2019

Project Objective

To prepare a survey method protocol for ESA-listed snails that is statistically sound and applicable, to provide field and classroom training for natural resource staff and partners, and to create a snail ID field booklet.

Conservation Benefit

Identifying locations of ESA-listed snail species will allow for management actions to avoid and conserve locations of protected species and host plant species. The survey protocol will be coordinated with natural resource partners.

FY19 Status

- A Cooperative Agreement was awarded through the CESU network to UOG in July 2018. Deliverables include the survey protocol, field training, and a snail ID booklet (in coordination with USFWS).
- The Survey Protocol was reviewed by USFWS, DAWR and will be finalized in November 2019.
- The snail ID booklet is pending.
- Snail survey classroom and field training was conducted for JRM NR managers, USFWS, and DAWR biologists in June 2019.

EPR: 1 CP MAR NBG AAFB Conservation Management of Endangered Mariana Eight-spot Butterfly and Treesnails; 61128NR203

2019 JRM INRMP Reference: TPS-1; 5-88, TPS-1; 6-46, TPS-1; 7-55, TPS-1; 8-54, TPS-4; 9-76; TPS-5; 11-66

Biomonitor Support for Natural Resource Management at Joint Region Marianas Area of Responsibility

Location: JRM AOR **Period of Performance:** JUL2019 – JAN2021

Project Objective

Provide biomonitor support to assist the Department of the Navy in natural resource management across lands under Joint Region Marianas AOR.

Conservation Benefit

Biomonitors will conduct surveys for threatened and endangered species, culturally valuable plant species, rare plants, and non-native/invasive species. Activities support the GMK MOA (2015) and the Biological Opinion for the Department of the Navy's Relocation of the U.S. Marine Corps from Okinawa to Guam and Associated Activities on Guam (USFWS, 2015, 2017, 2018).

FY19 Status

- Awarded as cooperative agreement through the CESU network to UOG-CIS on 29 July 2019.

EPR: DPRI: Marine Corps Relocation 2017/2018 amendment to 2015 BO, Conservation Measures to Contribute to the Recovery of Listed Species.

2019 JRM INRMP Reference: TPS-1; 7-55

Mariana Common Moorhen Surveys, Fena Reservoir

Location: NMS **Period of performance:** Recurring Annually

Project Objective

Monitor the population of Mariana Common Moorhen (*Gallinula chloropus guami*) at Fena Reservoir.

Conservation Benefit

Knowing presence and populations size will allow proper management of an endangered species.

FY 19 Status:

- Fena reservoir moorhen surveys have been discontinued due to no moorhen detections for an extended period of time (Figure 42). No moorhen have been observed at Fena during a survey since 2013. There were incidental sightings of single moorhen at the spillway from 2013-2015. The spillway is still monitored as it is part of the migratory bird monitoring program.
- Moorhen monitoring in other areas via trail camera is being considered for other ponds/wetlands.

EPR: 1 S MAR NBG Endangered Species Monitoring; 61755NR142

2019 JRM INRMP Reference: TPS-2; 5-89

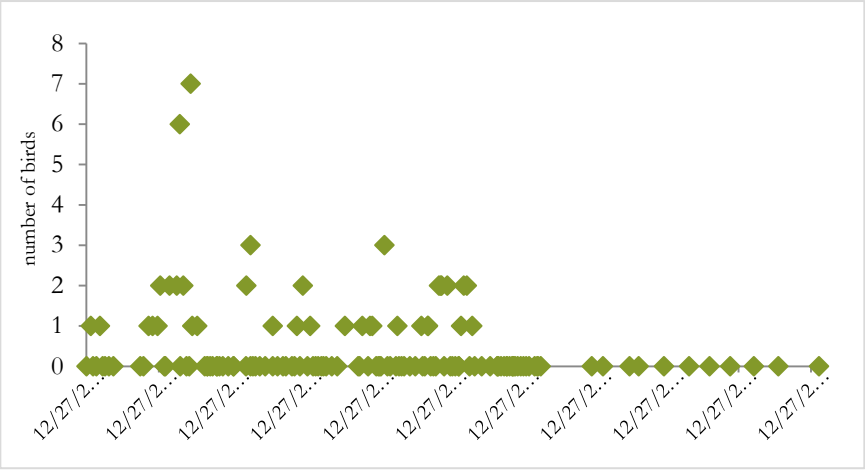


Figure 42. Summary of Observations of Mariana Common Moorhen at Fena Reservoir, NMS (FY07-FY18).

Sea Turtle Nesting Beach Habitat Enhancement – NBG

Location: NBG **Period of Performance:** Ongoing

Project Objective

To increase the likelihood of hatchling turtles successfully traversing strand vegetation at Spanish Steps to access the ocean and enhance natural regeneration of native strand vegetation by removal of invasive vegetation. To reduce predation of sea turtle nests by trapping and removal of monitor lizards (*Varanus indicus*).

Conservation Benefit

Enhance and restore habitat and in an effort to recover sea turtle populations.

FY 19 Status:

- Beach cleanups were performed on Dadi, Polaris and Gabgab beaches. Due to staffing change Spanish Steps beach did not have a cleanup this year.
- Non-native vegetation was removed from Spanish Steps beach in small increments during beach inspections for turtle activity or while checking monitor lizard traps.
- There were 208 trapping days in 2019 with zero lizards captured. Monitor lizard culling was conducted from August 2015-August 2018 at Spanish Steps beach. From 2015-2017 noose traps, pipe traps, gopher traps, A24 rat traps and active hunting captured has captured eight lizards. In 2017, Conibear Jaw traps were utilized (138 trap days) and captured five lizards. A total of 13 monitor lizards have been captured from 2015-2018. The size of the lizards has increased over time; mostly males were captured in 2017 and 2018. This implies a demographic shift as a result of trapping. Since males have larger home ranges than females, it's probable that the localized population was extirpated and males are now migrating into the area from elsewhere.
- 32 total activities (20 nests and 12 non-nesting emergences) have been observed at Spanish Steps (SS); SS was the only NBG beach which experienced activity this season.
- 15% (3 of 20) of nests were depredated by monitor lizards. This is an increase from 5.6% in 2018 but lower than the 65% of 2017.
- Regular monitoring for sea turtle activity of all NBG-managed beaches includes following locations: GabGab, San Luis, Dadi, Haputo, Tipalao, and Spanish Steps
- Intermittent monitoring for sea turtle activity occurred at Reserve Craft beach

prior to and during military training events
- "No Driving on Beach" signs and barriers were installed on Dadi beach barricades to protect sea turtle nesting areas.

EPR: 1 S MAR NBG Endangered Species Monitoring; 61755NR142

2019 JRM INRMP Reference: TPS-2; 5-89

Sea Turtle Surveys – NBG

Location: NBG; NBG TS **Period of Performance:** SEP2019 - SEP2020

Project Objective
- Conduct sea turtle surveys on NBG beaches.
- Conduct monitor lizard control in sea turtle nesting areas.

Conservation Benefit
- Monitor the sea turtle nesting population at NBG and protect sea turtle nesting beaches for the recovery of sea turtles.

FY19 Status
- Conducted 69 surveys at seven NBG beaches: Spanish Steps (1-3), Haputo, Double Reef, GabGab, Tipalao, San Luis, and Dadi.
- All nesting and Non-nesting emergences (NNEs) were documented from green turtles (*Chelonia mydas*); 20 nests and 12 NNEs at Spanish Steps from October 2018 through September 2019 (Figure 43 and Table 8).
- Monitor lizard (*Varanus indicus*) control ongoing; no captures in 208 trapping days; three nests (15%) were predated by monitor lizards, reduced from previous years.

EPR: 1 RP MAR NBG Green and Hawksbill Sea Turtle Nesting Habitat – Invasive Plant and Predator Control; 61755NR808

2019 JRM INRMP Reference: TPS-2; 5-89

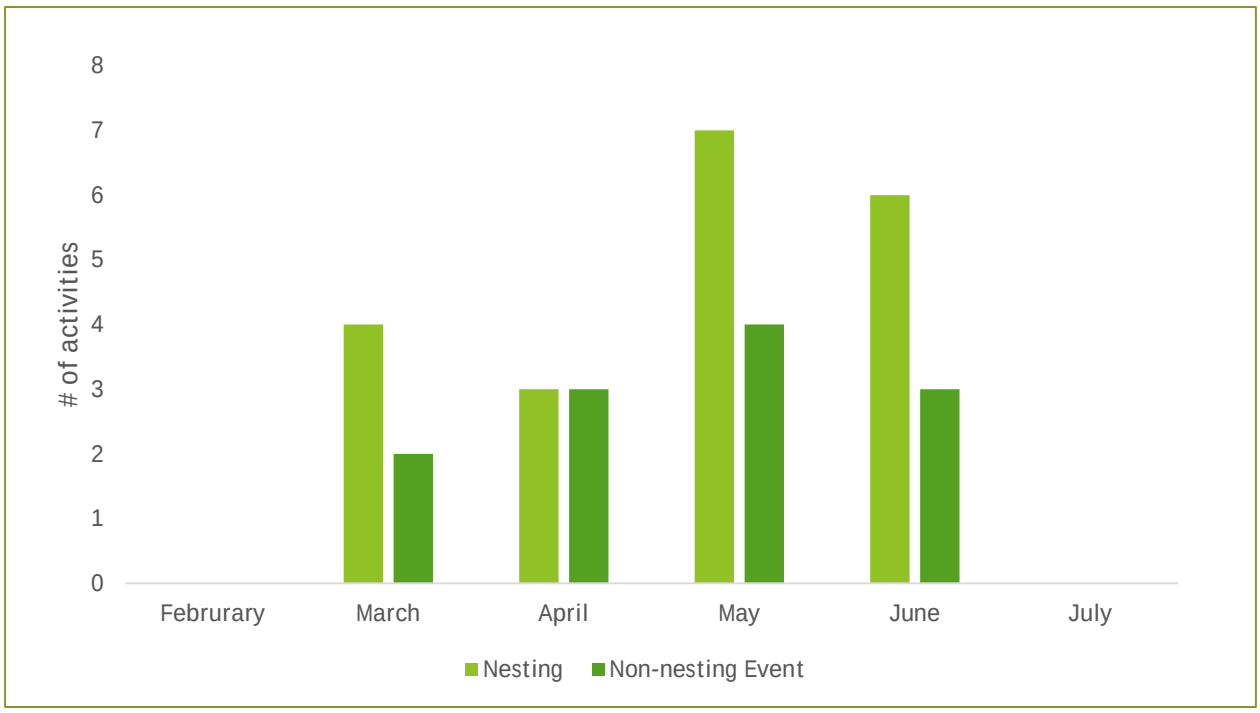


Figure 43. Summary of observations of sea turtle activities at Spanish Steps Beach, NBG (Oct 2018 – Sept 2019).

Table 8. Summary of observations of sea turtle nests and non-nesting emergences (NNE) on NBG Beaches from Oct 2018 through Sept 2019.

Beach	Nests	NNEs
Spanish Steps 1	17	11
Spanish Steps 2	3	1
Spanish Steps 3	0	0
Haputo	0	0
Dadi	0	0
GabGab	0	0
San Luis	0	0
Tipalao	0	0
Double Reef	0	0
Reserve Craft	0	0
Total	20	12

Survey and Monitoring of Seagrass Bed at Dadi Beach

Location: NBG **Period of Performance:** SEP2017 – JAN2020

Project Objective

- Determine and document biodiversity of marine plants and macro-invertebrates.
- Determine the current health of the seagrass bed by quantifying the abundance of epiphytic plants on seagrass and the abundance and biodiversity of macro algae and any additional relevant information that may affect the ecosystem health of the seagrass bed.
- Capture temporal changes through in-water pictoral record of seagrass bed.

Conservation Benefit

- Increase habitat for ESA-listed species (e.g., sea turtles, listed corals, marine mammals, scalloped hammerhead shark).
- Support habitat areas of particular concern which align with Magnuson-Stevens Fishery Conservation Act for Essential Fish Habitat and the Marianas Fishery Ecosystem Plan.

FY19 Status

- Two dry season surveys and one wet season survey completed.
- One wet season survey remaining and will be completed by OCT19.
- No-cost extension until DEC19; final report expected by JAN20.

EPR: 1 S MAR NBG Marine Ecosystem Monitoring and Coral Reef Indicators (CHS); 61755NR168

2019 JRM INRMP Reference: TPS-2; 5-89

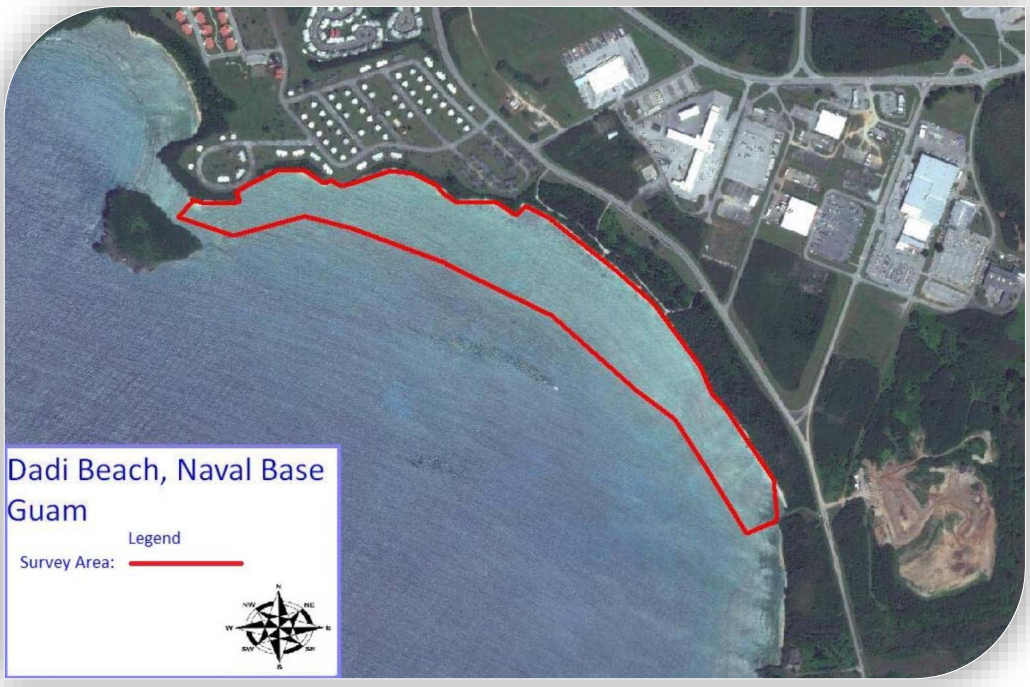


Figure 44. Map depicting Dadi Beach survey area on NBG.

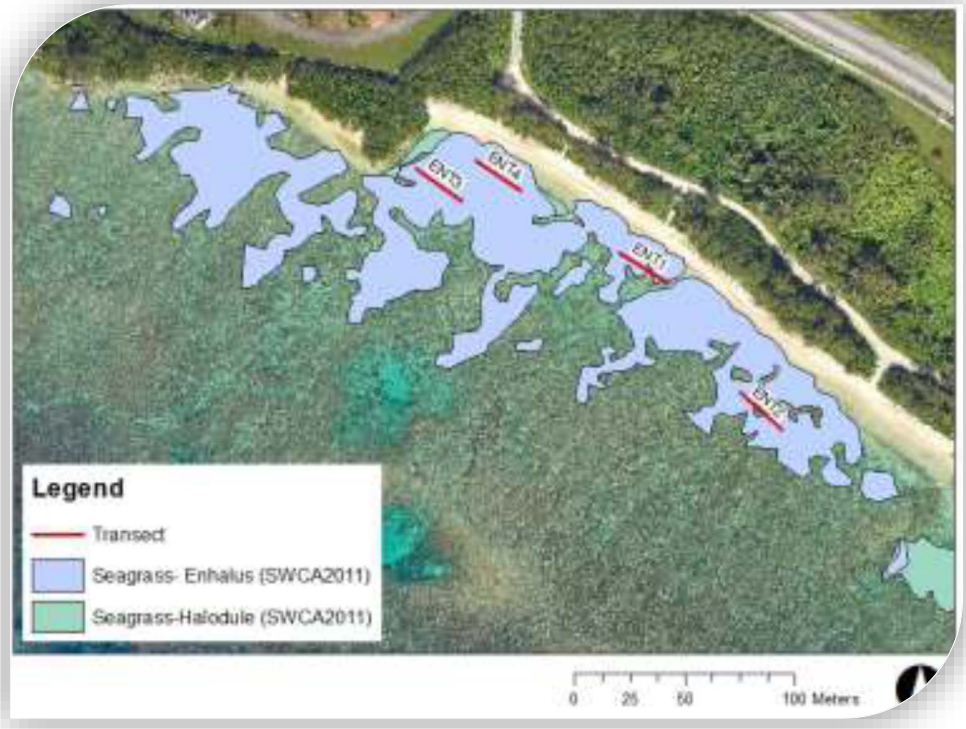


Figure 45. Map depicting locations of transects within the *Enhalus*-dominated zone at Dadi Beach, Naval Base Gaum (n=4).

Restoration/Enhancement of Mariana Moorhen Habitat

Location: NBG; NMS **Period of Performance:** SEP2018 – SEP2020

Project Objective

To provide nesting platforms in ponds/wetlands where Mariana Common Moorhen (*Gallinula chloropus guami*) are known to occur. Platforms will be installed at two ponds on NMS, two ponds on the main Navy base and one pond at the old Barrigada golf course. To determine the viability for monitoring for moorhen presence via trail cameras.

Conservation Benefit

Improve nesting habitat for a listed species and increase population numbers on Guam. If successful the technique could be used in other areas with moorhen.

FY 19 Status

- A total of 32 platforms were installed in five ponds (see Figures 46 - 48).
- Four platforms at ponds 3, 4, and 5 were utilized for nesting by moorhen.
- In 2020 the platforms will continue to be monitored and trail cameras will be placed on 6 different ponds.
- Four of the ponds (1, 3, 4, and 5) are known to have moorhen present and two have had historic but not recent presence.



Figure 46. Map depicting the location Ponds 1 and 2 on NBG.

EPR: 1 RP MAR Restoration of Mariana Moorhen at Fena Reservoir; 61744NR895

2019 JRM INRMP Reference: TPS-3; 5-89



Figure 47. Map depicting the location Ponds 3 and 4 on NMS.



Figure 48. Map depicting the location Pond 5 on old Barrigada golf course.

Mariana Swiftlet Recovery and Habitat Use

Location: NMS **Period of Performance:** SEP2018 – SEP2022

Project Objective

To provide an understanding of Mariana swiftlet (*Aerodramus bartschi*) habitat use, movement, reproductive success, and breeding site selection to inform management actions and meet specific objectives identified in the USFWS Recovery Plan for the Mariana Swiftlet.

Conservation Benefit

Implement actions for the recovery and potential down-listing of the Mariana Swiftlet.

FY19 Status

- Funding for the project began in September 2018.
- Purchasing of two camera thermal camera systems for in-cave monitoring.
- Tested in-cave thermal camera monitoring of movement and roosting of swiftlets with through an Interagency Agreement with USGS-Fort Collins sub-award to USGS PIERC.
- Collaboration with U.S. Army Engineer Research and Development Center to test thermal camera systems in FY19.
- Planning for FY20 banding, tracking, and in-cave nest monitoring for swiftlets.
- FY20 work will include:
    - Erecting telemetry towers on NMS to track swiftlet movements
    - Capturing and outfitting 30 swiftlets with telemetry transmitters
    - Monitoring reproductive success of swiftlets within caves on NMS
    - Measuring physical features of occupied versus unoccupied caves to assess breeding site selection

EPR: 1 RP MAR NBG Mariana Swiftlet Habitat Use; 61755NR303

2019 JRM INRMP Reference: TPS-4; 6-47

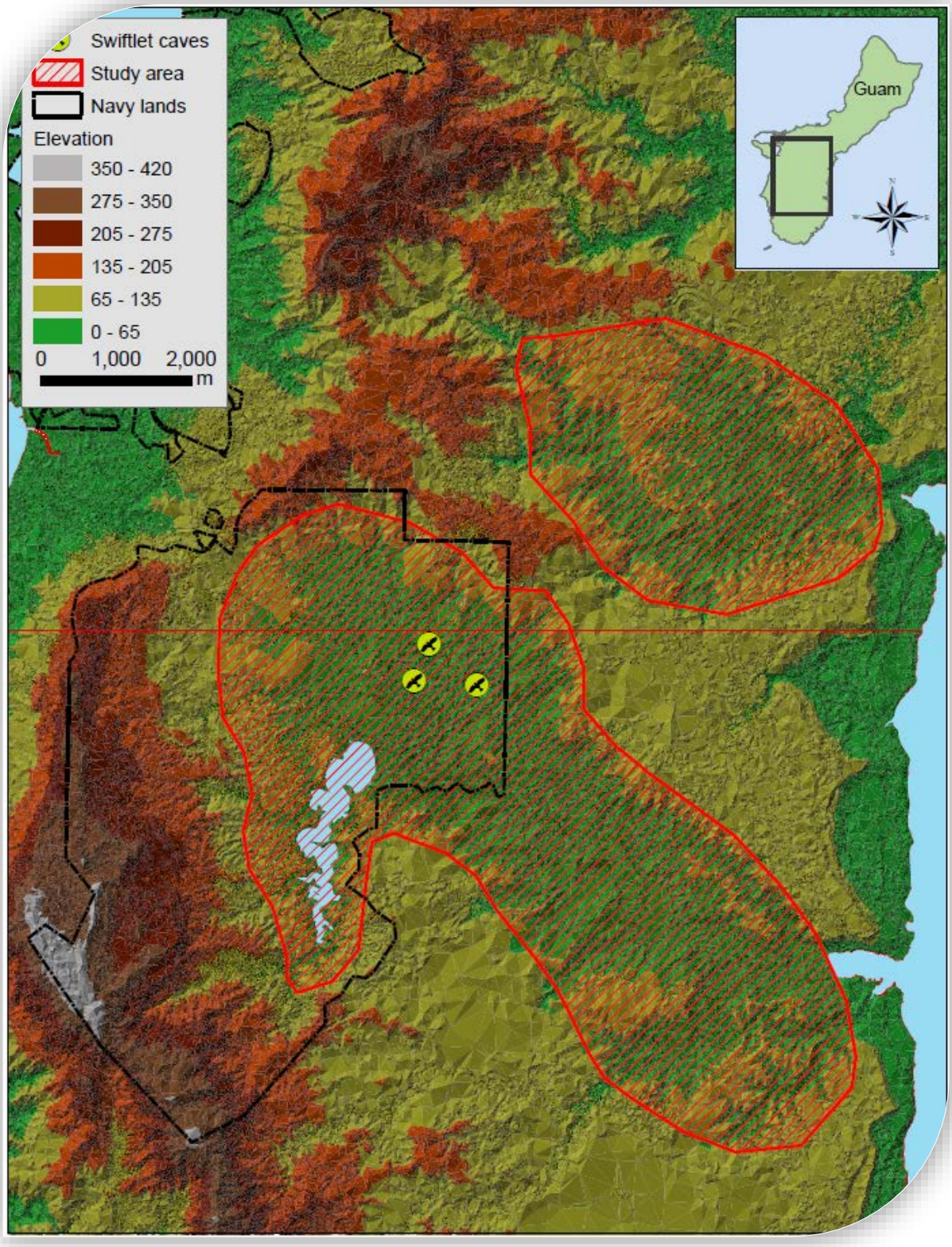


Figure 49. Three occupied swiftlet caves on the NMS and proposed study area for tracking swiftlet movement on the landscape of southern Guam.

Monitoring of Mariana Swiftlets

Location: NMS **Period of Performance:** Recurring annually

Project Objective

Monitor population trends of Mariana swiftlets (*Aerodramus bartschi*) at three caves on NMS.

Conservation Benefit

Monitoring to allow for management actions to enhance and restore habitat, reduce habitat fragmentation, buffer protected areas, and implement new conservation strategies.

FY 19 Status:

- Conducted quarterly surveys Maemong, at Mahlac, and Fachi totaling four (4) surveys at each cave
- Estimated population size of swiftlets on NMS in 2019 was 1,090 (Figures 50 - 53).

EPR: 1 S MAR NBG Endangered Species Monitoring; 61755NR142

2019 JRM INRMP Reference: TPS-4; 6-47

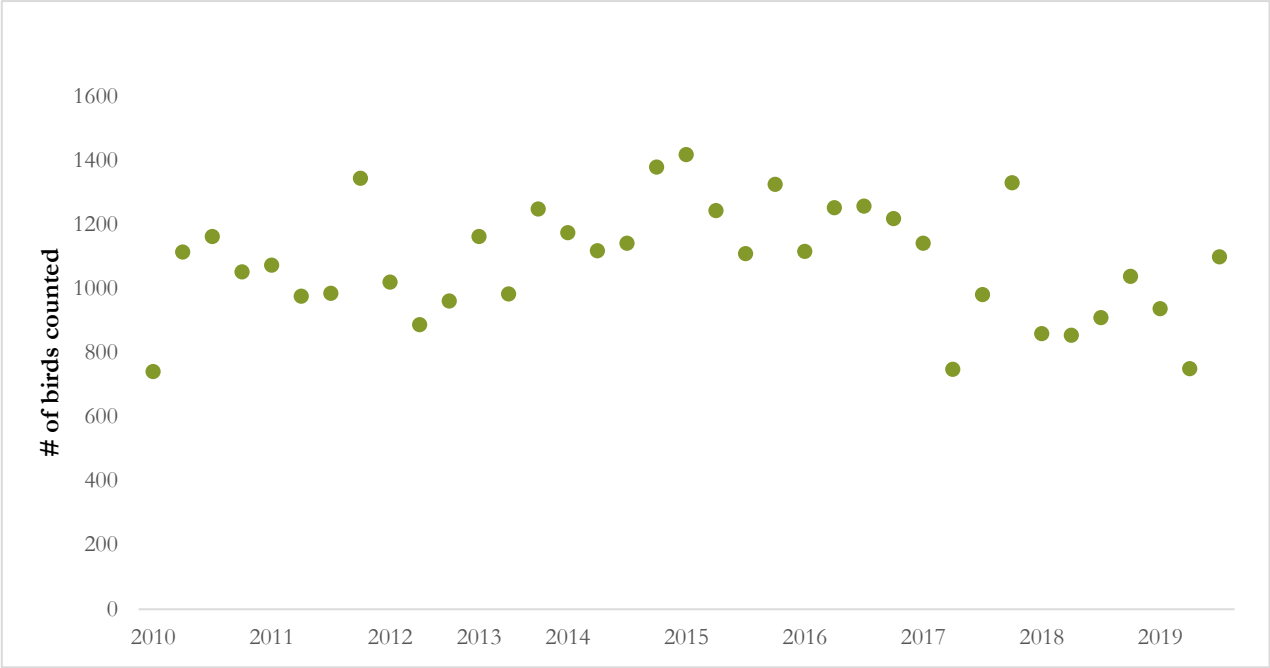


Figure 50. Summary of Observations of Mariana Swiftlets at Mahlac Cave, NMS (2010-2019).

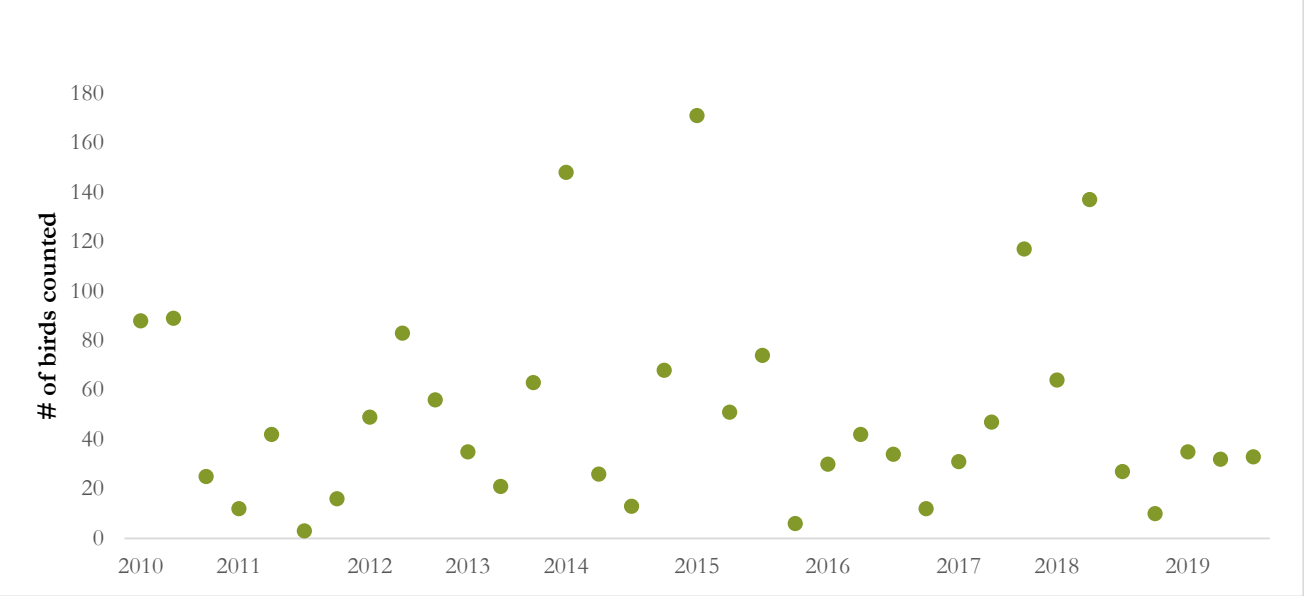


Figure 51. Summary of Observations of Mariana Swiftlets at Fachi Cave, NMS (2010-2019).

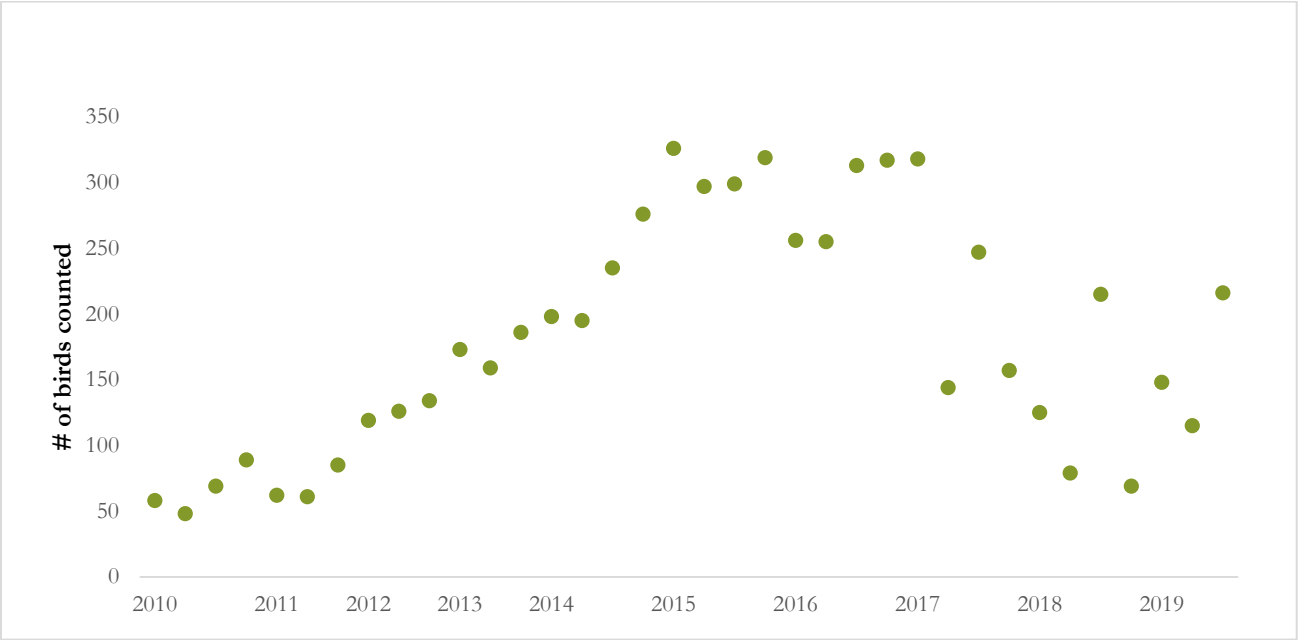


Figure 52. Summary of Observations of Mariana Swiftlets at Maemong Cave, NMS (2010-2019).

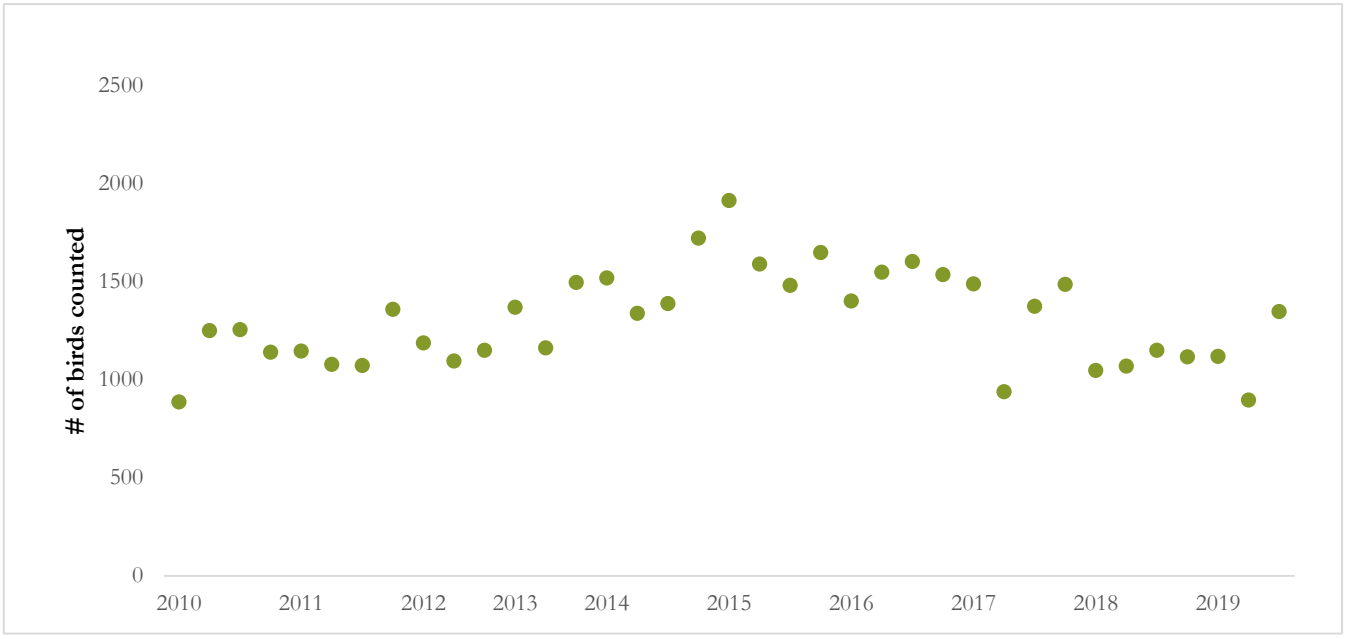


Figure 53. Summary of Observations of Mariana Swiftlets at Mahlac, Fachi, and Maemong Caves, NMS (2010-2019).

Sea Turtle Monitoring, Protection, and Educational Outreach – AAFB

Location: AAFB **Period of Performance:** JUL2018 – DEC2019

Project Objective

- Organize and qualitatively and quantitatively analyze AAFB sea turtle data.
- Conduct sea turtle monitoring and record nesting activities.
- Provide protection of nesting beaches and active nests until hatchlings emerge.
- Conduct educational outreach for the public regarding sea turtles including two beach cleanup events.

Conservation Benefit

Implement recovery actions by: conducting long-term monitoring to determine population estimates and abundance; providing protection of sea turtles and their nesting habitats; and conducting outreach and education to the public regarding sea turtles and their habitats.

FY19 Status

- Nesting activity monitoring was awarded as a cooperative agreement through the CESU network to UOG, SeaGrant.
- During 2019, all nests up to August 31 have been on Explosive Ordnance Disposal (EOD) and Pati Beaches. There have been a total of 126 emergences, with 101 nests and 25 false crawls. There have been 3 events on Pati and 124 on EOD (Figure 55).
- As of August 2019 a total of 4 nesting turtles were PIT tagged, and of those 2 were additionally tagged with satellite tags.
- Clutch data was taken on previously marked nests that were located successfully either after the emergence of hatchlings or after 70 days incubation. Data from nest inventories estimated hatching and emergence success.
- During a nest inventory in August, 115 live hatchlings were found within a nest that had shown signs of hatching. After the inventory all hatchlings were observed safely entering the ocean (Photo 54).

- Project Final Report due December 2019.

EPR: 1 LC MAR AAFB Sea Turtle Monitoring; M5240CN037

2019 JRM INRMP Reference: TPS-1; 9-75



Figure 54. Live hatchlings found trapped in a nest in August 2019.

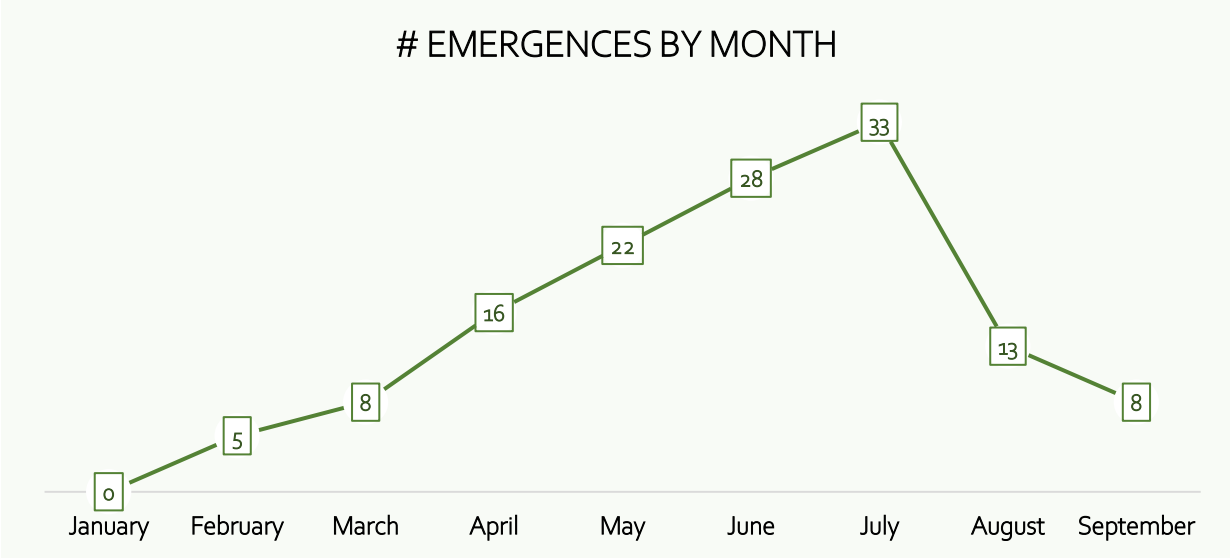


Figure 55. Total number of emergences by month for 2019, with peak activity from June to July.

Mariana Fruit Bat Monitoring – AAFB

Location: AAFB **Period of Performance:** FEB2018 – AUG2020

Project Objective

Conduct surveys for Mariana fruit bats (*Pteropus mariannus mariannus*) at AAFB as part of long-term population monitoring and to provide analysis on the effects aircraft overflights on the behavior of Mariana fruit bats at Pati Point.

Conservation Benefit

Monitoring will allow for management actions to enhance and restore habitat and increase efforts to recover Mariana fruit bat populations on Guam.

FY19 Status

- Addresses three of the recovery criteria in the 2009 U.S. Fish and Wildlife Service (USFWS) Draft Revised Recovery Plan for the Mariana Fruit Bat or Fanihi by implementing seven of the Recovery Actions outlined in the Draft Plan.
- Option Year 3 has just begun. This Option year will only have 1 base-wide survey, but will continue to allow UOG employees to participate in weekly surveys.
- Surveys have been done by installation personnel and UOG employees from February through May. More surveys are planned for late 2019.
- The Annual Base-wide Count occurred on May 17, 2019. This year 133 individuals took part, a 33% increase over the previous year. Preliminary data estimates about 50 fruit bats are present on AAFB (Table 9, Figure 56).
- Pati Point surveys continue to occur on a quarterly basis. There has been no sign of fruit bats present at the historic roost site.

EPR: 2 BO MAR AAFB Fruit Bat Monitoring; M5240CN041

2019 JRM INRMP Reference: TPS-2; 9-75

Table 9. Results of AAFB annual base-wide Mariana fruit bat counts from 2014-2019.

YEAR	POPULATION ESTIMATE	METHOD	REFERENCE
2014	15	Base-wide count	Mildenstein et al. 2015
2015	24	Base-wide count	Mildenstein et al. 2015
2016	45	Base-wide count	U.S. Navy 2017
2017	57	Base-wide count	U.S. Navy 2018
2018	59	Base-wide count	U.S. Navy. 2019
2019	52	Base-wide count	U.S. Navy 2019

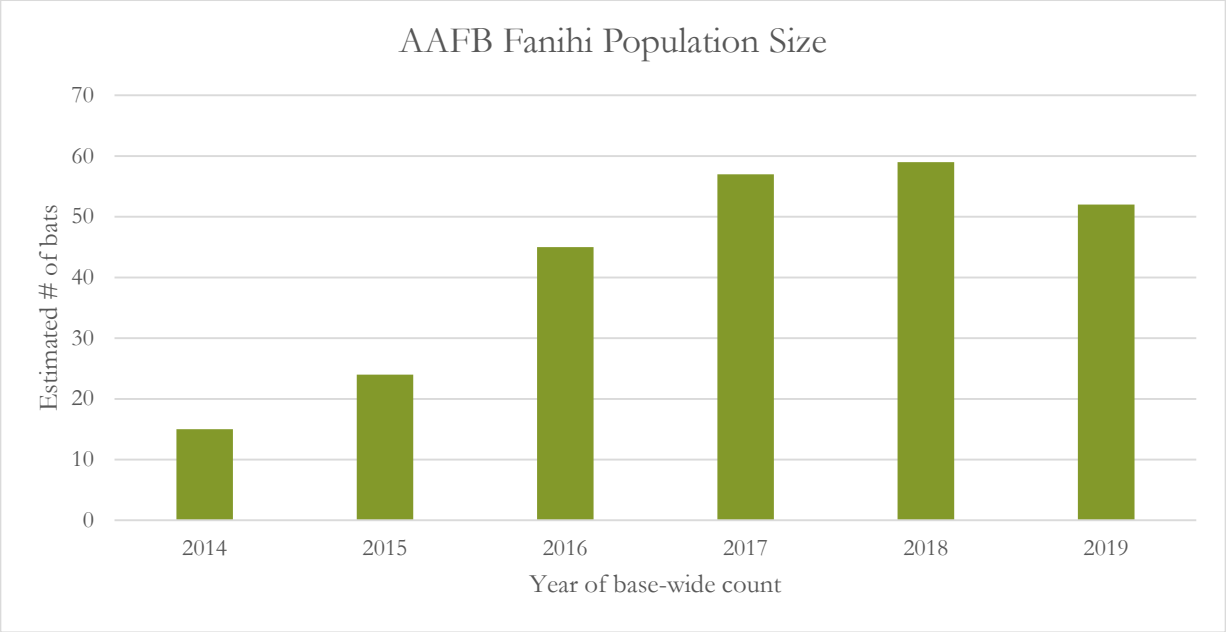


Figure 56. Estimations of AAFB Fruit Bat population size by year.

Serianthes nelsonii Monitoring and Management – AAFB

Location: AAFB **Period of Performance:** MAY2016 – OCT2017

Project Objective

Maintenance and monitoring of mature tree at Ritidian including seedlings and fence maintenance, monitoring and maintenance of outplanted seedlings, and nursery propagation and maintenance of seedlings.

Conservation Benefit

Implement recovery actions such as increasing populations, insuring against catastrophic events, and testing and implementing new conservation strategies.

FY19 Status

- Ritidian Tree- the mature tree at Ritidian remains stable despite the heartwood is 80% infected with the fungus *Ganoderma sp*., which is weakening the internal structure of the tree. In August of 2019 there were 24 seedlings within the enclosure and 404 seeds have been collected (Figure 57).
- Outplantings - Serianthes are being outplanted in two fenced cycad plots at Tarague and the Golf Course. There are 11 in the Tarague plot, with 4 being in very poor condition. The Golf Course plot contains 10 saplings with 2 in very poor condition. Further research is needed to determine the reason the Tarague plants are not doing as well as the Golf Course plants.
- GPEPP Rare Plant Nursery - In August of 2019 there were 35 seedlings in the nursery (Figure 58). Eight (8) saplings remain from a previous contract, three (3) from 2016, six (6) from 2017, and 35 from 2018.
- Tissue Culture - In August of 2019, ten (10) embryos were extracted from immature seeds. These are germinating in #2 media.
- In early September 2019 a kick-off meeting was held for the new option year of the project. Plans include air layering and maintenance of the Serianthes on the Guam National Wildlife Refuge. The Serianthes Management Plan will be updated and partners brought in for discussion.

EPR: 2 LC MAR AAFB *Serianthes nelsonii* Monitoring and Management; M5240CN039

2019 JRM INRMP Reference: TPS-5; 9-76

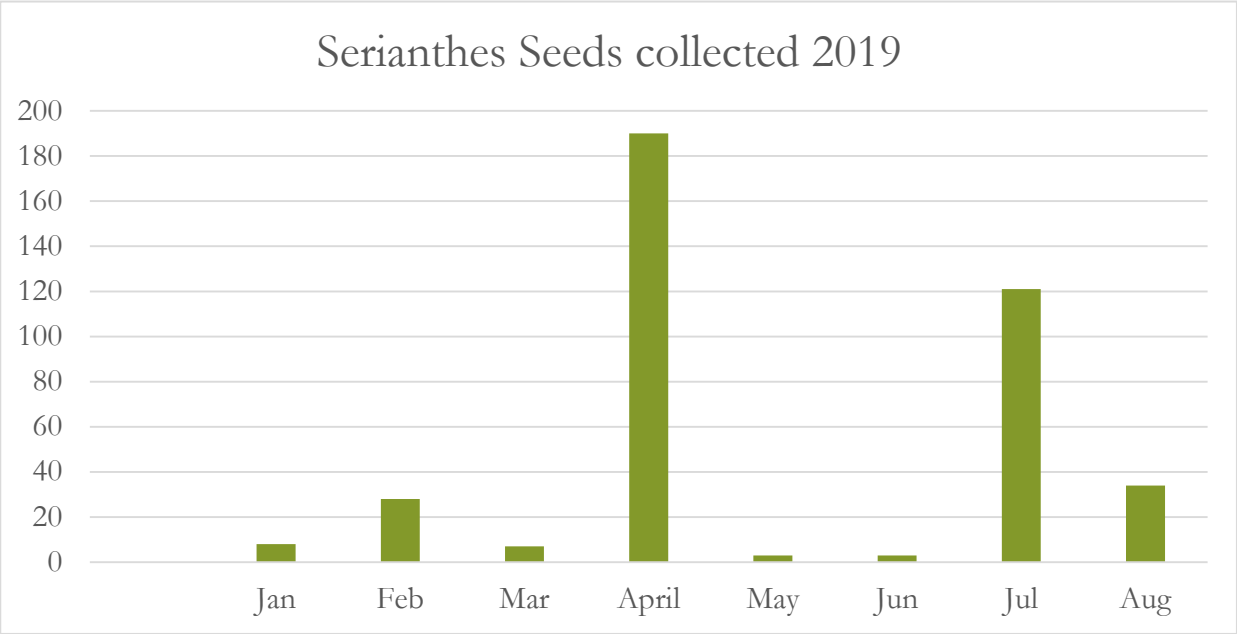


Figure 57. Serianthes seeds collected by month in 2019 on AAFB.



Figure 58. Seedlings planted in June were transplanted to 1 gallon root-maker pots.

Cycad Conservation – AAFB

Location: AAFB **Period of Performance:** SEP2017 – MAR2020

Project Objective

Maintenance and monitoring of five, 1-acre permanent fenced cycad (*Cycas micronesica*) plots (Achae Point, Ritidian Point, Tarague Basin, HMU, and Golf Course).

Conservation Benefit

Monitoring to allow for management actions to enhance and restore habitat; maintain or increase *Cycas micronesica* populations.

FY19 Status

- A new Cooperative Agreement through the CESU network was awarded to UOG on September 2017.
- UOG continues to monitor the Tarague, Ritidian Achae, Palms Golf Course, and NWF plots. The cycad plot at the HMU is no longer being monitored due to access issues and poor health of trees.
- On February 2018, UOG established unfenced plots adjacent to the existing cycad plots at Tarague, Ritidian Achae, Palms Golf Course, and Northwest Field to use as controls in order to gauge the effectiveness of conservation methods being implemented. The construction of the LFTRC will limit access to the NWF plot. As of August 2019 two new plots are being approved by Planning and Environmental at AAFB. One will be placed in Tarague Basin. A second site location was rejected due to cultural resource issues. GPEPP is currently searching for a suitable alternative site.
- Yearly data collection of cycads was conducted in the Tarague, Ritidian Achae, Palms Golf Course, and NWF plots. The data that were collected for each tree included: base circumferences; trunk circumference at 1.45 m; total height; number of leaves. Additional notes describe the overall assessment of each tree. Sticky traps are being deployed within the plots as part of a study to determine the seasonality of scale breeding. Crawler stage scales are captured by the sticky traps and can be counted (Figure 59).
- The Tarague plot fence is in good condition. Cycads are being treated with Merit and all vines and weeds removed from the trees. Sticky traps have found low densities of cycad crawlers. There are currently 19 seedlings in the plot, half of

which are infested with scale. These have been treated with Distance.

- The perimeter of the fence at the Ritidian Achae plot is heavily disturbed by ungulates. In August of 2019 a feral pig was found inside the plot and captured. A fence inspection found three places where pigs had dug underneath the chicken wire on the basal portion of the fence. These areas were tucked under enough rocks to prevent more pigs from entering. In August of 2019 there were fourteen female trees with maturing sporophylls, but no males with cones. Sticky traps show a similar number of crawlers as past months.
- The fence at NWF plot is in good condition. Sticky traps have showed low density of crawlers in August 2019. There is one seedling which was treated for scale.
- The fence at the Palms Golf Course plot is in good condition. Sticky traps are showing a higher density of crawlers compared to the other plots. As of August 2019 there were 6 female trees with sporophylls, although 3 appeared unfertilized/aborted. There were 2 males with cones.
- Merit, an insecticide containing the active ingredient imidacloprid was spread around the base of all cycads. Insecticides are applied to all cycads on all plots quarterly.
- Seedlings (Figure 60) within the Palms Golf Course and Tarague cycad plots show signs of scale infestation.



Figure 59. All life stages of the scale on a cycad leaf.

EPR: 3 SAR JRM, AAFB - *Cycas micronesica* Management for Conservation; M5240NR061

2019 JRM INRMP Reference: TPS-5; 9-77

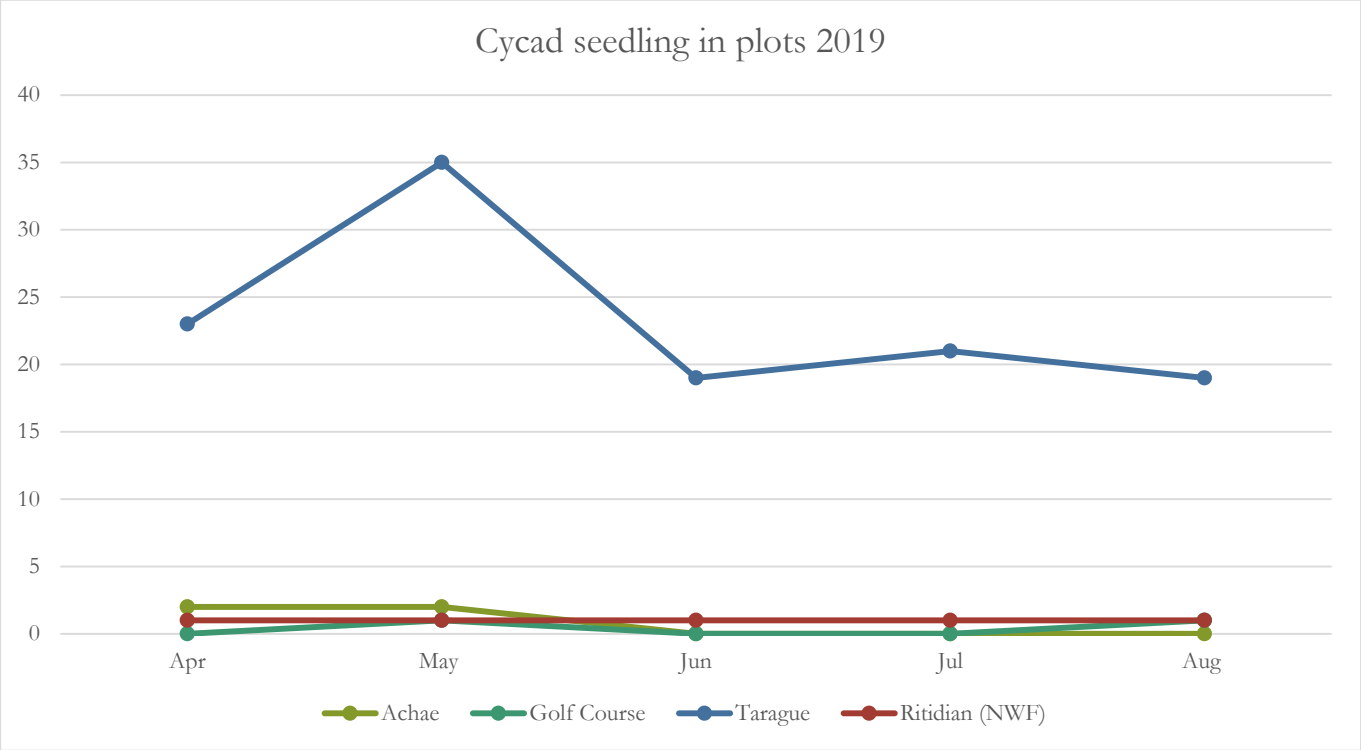


Figure 60. Seedlings in cycad plots on AAFB.

Tracking Movement of Micronesian Starlings and BTS on Andersen Air Force Base with an Automated Telemetry Tracking Network

Location: AAFB **Period of Performance:** SEP2019 – MAR2021

Project Objective

The goals of this project are to track the movement of Micronesian starlings (*Aplonis opaca*) and BTS on AAFB to identify areas of high use and routes of transit through automated telemetry towers, and document areas of high predation by BTS.

Conservation Benefit

This project is one of four projects that will, collectively, further develop information on BTS behaviors related to predation and movement in the presence of abundant avian species. Additionally, population demographics that could be useful for supporting future avian restoration projects and controlling BTS in low density with competing food sources in the presence of control regimes.

FY19 Status

- New funded project through an Interagency Agreement with USGS –PIERC starting in FY2019
- Project in early phases

EPR: 1 RP JRM Brown Tree Snake Eradication and Control to Support Recovery of ESA-Listed Birds; 61128NR202

2019 JRM INRMP Reference: TPS-6; 9-77

Evaluating and reducing BTS predation threat in urban Micronesian Starling Habitat – AAFB

Location: AAFB **Period of Performance:** SEP2019 – MAR2021

Project Objective

The project will evaluate control tools for urban BTS suppression in experimental high and low snake density plots. Also, monitor the relative abundance of BTS as a predation or dispersal threat via contact rates with baited camera devices. Overall this project will evaluate BTS control tools for suitability and efficacy in urban habitat, and use camera monitoring to index the decrease in Micronesian starling (*Aplonis opaca*) predation threat following snake removal.

Conservation Benefit

This project is one of four projects that will, collectively, further develop information on BTS behaviors related to predation and movement in the presence of abundant avian species. Additionally, population demographics that could be useful for supporting future avian restoration projects and controlling BTS in low density with competing food sources in the presence of control regimes.

FY19 Status

- New funded project through an Interagency Agreement with USDA –NWRC starting in FY2019
- Project in early phases

EPR: 1 RP JRM Brown Tree Snake Eradication and Control to Support Recovery of ESA-Listed Birds; 61128NR202

2019 JRM INRMP Reference: TPS-6; 9-77, TIS-3; 9-72

Monitoring Survival and Demography of Micronesian Starlings

Location: AAFB **Period of Performance:** JUL2019 – JAN2021

Project Objective

To monitor and analyze for Micronesian starling (*Aplonis opaca*) nest success and fledgling survival using telemetry, nest monitoring, and survey methods in relation to BTS control efforts. Through monitoring fledging survival and population recruitment efficacy of BTS control techniques can be assessed.

Conservation Benefit

This project is one of four projects that will, collectively, further develop information on BTS behaviors related to predation and movement in the presence of abundant avian species. Additionally, population demographics that could be useful for supporting future avian restoration projects and controlling BTS in low density with competing food sources in the presence of control regimes.

FY19 Status

- New cooperative agreement through the CESU network with Iowa State University (ISU)
- Survey for fledglings and juveniles in progress
- Installation of 21 new nest boxes
- No data or information available at this time

EPR: 1 RP JRM Brown Tree Snake Eradication and Control to Support Recovery of ESA-Listed Birds; 61128NR202

2019 JRM INRMP Reference: TPS-6; 9-77, TIS-3; 9-72

Salvage and Transplantation of *Partula radiolata* – NBG TS and AAFB

Location: AAFB **Period of Performance:** JAN2019 – JUL2020

Project Objective

To salvage and translocate federally endangered *Partula radiolata* identified within the construction footprint on Andersen South associated with the Guam Relocation.

Conservation Benefit

To minimize impacts of military construction activities to native ecosystems by salvaging as many healthy individuals as possible and preserving the genetic diversity of the species.

FY19 Status

- Snail surveys began in January 2019
- Over 75% of the project area at Andersen South has been surveyed for snails.
- *Partula radiolata* have been located in two main areas of the project area (Figure 61).
- All snails located within the project footprint will be translocated. To date, 645 snails have been translocated.

EPR: DPRI: Marine Corps Relocation 2017/2018 amendment to 2015 BO, Conservation Measures to Contribute to the Recovery of Listed Species.

2019 JRM INRMP Reference: TPS-1; 7-55

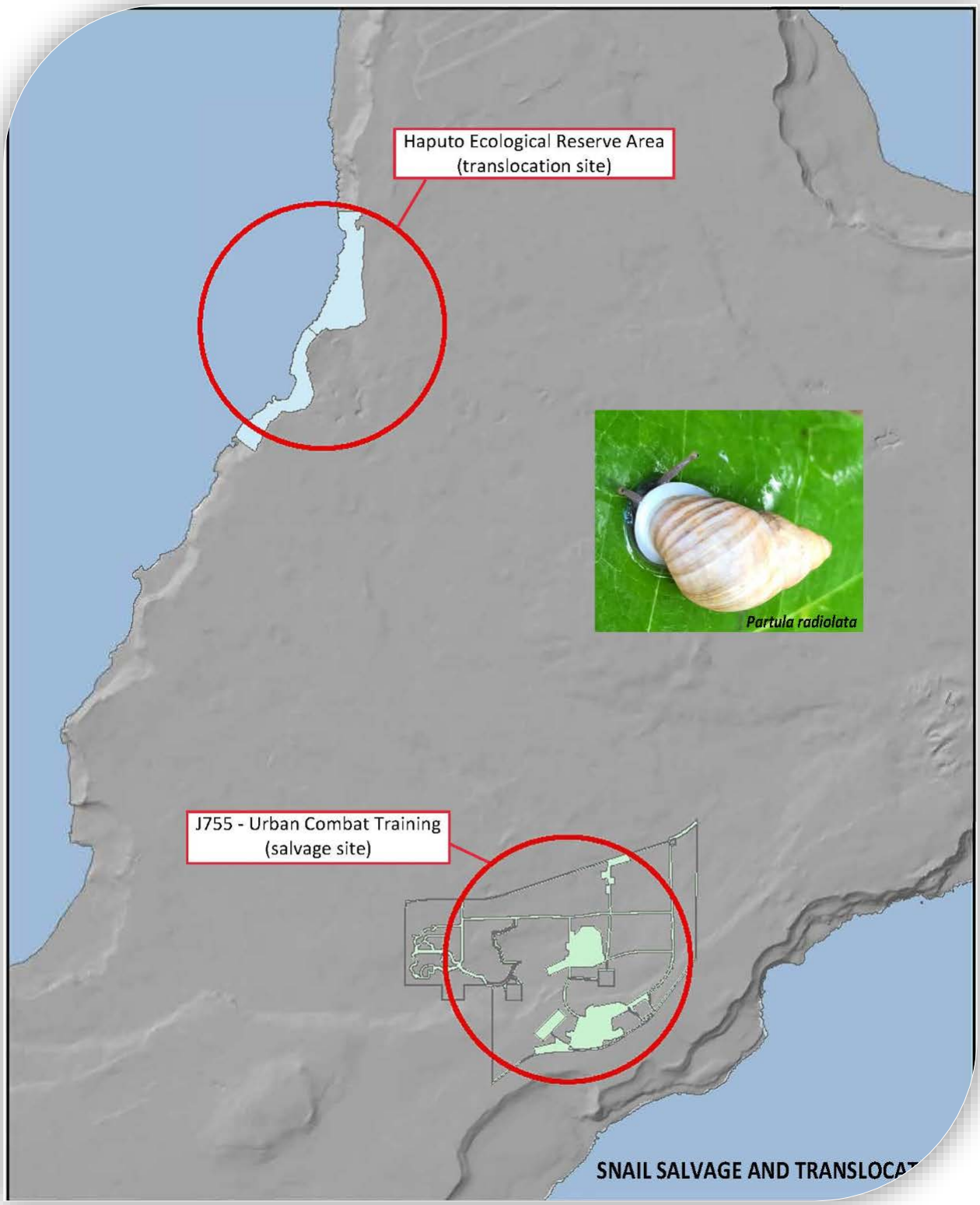


Figure 61. Map depicting locations of salvage and transplantation of *Partula radiola*.

Native Plant Seed Collection, Salvage, Storage, and Nursery Propagation for Forest Enhancement

Location: NBG TS **Period of Performance:** OCT2017 – OCT2022

Project Objective

The primary objective of this project is to provide native plant material for use in limestone forest enhancement projects in northern Guam by designing, installing, and operating a native plant nursery.

Conservation Benefit

To maintain a stock of healthy native plants ready to be used in forest enhancement planting. Native plant species from within DoD construction areas will be salvaged and propagated at the native plant nursery to maintain genetic diversity.



Figure 62. Native plant nursery at Finegayan.

FY19 Status

- Native plant nursery installed at Finegayan.
- Irrigation and water filtration system installed.
- Contractor received a 10(a)(1)(A) permit for collection of threatened and endangered species.
- Native plant seed collection - *Clayoxylon marianum, Syzygium thompsonii, Pongamia pinnata,* and *Psychotria hombroniana*.
- Seed transfers - 1,300 + seeds of *T. rotensis, H. longipetiolata, Meiogyne*

cylindrocarpa, S. thompsonii.

- Seed propagation - Began propagation of *T. rotensis* and *H. longipetiolata* seeds.
- Plant material collected - cuttings from *Procris pedunculata* and *Elatostema calcareum*.

EPR: DPRI: Marine Corps Relocation 2017/2018 amendment to 2015 BO, Conservation Measures that will Contribute to the Recovery of Listed Species.

2019 JRM INRMP Reference:
TPS-1; 7-55

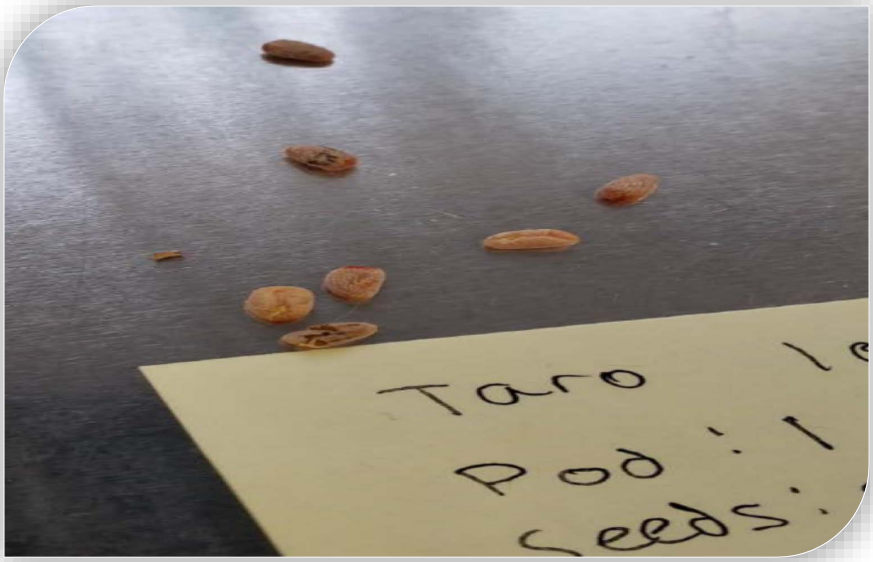


Figure 63. *Tabernaemontana rotensis* Seeds collected and submitted to the native plant nursery.

Surveys for ESA-listed Plants, Treesnails, Butterflies and Butterfly Host Plants – NBG TS and NBG

Location: NMS; NBG TS **Period of Performance:** JUL2017 – JUL 2019

Project Objective
To document locations and estimate population densities of ESA-listed species on 887 hectares (2,191 acres) of NMS sites that are proposed ungulate exclusion areas and to document listed snail colonies at Haputo ERA, NBG TS.

Conservation Benefit
Identifying locations and population numbers of ESA-listed species will aid in fence construction and allow monitoring of populations after fence construction and ungulate eradication. Will also allow estimates for the total populations of ESA-listed species on NMS and Navy lands on Guam.

FY19 Status

- Project complete
- Using Distance transect methodology, densities and populations were estimated for ESA-listed species on 887 hectares (Figure 64 - 65).
- The number recorded species including those that population estimates could not be calculated are listed in the Table 10.
- Snail surveys at Haputo ERA documented 1,530 *Partula radiolata* and 136 *Partula gibba*. A previously unknown colony of *P. gibba* was also documented.

EPR: 1 S MAR NBG Endangered Species Monitoring; 61755NR142

2019 JRM INRMP Reference: TPS-1; 6-46

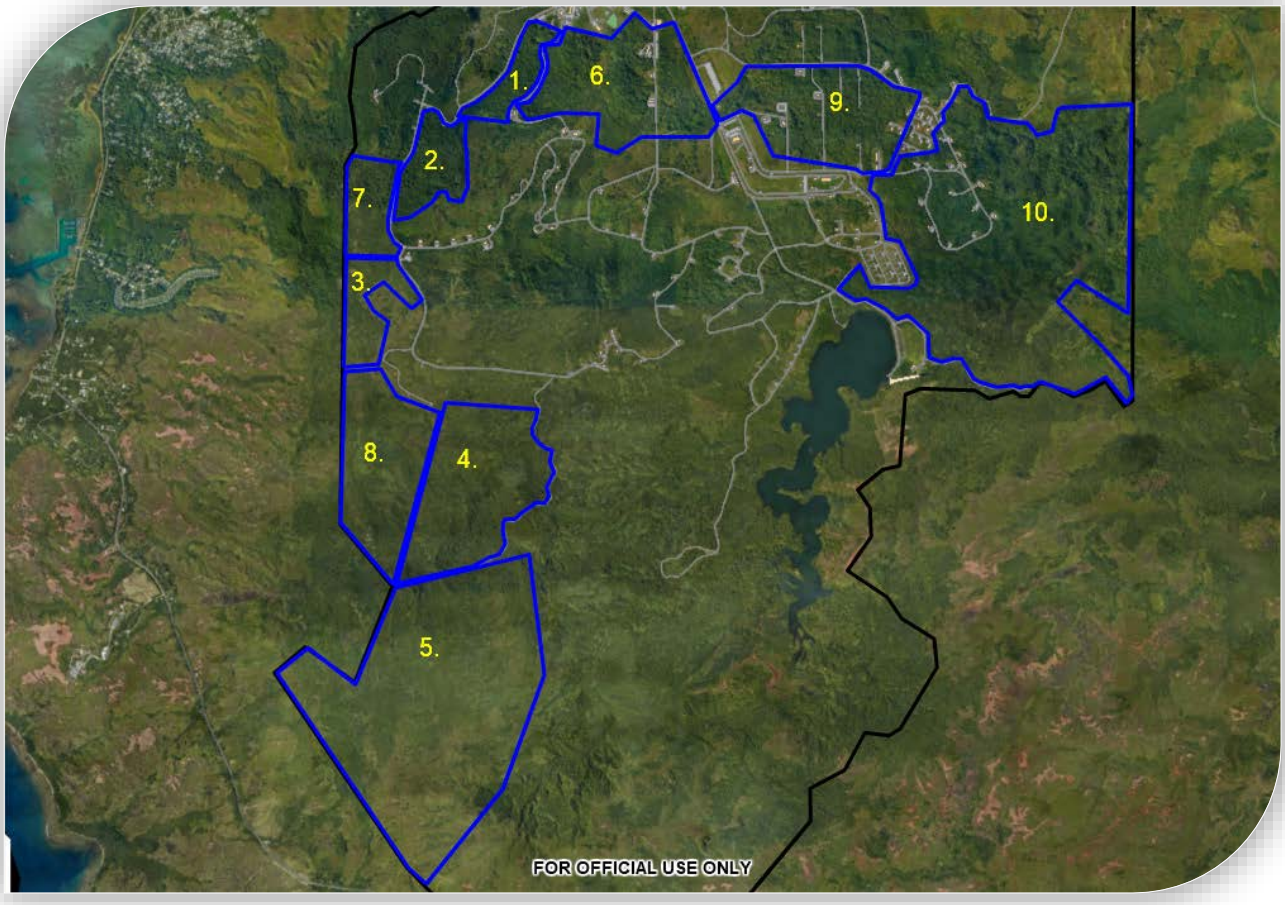


Figure 64. Map depicting areas Surveyed on NMS.



Figure 65. Map depicting area Searched at Haputo ERA.

Table 10. Threatened and Endangered species numbers, density and population estimates on the surveyed 887 hectares on the NMS.

Species	Number of trees with orchids/number individuals recorded	Number of orchids recorded	Mean cluster size	Host tree density (per ha) estimate with 95% confidence	Orchid Density (per ha) estimate with 95% confidence	Host tree population estimate with 95% confidence	Orchid population estimate with 95% confidence
Dendrobium guamense	1725	2,795	1.83	8 6-11	13 9-19	8,687 6,480-11,937	14,128 10,115-20,485
Tuberolabium guamense	442	3,301	8.85	3 2-6	31 17-63	3,321 2,187-5,324	28,930 17,616-50,622
Bulbopyllum guamense	527	1,631	2.59	2 1-4	5 3-8	2,840 1,852-4,434	6,320 3,887-10,542
Cycas micronesica	738	NA	NA	2 2-4	NA	2207 1754-2893	NA
Procris pedunculata Butterfly host plant	11	NA	NA	NA	NA	NA	NA
Elatostema calcareum	6	NA	NA	NA	NA	NA	NA
Hypolimnus octocula marianensis	Adult – 2 Larvae – 13 Eggs - 12	NA	NA	NA	NA	NA	NA
Nervilia jacksoniae	2	NA	NA	NA	NA	NA	NA
Maesa	4	NA	NA	NA	NA	NA	NA

Species	Number of trees with orchids/number individuals recorded	Number of orchids recorded	Mean cluster size	Host tree density (per ha) estimate with 95% confidence	Orchid Density (per ha) estimate with 95% confidence	Host tree population estimate with 95% confidence	Orchid population estimate with 95% confidence
walkeri							
Phyllanthus saffordi	12	NA	NA	NA	NA	NA	NA

Comprehensive Baseline Vegetation Survey and Long Term Monitoring Plan for the Forest Enhancement Areas at Finegayan

Location: NBG TS; AAFB **Period of Performance:** SEP2018 – MAR2020

Project Objective

The project will complete an ecosystem vegetation baseline survey within the North Finegayan and Finegayan Forest Enhancement Sites. The survey and a suite of environmental data will be used to recommend treatment areas, identify sites appropriate for threatened and endangered plant species, develop long term monitoring protocols for the sites, and establish success criteria for enhancement efforts.

Conservation Benefit

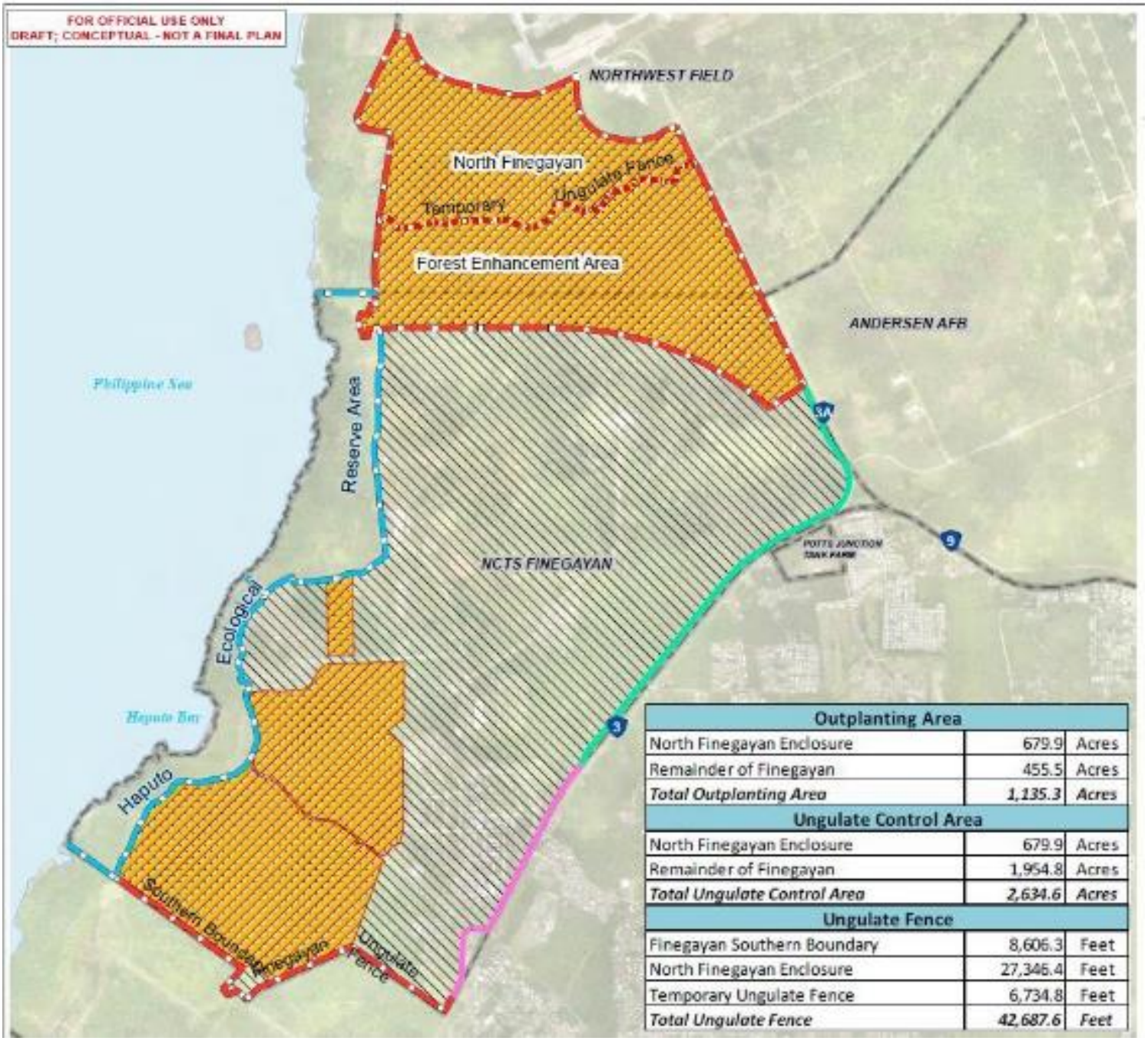
The plan will inform forest enhancement efforts intended to restore limestone forests and improve degraded landscapes to better support native species, including threatened and endangered plants and animals.

FY19 Status

- CESU awarded to ISU in September 2018.
- Forest enhancement site transects and data collection completed. Reference site surveys will begin in late 2019.
- Final report expected March 2020.

EPR: DPRI: Marine Corps Relocation 2017/2018 amendment to 2015 BO, Conservation Measures to Contribute to the Recovery of Listed Species.

2019 JRM INRMP Reference: TPS-1; 7-55



Outplanting Area		
North Finegayan Enclosure	679.9	Acres
Remainder of Finegayan	455.5	Acres
Total Outplanting Area	*1,135.3*	*Acres*
Ungulate Control Area		
North Finegayan Enclosure	679.9	Acres
Remainder of Finegayan	1,954.8	Acres
Total Ungulate Control Area	*2,634.6*	*Acres*
Ungulate Fence		
Finegayan Southern Boundary	8,606.3	Feet
North Finegayan Enclosure	27,346.4	Feet
Temporary Ungulate Fence	6,734.8	Feet
Total Ungulate Fence	*42,687.6*	*Feet*

Figure 66. Map depicting North Finegayan and Finegayan Forest Enhancement Areas.

Cycad Conservation – Tinian

Location: Tinian, CNMI **Period of Performance:** APR2019 – APR2020

Project Objective

To conserve representative plants of *Cycas micronesica* populations from Guam; ongoing project from 2007.

Conservation Benefit

Increase populations, insure against catastrophic events, and test and implement new conservation strategies.

FY19 Status

- Due to a contract award gap, contractors were not able to perform plot maintenance work from July 2018 through April 2019.
- The plots were subjected to Typhoon Mangkhut (September 2018) and Super Typhoon Yutu (October 2018).
- Post Typhoon Mangkhut and Super Typhoon Yutu evaluation showed approximately 70% survival.
- The project was awarded as a cooperative agreement to UOG in 2019. Initial evaluation after FY19 award, shows most survived. The Preliminary estimate appears close to what was found in the FY18 report.
- The lack of over story species has allowed understory species to grow quite rapidly, “burying” many of the cycad seedlings. Without regular maintenance, these trees will likely be overwhelmed by encroaching vegetation.
- During the August 26 – 29 site visit, scale was discovered on five of the 96 plants in Plot 12. Although brown scale has been documented previously, this scale is white and appears to be aulacaspis scale (*Aulacaspis yasumatsui*) (Figure 67).
- In addition to scale in this plot, three (3) plants were also discovered to have butterfly larva on newly emerging leaves.
- These larva appear to be the early instar stage of cycad blue butterfly larva (*Chilades pandava*) (Figure 68).

- All protective measures were taken to avoid contaminating the Tinian cycads. Tools used in Tinian were purchased new and stored on Tinian. All clothing and boots are thoroughly washed and frozen for at least 48 hours prior to transport from Guam to Tinian.
- Pesticides will be applied along with plot maintenance and inspection for scale and butterfly in other plots.

EPR: 1 CP MAR Conservation Management of Tinian Cycads; 61128NR162

2019 JRM INRMP Reference: TPS-1; 11-63



Figure 67. Larva (instar stage) of Cycad blue butterfly (*Chilades pandava*) was discovered on three plants in plot 12.

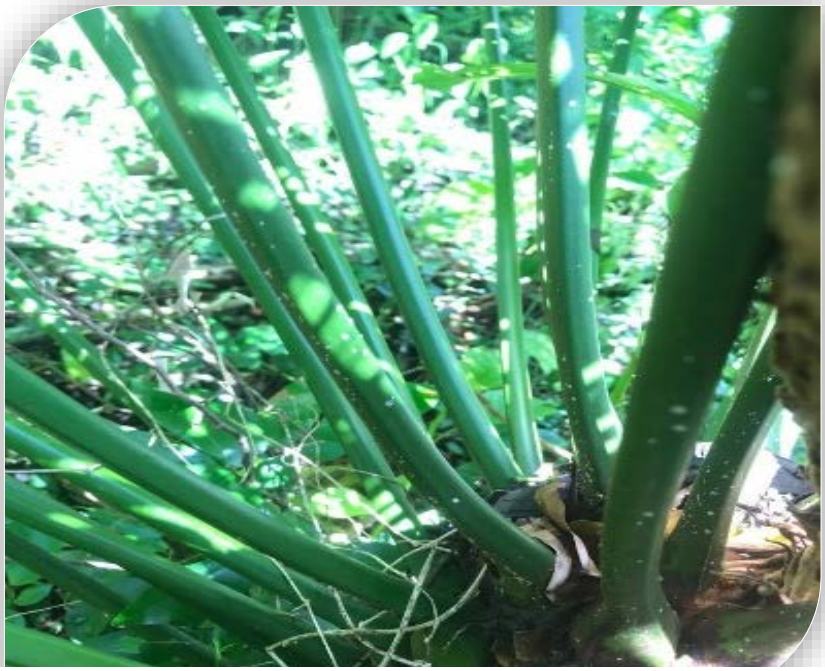


Figure 68. Cycad aulacaspis scale (*Aulacaspis yasumatsui*) was discovered on 5 plants in plot 12.

Beach Cleanups at Tinian Sea Turtle Nesting Beaches

Location: Tinian, CNMI **Period of Performance:** AUG2018 – SEP2019

Project Objective

Removal of marine debris from all sea turtle nesting beaches in the Military Lease Area (MLA) with particular attention to the windward beaches of Dangkulo, Chigit and Masalok where debris accumulates after storms. Cleanup would be conducted annually at a minimum and more frequently as needed.

Conservation Benefit

The removal of marine debris benefits sea turtles by preventing entanglements and allowing successful nest excavation and egg deposition.

FY19 Status

- Beach cleanups were conducted every four months, following storm events when marine debris tended to accumulate at an increased rate.
- A total of 1,807.5 lbs. of marine debris and trash were collected during three cleanup events.
- Marine debris was sorted into a total of 134 bags of recyclables (plastic, aluminum, glass) and non-recyclables (foam, footwear, fishing gear, etc).
- All bags of sorted marine debris were transported by rental trucks and charter vessels from Tinian, CNMI beaches to the Lower Base Refuse Transfer Station located on Saipan, CNMI for final disposal.
- A high density of marine debris was documented on windward, east-facing MLA beaches (ex. Dangkulo); while on leeward, west-facing beaches (ex. Chulu) litter from beach visitors and picnickers was observed in greater abundance.
- The top four materials collected by weight were plastics (63%), fishing gear (23%), footwear (7%), and glass (5.6%) (See Figures 69 - 71).

EPR: 1 RP MAR CNMI ESA and MBTA Species Management; 61128NR211

2019 JRM INRMP Reference: TPS-2; 11-64

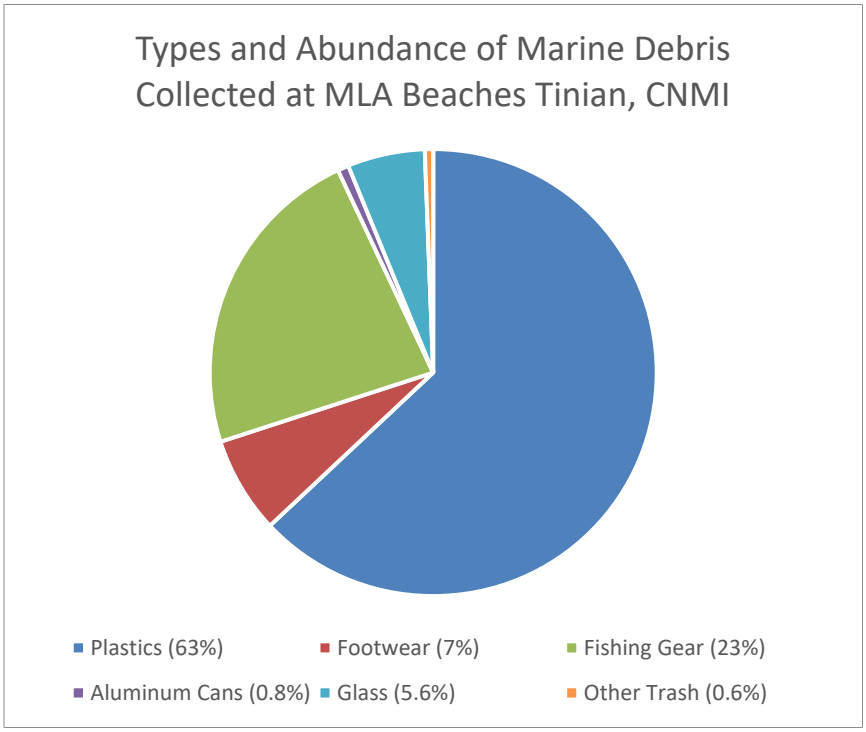


Figure 69. Types and abundance of collected marine debris at MLA beaches Tinian, CNMI.



Figure 70 & 71: Photos of before and after the beach cleanup on Dangkulo.

Concrete barrier - Sea Turtle Conservation – CNMI

Location: Tinian, CNMI **Period of Performance:** SEP2018 - SEP2019

Project Objective

The intent of this contract is to fabricate, paint, transport and place, eighty (80), six foot concrete barriers to North Field, Military Leased Area, Tinian. Barriers will be placed on MLA beach access roads with input from CNMI resource partners on placement.

Conservation Benefit

Poaching and predation of sea turtle nests and recreational use of sea turtle nesting beaches have resulted in disturbance of habitat and illegal intentional take of these endangered species. Concrete barriers will prevent vehicles from disturbing nesting female turtles, their nests and nesting habitats.

FY19 Status

- Barriers are fabricated and painted. They are currently stored on FPA Corp lot (Figure 72).
- Awaiting concurrence from CNMI SHPO to deliver and place on North Field at the time of this report.
- Currently coordinating with CJCO, and CNMI, Bureau of Military Affairs regarding comments and suggestions for barrier placement on Tinian MLA beach access roads.

EPR: 1 RP MAR CNMI ESA and MBTA Species Management Tinian; 61128NR211

2019 JRM INRMP Reference: TPS-2; 11-64



Figure 72. Photo of concrete barriers fabricated for turtle nest protection.

Sea Turtle Surveys – Tinian

Location: Tinian, CNMI **Period of Performance:** OCT2018 - OCT2019

Project Objective

Ongoing monthly monitoring of sea turtle nesting activities on Tinian MLA beaches

Conservation Benefit

Collecting long-term trends of sea turtle nesting can determine population estimates and abundance on Tinian and throughout the region.

FY19 Status

- 38 nests and three (3) non-nesting emergences (NNEs) were observed on Tinian MLA beaches during 16 surveys between October14, 2018 – August 31, 2019 (Figure 73).
- Turtle activities occurred at Masålok, Dangkulo, Babui and Chulu beaches.
- It is estimated that Tinian MLA beaches supported a total of four nesting turtles during the 2019 season: Masålok (n=1) and Dangkulo #1, #4, #5 and #8 (n=4).
- Remaining nests for which hatching evidence was observed were inventoried; mean clutch size was 95 (n=19), hatch success was calculated to be 84% (n=19) while emergence success was not calculated at the time of this report.
- Final report will be available October 2019

EPR: 1 S RP MAR CNMI ESA and MBTA Species Management; 61128NR211

2019 JRM INRMP Reference: TPS-2; 11-64

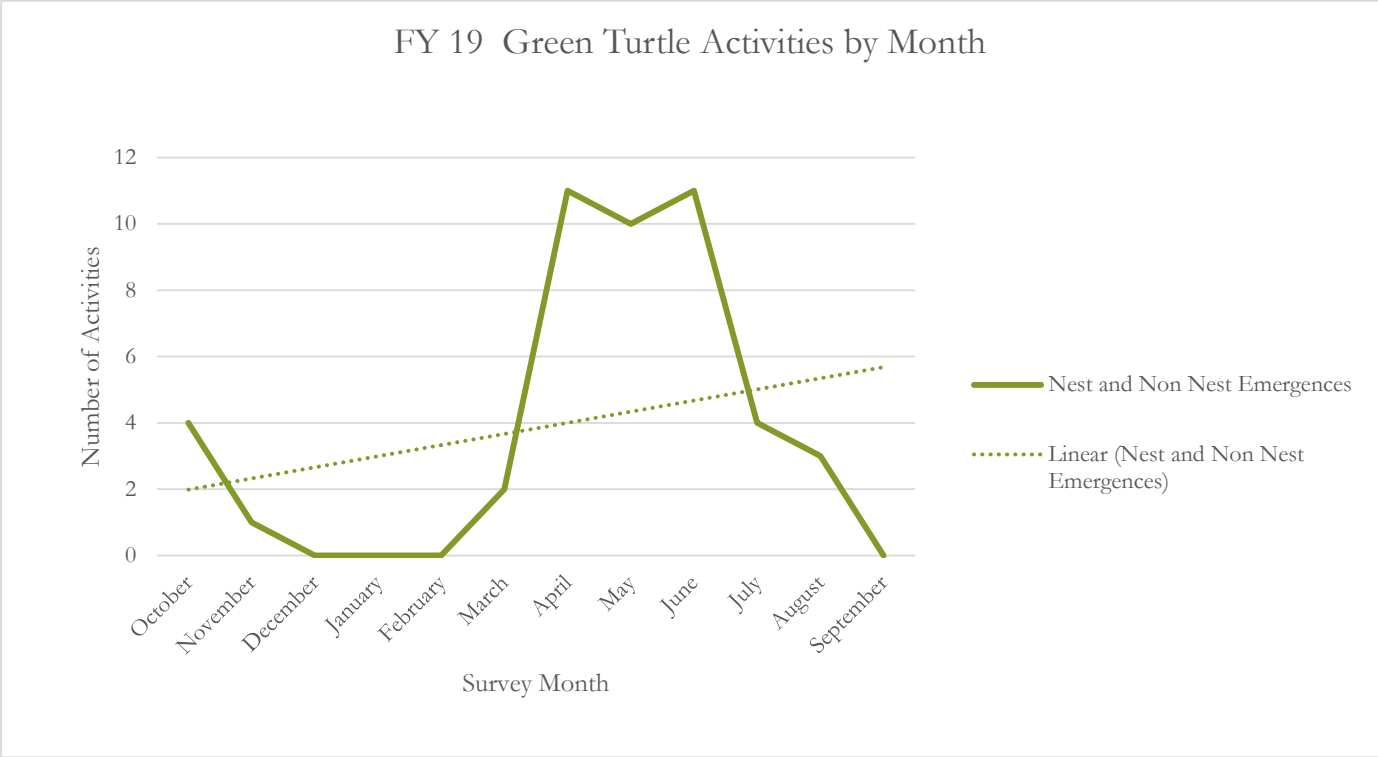


Figure 73. Frequency of MLA Tinian, CNMI green turtle nesting activities observed during monthly surveys for the period Oct 2018 to Sept 2019.

Mariana Common Moorhen Surveys – Tinian

Location: Tinian, CNMI **Period of Performance:** SEP2018 – SEP2019

Project Objective

Ongoing monitoring of nesting moorhens (*Gallinula chloropus guami*) at Hagoi and Bateha Wetlands in the Tinian MLA. (Previous Mariana Islands Range Complex [MIRC] BO Requirement, continued as an INRMP project).

Conservation Benefit

Monitor long-term trend of the moorhen population.

FY19 Status

- Four (4) surveys were conducted at Hagoi wetland quarterly between October 2018 and July 2019.

- The number of Mariana Common Moorhens detected per survey during the four surveys between October 2018 and July 2019 was 15 ± 10 SD (range 0-21) (Figure74).
- Eleven (11) active or old moorhen nests were observed at the Hagoi wetland between October 2018 and July 2019.
- No moorhen surveys were possible at the Bateha B-01 wetland in 2018-2019; nevertheless, ponded water was not observed in this wetland from an airplane on 2 and 10 August 2019.
    - Due to uprooted trees and vine growth following Super Typhoon Yutu, Bateha B-01 trail was impassable and presented a safety issue.
- Final report received September 2019

EPR: 1 S RP MAR CNMI ESA and MBTA Species Management; 61128NR211

2019 JRM INRMP Reference: TPS-3; 11-65

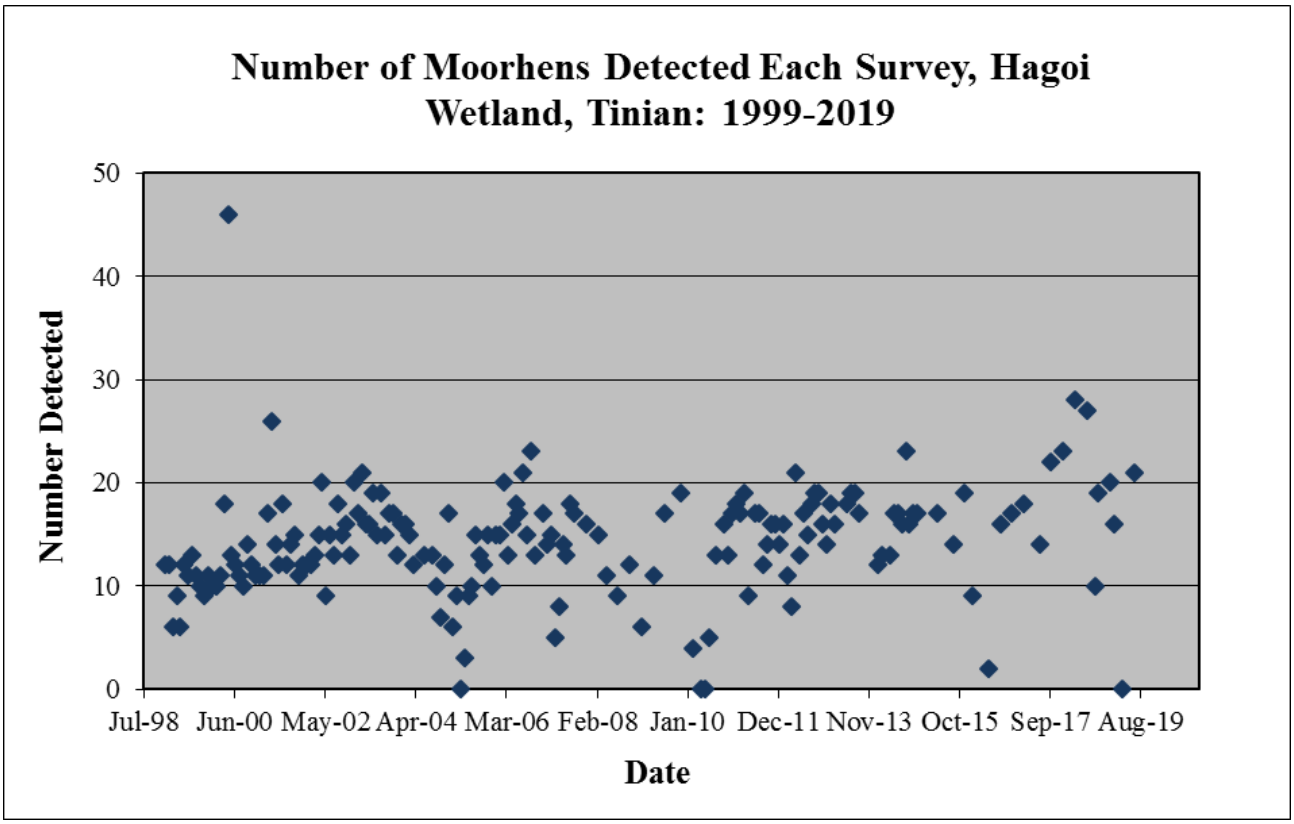


Figure 74. Moorhen surveys conducted at Hagoi Wetland, Tinian from 1998 – 2019. Each dot represents one complete Hagoi Survey.

Tinian Forest Bird Monitoring and Assessment

Location: Tinian, CNMI **Period of Performance:** SEP2018 – FEB2020

Project Objective

Understand overall population status of forest birds of Tinian, especially the Tinian monarch and Micronesian megapode. Provide data to enable analyses of population trends over time of forest bird species on Tinian to enhance and conserve populations.

Conservation Benefit

Inform conservation and management actions for the Tinian monarch. Track the population status of the federally-endangered Micronesian megapode and other Tinian forest birds.

FY19 Status

- Awarded as a Cooperative Agreement to UoG through the CESU network in September 2018.
- Work will consist of:
    - Conducting surveys for forest birds on Tinian MLA using large-scale variable circular plot surveys.
    - Conducting Micronesian Megapode surveys.
    - Investigating the status and viability of the Tinian monarch, by assessing: 1) adult and juvenile survival, 2) reproductive success, 3) site fidelity, 4) habitat use and homerange size, and 5) potential limiting factors and applying predator control measures, if appropriate, to improve nesting success and juvenile and adult survival
    - Conducting vegetation sampling within Tinian monarch nesting habitat.
- Final report due in February 2020 (requested NCE will move this date to March 2021).

EPR: CHS MAR JRM Tinian Forest Bird Monitoring; EPR 61755NR303

2019 JRM INRMP Reference: TPS-4; 11-64

Monitoring for Micronesian Megapodes and Mariana Fruit Bats

Location: FDM **Period of Performance:** OCT2018 – SEP2019

Project Objective

To conduct Micronesian megapode (*Megapodius laperouse*) surveys along established trails and paths to use as an index of megapode population change over time; record Mariana fruit bats (*Pteropus mariannus mariannus*) observed during surveys, and conduct habitat ground surveys to monitor habitat change over time per the 2015 Mariana Islands Training and Testing (MITT) BO terms and conditions.

Conservation Benefit

To ensure compliance with the Incidental Take Statement of the 2015 MITT BO.

FY19 Status

- Survey conducted on April 12, 2019 at eight stations previously established and two new stations establish during this survey (Figure 75).
- Total of 20 megapodes were detected during survey effort. Eighteen birds detected at seven playback survey stations and two birds detected between stations No. 3 and No. 4 that were unresponsive to station playbacks (Table 11).
- No Mariana fruit bats observed while implementing megapode surveys.
- Vegetation photo points collected at megapode survey stations.
- Final survey report expected November 2019.

EPR: BO MAR Mariana Islands Training and Testing (MITT) Implementation; 61128NR218

2019 JRM INRMP Reference: TPS-1; 12-34

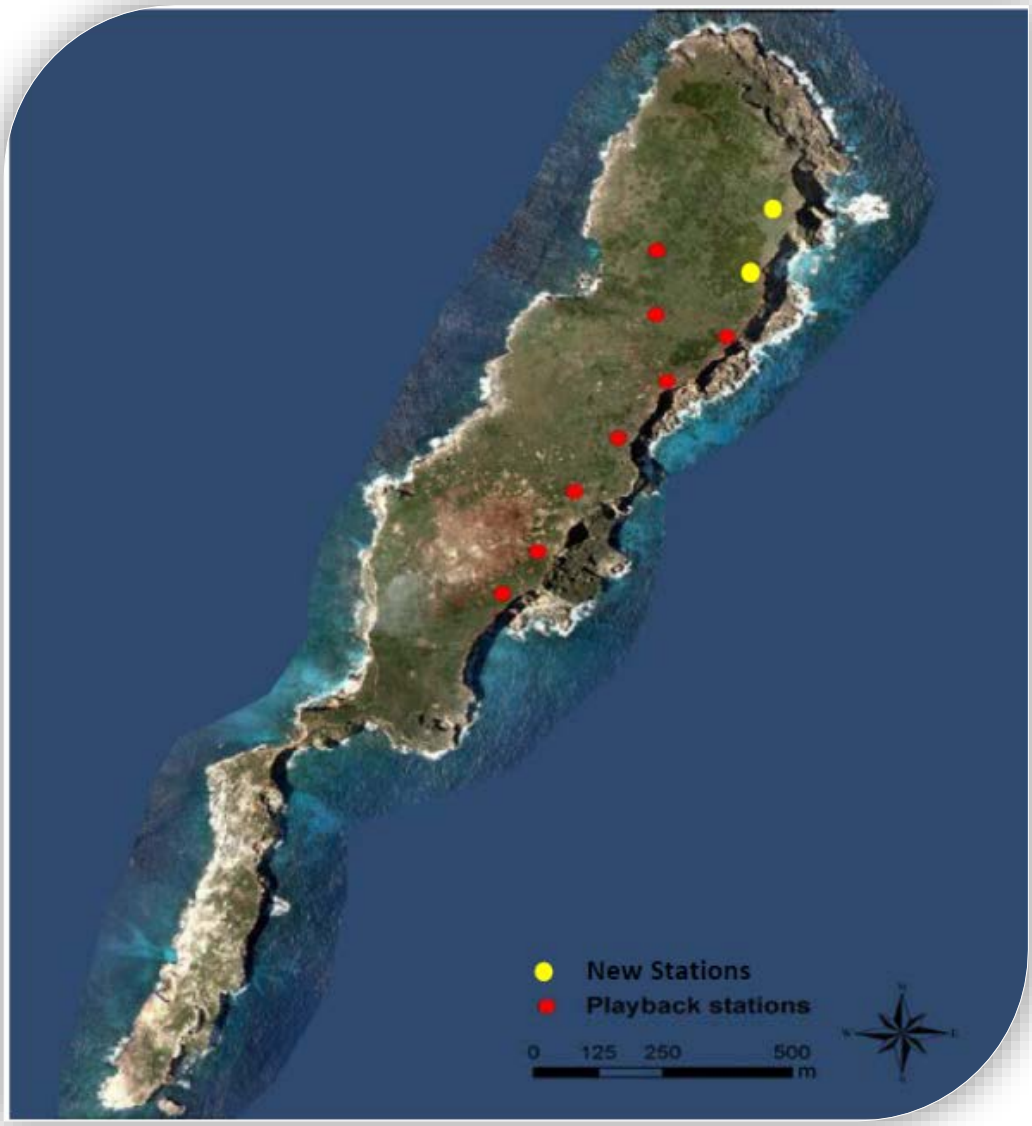


Figure 75. FDM Micronesian megapode playback survey stations (April 12, 2019).

Table 11. Comparison of Micronesian megapode detections at playback survey stations between 2013 and 2019.

Year	Stn1	Stn2	Stn3	Stn4	Stn5	Stn6	Stn7	Stn8	Stn9	Stn10	Total
2013	1	1	0	0	1	2	4	2	NA	NA	11
2019	1	2	0	0	3	3	2	3	0	4	18

Migratory Bird Management

Migratory Bird Surveys – NBG

Location: NBG; NMS; NBG TS **Period of Performance:** recurring annually

Project Objective

To: (1) identify migratory bird species on NBG; (2) examine trends in abundance; (3) identify and quantify suitable habitat for migratory birds; and (3) examine habitat relationships of migratory birds.

Conservation Benefit

Monitor long-term trends of spatial and temporal distribution of migratory birds on NBG lands.

FY19 Status

- Migratory bird abundance was monitored at 20 sites on NBG between October 2018 and August 2019.
- 220 surveys conducted at 20 sites.
- 12 species were recorded with Pacific golden plovers accounting for 65% of migratory birds observed, ruddy turnstones 17%, whimbrels 12%, and all other species collectively accounted for 6% of observations. These findings are consistent with data from past years.
- Abundance was higher during September – April compared to May – August.
- Migrants used grass fields more often than shoreline or wetland habitats; however, habitat use varied among species.
- Navy plans to continue conducting migratory bird surveys on NBG and examine the relationship between habitat use and maintenance plans at grass fields.

EPR: 1 RP MAR CNMI ESA and MBTA Species Management (Key species Moorhen and Sea Turtles); 61128NR211

2019 JRM INRMP Reference: MIG-1; 5-90

Monitoring of MBTA-Listed Bird Species – FDM

Location: FDM **Period of Performance:** OCT2018 – SEP2019

Project Objective

To identify migratory bird species on FDM; examine trends in abundance; identify and quantify suitable habitat relationships of migratory birds. Monitor long-term trends of three booby species (Brown, Masked, Red-footed) on FDM via helicopter surveys.



Conservation Benefit

Provides information of bird species present and habitat usage to guide implementation of appropriate conservation practices.

FY19 Status

- No aerial surveys conducted in FY19 due to lack of commercial helicopter support in the CNMI.
- JRM continuing to explore options to continue monitoring long-term seabird trends for the three booby species.

EPR: 1 S MAR NBG Endangered Species Surveys; 61128NR211

2019 JRM INRMP Reference: MIG-1; 12-35

Terrestrial Natural Resources Educational Outreach

Biosecurity Outreach and Education on Guam

Location: JRM **Period of Performance:** AUG2019 – AUG2020

Project Objective

The project objective is to broadcast radio, television, and web public service announcements on Guam to educate the military personnel and contractors about invasive species and promote native species.

Conservation Benefit

Minimize the effects of invasive species by educating DoD and civilian populations through prevention. Provide awareness of introduced and invasive species, the impacts of invasive species on native species and ecosystems, and what can be done to prevent and control invasive species.

FY19 Status

- FY17: Targeted time period of broadcasts were between 0600-2200, including the nightly news television broadcast, with specific broadcasts coinciding with international events to be held on Guam to maximize viewers and listeners. Guam Department of Agriculture (GDOAg) biosecurity division reported 20+ calls were a direct result of TV/radio broadcasts.
- FY18: Targeted time period of television and radio broadcasts were between 0600-2200, including the nightly news television broadcast, with specific broadcasts coinciding with international and regional events to be held on Guam to maximize viewers and listeners. Social media video Public Service Announcements run between 1500-2400 on Guam. Final Report submitted in July 2019.
- FY19: Biosecurity Outreach contract awarded on 29 August 2019. DON working with GDOAg Biosecurity division to link social media page with video ads.

EPR: DPRI: Marine Corps Relocation 2017/2018 amendment to 2015 BO, Conservation Measures to Minimize the Effects of Invasive Species.

2019 JRM INRMP Reference: TEDU-1; 7-57

Outreach and Education – NBG

Location: NBG TS **Period of Performance:** AUG2019 - SEP2020

Project Objective

This project will develop, design, and produce/print custom outreach materials and educational signs for Public Works EV, Naval Base Guam.

Conservation Benefit

Avoid and minimize adverse impacts from recreational activities to ESA-listed species and other marine natural resources.

FY19 Status

Project was awarded in FY19. The project is expecting the following results:

- Replace educational signs including a fishing regulation sign and a seafood health advisory sign
- A Naval Facilities Engineering Command (NAVFAC) banner for use at outreach events
- Fishing regulation trifold brochure
- A trifold brochure that shows the location of mooring buoys for fishing boats as well as water safety.
- A 2019 Tide Chart Calendar, marine resources educational calendar

EPR: Listed Species Outreach Material; 61755NR306

2019 JRM INRMP Reference: TEDU-1; 5-91, MEDU-1; 5-104



Figure 76. An image of the trifold brochure depicting the location of mooring buoys for fishing boats as well as water safety.

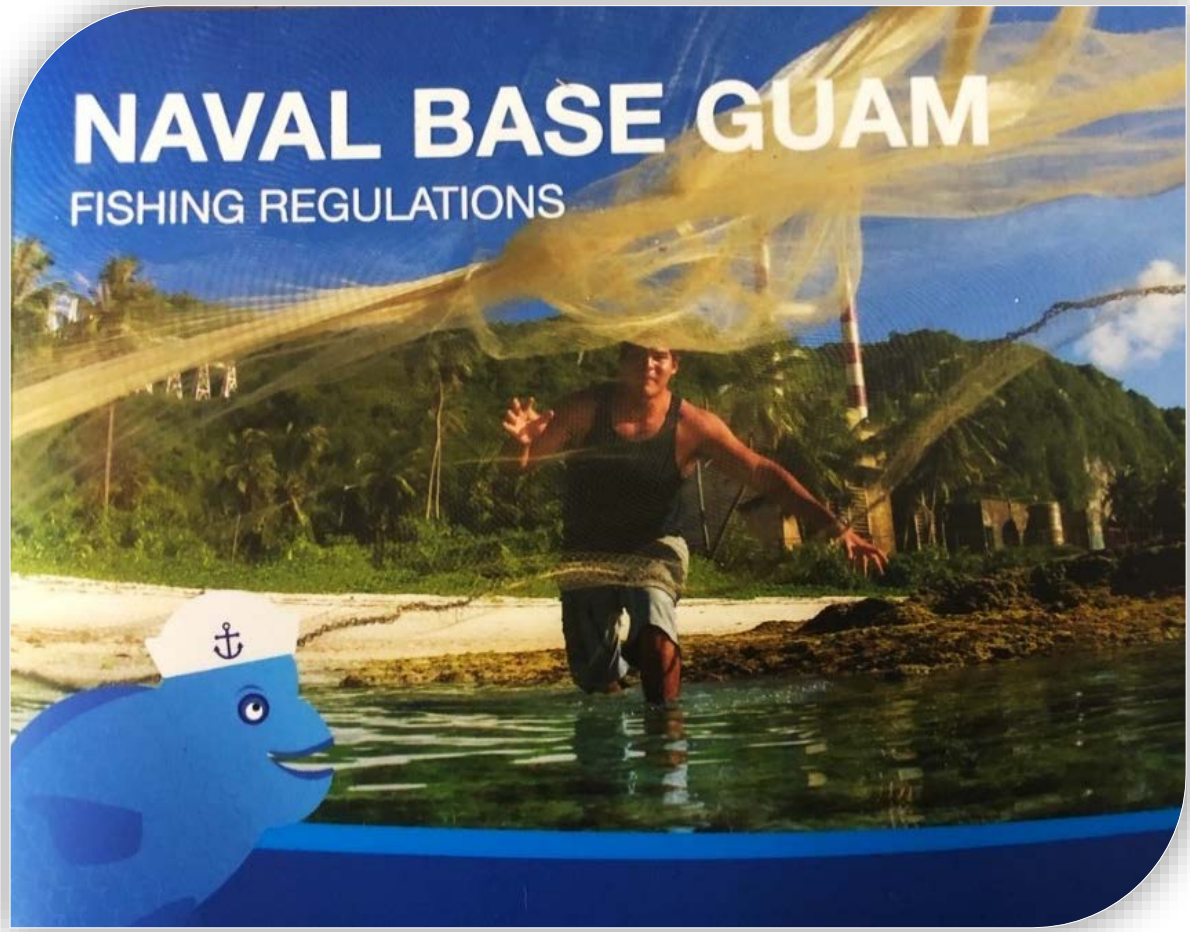


Figure 77. An image of the fishing regulation trifold brochure.

Terrestrial Geographic Information Systems (GIS) and Data Management

Digital Orthography Lidar and Planimetric Data – CNMI

Location: FDM; Saipan; Tinian **Period of Performance:** SEP2018 - SEP2019

Project Objective

- Obtain aerial imagery of Tinian, Saipan, and FDM
- Obtain lidar data for bathymetric products at FDM

Conservation Benefit

- Increase habitat for ESA-listed species (e.g., corals, sea turtles, marine mammals).
- Support habitat areas of particular concern which align with Magnuson-Stevens Fishery Conservation Act for Essential Fish Habitat and the Marianas Fishery Ecosystem Plan.

FY19 Status

- GIS data capture (aerial imagery for Tinian, Saipan, and FDM; and lidar for FDM) completed JULY2019 and currently being analyzed.
- Executed no-cost extension until APR2020 due to Typhoon Yutu which hit the CNMI on OCT2018, postponing field work.

EPR: 1 CP MAR JRM GIS Database Management; 61128NR200

2019 JRM INRMP Reference: TGIS-1; 11-68, TGIS-1; 12-36, MGIS-1; 11-77; MGIS-1; 12-43

Marine Habitat Management

Water Quality Monitoring on Joint Region Marianas Submerged Lands – NBG

Location: NBG **Period of Performance:** SEP2018 - MAR2020

Project Objective

- Install, deploy, and maintain four conductivity-temperature-depth (CTD) mounting frames and four pH sensor mounting frames at four locations in Apra Harbor (e.g., Sasa Bay, Inner Harbor, Middle Harbor, and Outer Harbor), one CTD mounting frame and one pH sensor mounting frame at one location in Orote Peninsula ERA (e.g., Spanish Steps), one CTD mounting frame and one pH sensor mounting frame at one location in Haputo ERA (e.g., Double Reef), and one CTD mounting frame and one pH sensor mounting frame at one location in Naval Support AAFB (e.g., Pati Point Marine Preserve Area).
- Install, deploy, and maintain four CTD and four pH sensors at four locations in Apra Harbor (e.g., Sasa Bay, Inner Harbor, Middle Harbor, and Outer Harbor), one CTD and one pH sensor at one location in Orote Peninsula ERA (e.g., Spanish Steps), one CTD and one pH sensor at one location in Haputo ERA (e.g., Double Reef), and one CTD and one pH sensor at one location in AAFB (e.g., Pati Point Marine Preserve Area).
- Analyze water quality results, and examine the spatial and/or seasonal (temporal) variations in Apra Harbor, Orote Peninsula ERA, Haputo ERA, and AAFB.

Conservation Benefit

- Increase habitat for ESA-listed corals (e.g., *A. globiceps, A. retusa,* and *S. aculeata*)
- Support habitat areas of particular concern which align with Magnuson-Stevens Fishery Conservation Act for Essential Fish Habitat and the Marianas Fishery Ecosystem Plan

FY19 Status

- Abbreviated consultation (NOAA-NMFS) completed on 30MAY2019 and ACOE permits obtained 10 June 2019.
- CTD and pH sensors (Figures 78 - 79) deployed at Apra Harbor (e.g., Anchor Reef and Middle Shoals); Orote ERA (e.g., Blue Hole); Haputo ERA (e.g., Double Reef)

(Figure 80).

- CTD and pH sensors will be deployed at Inner Apra Harbor and Pati Point by OCT2019.

EPR: 1 S MAR JRM Marine Ecosystem Monitoring and Coral Reef Indicators (CHS); 61128NR168

2019 JRM INRMP Reference: MHM-1; 5-98



Figure 78. Conductivity-depth-temperature sensor mounted on a stainless steel frame.



Figure 79. SeaFET sensor mounted on a stainless steel frame.

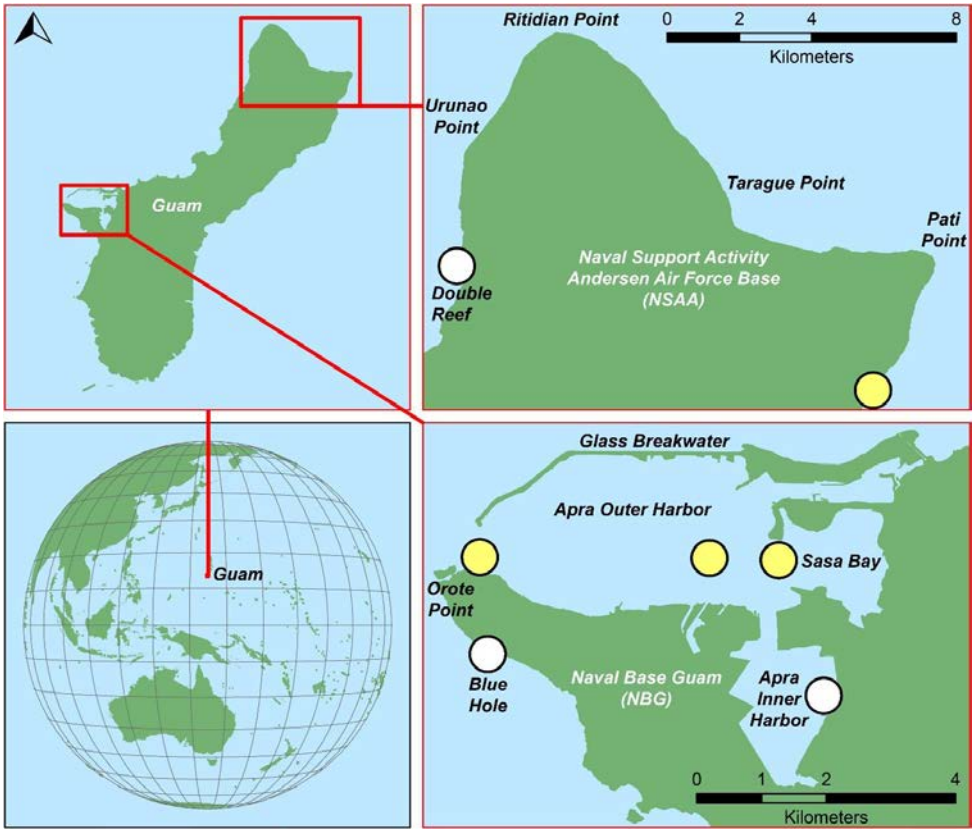


Figure 80. Deployment locations of water quality loggers. Yellow circles indicate sites for which previous water quality data is available and at which mounting frames are installed. White circles represent new monitoring stations.

Evaluate Mangrove Functionality in the Atantano Watershed

Location: NBG **Period of Performance:** SEP2018 - SEP2021

Project Objective

- Conduct an ecological assessment of the terrestrial and marine environments within Abo Cove.
- Identify an area within Abo Cove for a mangrove restoration demonstration project.
- Design a restoration project suited for the Abo Cove shoreline.

Conservation Benefit

- Increase habitat for ESA-listed species (e.g., sea turtles and scalloped hammerhead shark).
- Support habitat areas of particular concern which align with Magnuson-Stevens Fishery Conservation Act for Essential Fish Habitat and the Marianas Fishery Ecosystem Plan.

FY19 Status

- Field work (terrestrial and marine surveys) completed DEC2018
- Draft final report submitted MAY2019
- Final report will be completed by CY19

EPR: CHS JRM Evaluate and Enhance Mangrove Functionality of the Atantano Watershed to Protect Essential Fish Habitat and Coral Reefs; 61128NR656

2019 JRM INRMP Reference: MHM-3; 5-100



Figure 81. Map depicting the Abo Cove shoreline and location of the advanced feasibility study area.



Figure 82. Map depicting locations of terrestrial vegetation surveys.

Coral Protection and Mooring Buoy Installation - NBG

Location: NBG **Period of Performance:** SEP2019 - SEP2020

Project Objective

- Determination of suitable anchor placement sites, procurement and assembly of apparatus, and installation of Shallow Water Mooring Systems (SWMS) within Apra Harbor, Orote Peninsula, and Outer Breakwater sites.
- Provide secure vessel attachment points at popular SCUBA/snorkel/fishing locations used by recreation and commercial boaters.

Conservation Benefit

- Increase habitat for ESA-listed corals (e.g., *A. globiceps, A. retusa*, and *S. aculeata*).
- Support habitat areas of particular concern which align with Magnuson-Stevens Fishery Conservation Act for Essential Fish Habitat and the Marianas Fishery Ecosystem Plan.

FY19 Status

- Installation of 20 mooring buoys complete (Figure 83).
- Annual maintenance and inspections required.

EPR: 1 CP MAR NBG Coral Protection Buoys; 61755NR849

2019 JRM INRMP Reference: MHM-1; 8-62



Figure 83. Map depicting locations of mooring buoys in and around Outer Apra Harbor, NBG.

Monitoring and Control of Acute Impacts on Coral Reefs in Outer Apra Harbor and Orote Peninsula and Haputo Ecological Reserve Areas (ERAs)

Location: NBG; NBG TS **Period of Performance:** SEP2017 - SEP2019

Project Objective

- Host crown of thorns starfish (COTS) training workshops for Navy EXWC and NBG Dive Locker divers, JRM/NBG Natural Resource Marine Specialists, and Guam. COTS Response Team partners lead by a COTS expert; one classroom and one in-water skills COTS training workshop to include overview of COTS ecology and history on Guam, pre-culling surveillance methods, culling guidelines, and post-culling monitoring techniques.
- Implement a monitoring program for the detection of coral stressors and COTS/marine nuisance species control within Outer Apra Harbor, and Orote and Haputo ERAs.

Conservation Benefit

- Increase habitat for ESA-listed corals (e.g., *A. globiceps*, *A. retusa*, and *S. auleata*).
- Support habitat areas of particular concern which align with Magnuson-Stevens Fishery Conservation Act for Essential Fish Habitat and the Marianas Fishery Ecosystem Plan.

FY19 Status

- COTS classroom and in-water skills training completed with NBG Dive Locker and NAVFAC Marianas Marine Resources SMEs on FEB2019.
- Pre-bleaching surveys completed JULY2019; Peak-bleaching and post-bleaching surveys currently ongoing.
- Exercised the 12-month option year to increase sampling effort.

EPR: 1 S MAR NBG Marine Ecosystem Monitoring and Coral Reef Indicators (CHS); 61755NR168

2019 JRM INRMP Reference: MHM-1; 5-98

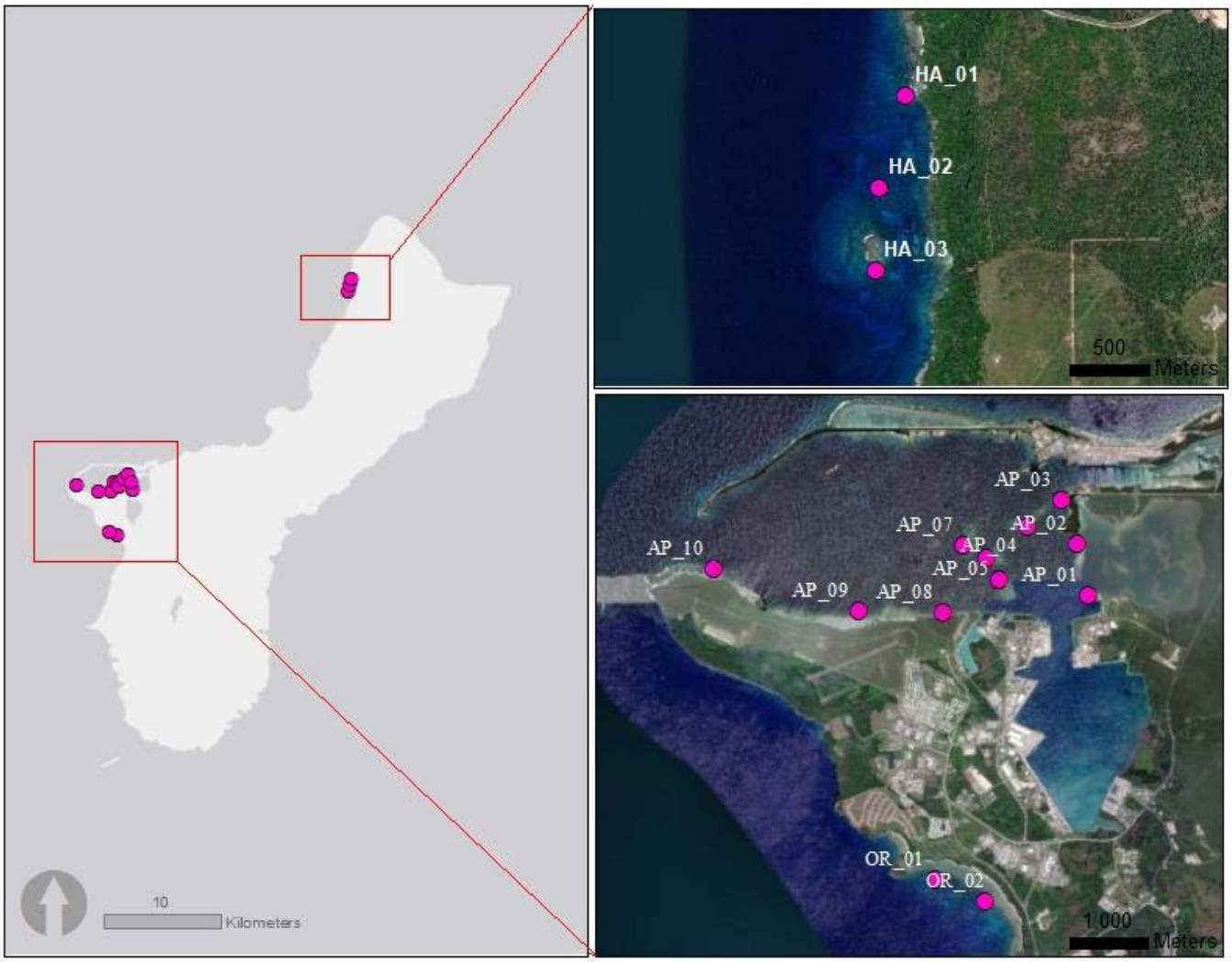


Figure 84. Map depicting survey sites at Apra Harbor, Orote ERA, and Haputo ERA.

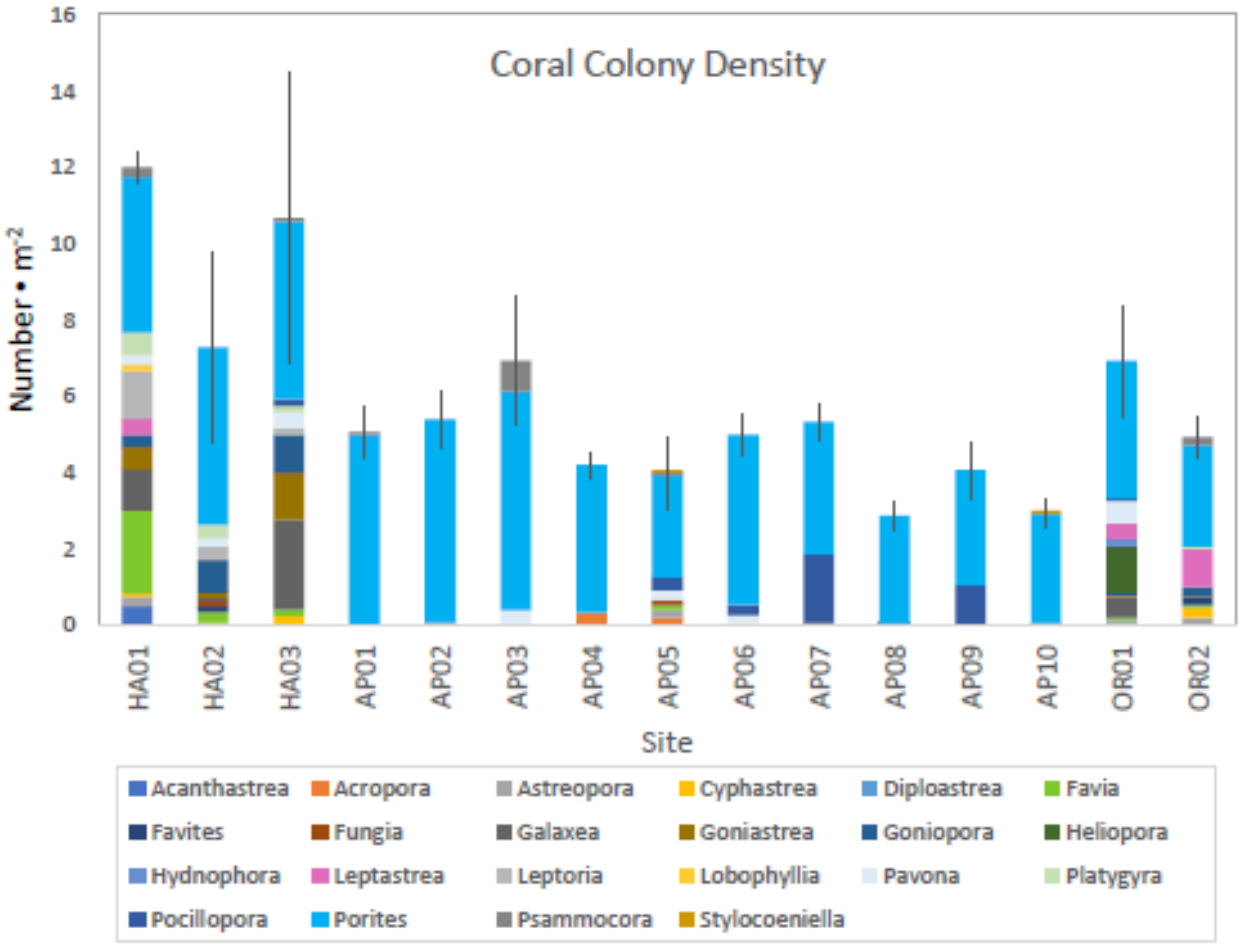


Figure 85. Mean coral colony density for each survey site. Error bars represent standard error for the overall coral density at each site.

FDM Fish Video Analyses – FDM

Location: FDM **Period of Performance:** SEP2018 - SEP2020

Project Objective

- Analyze twelve hours of fisheries videos using the appropriate desktop analysis software (e.g. VidSync or Image J).
- Submit a species list and species plot, number of observations/minimum abundance at six sites and estimate size class for fish assemblages if determinable, and comparisons of fish assemblages by site.

Conservation Benefit

- Increased habitat for ESA-listed corals (e.g. *A. globiceps*, *A. retusa*, and *S. auleata*).
- Support habitat areas of particular concern which align with Magnuson-Stevens Fishery Conservation Act for Essential Fish Habitat and the Marianas Fishery Ecosystem Plan.

FY19 Status

- Final report received AUG2019; final comments completed
- Final report will be available FY20

EPR: 1 S MAR JRM Marine Ecosystem Monitoring and Coral Reef Indicators (CHS); 61128NR168

2019 JRM INRMP Reference:
MHM-2; 12-40

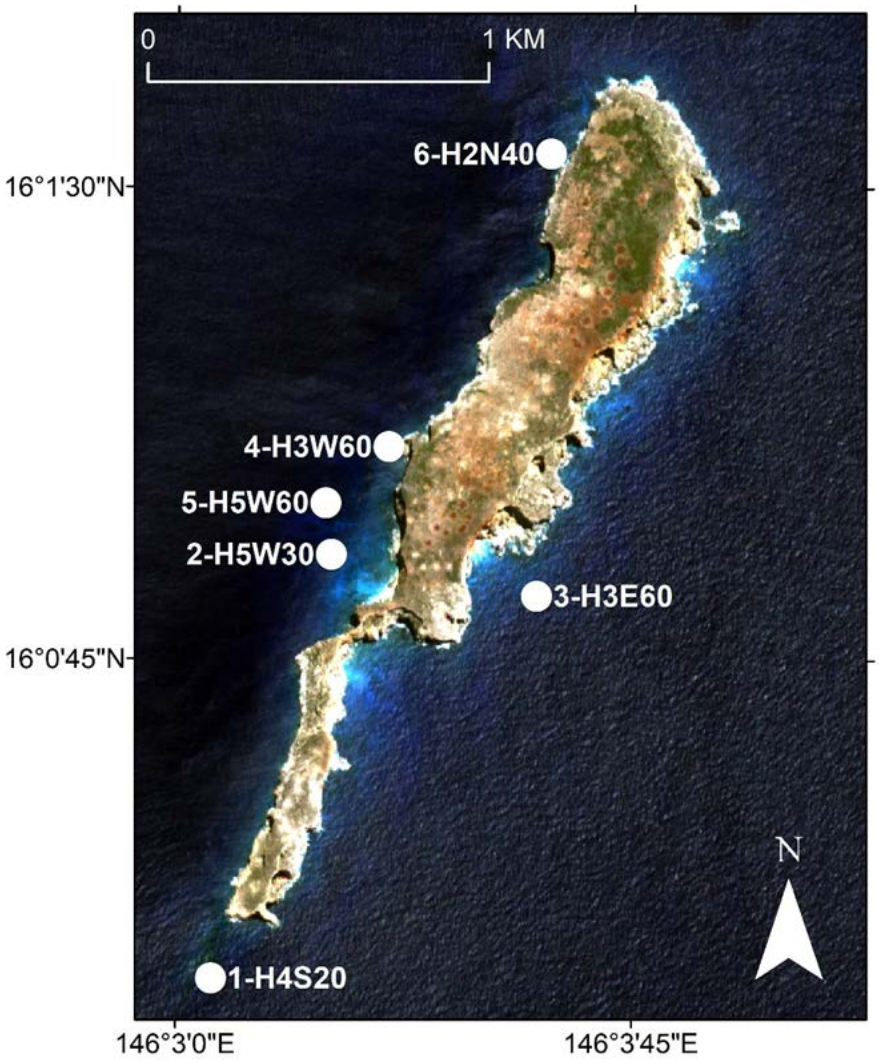


Figure 86. Map of FDM depicting the six locations where SCUBA divers collected fish video data that were analyzed in the present report.

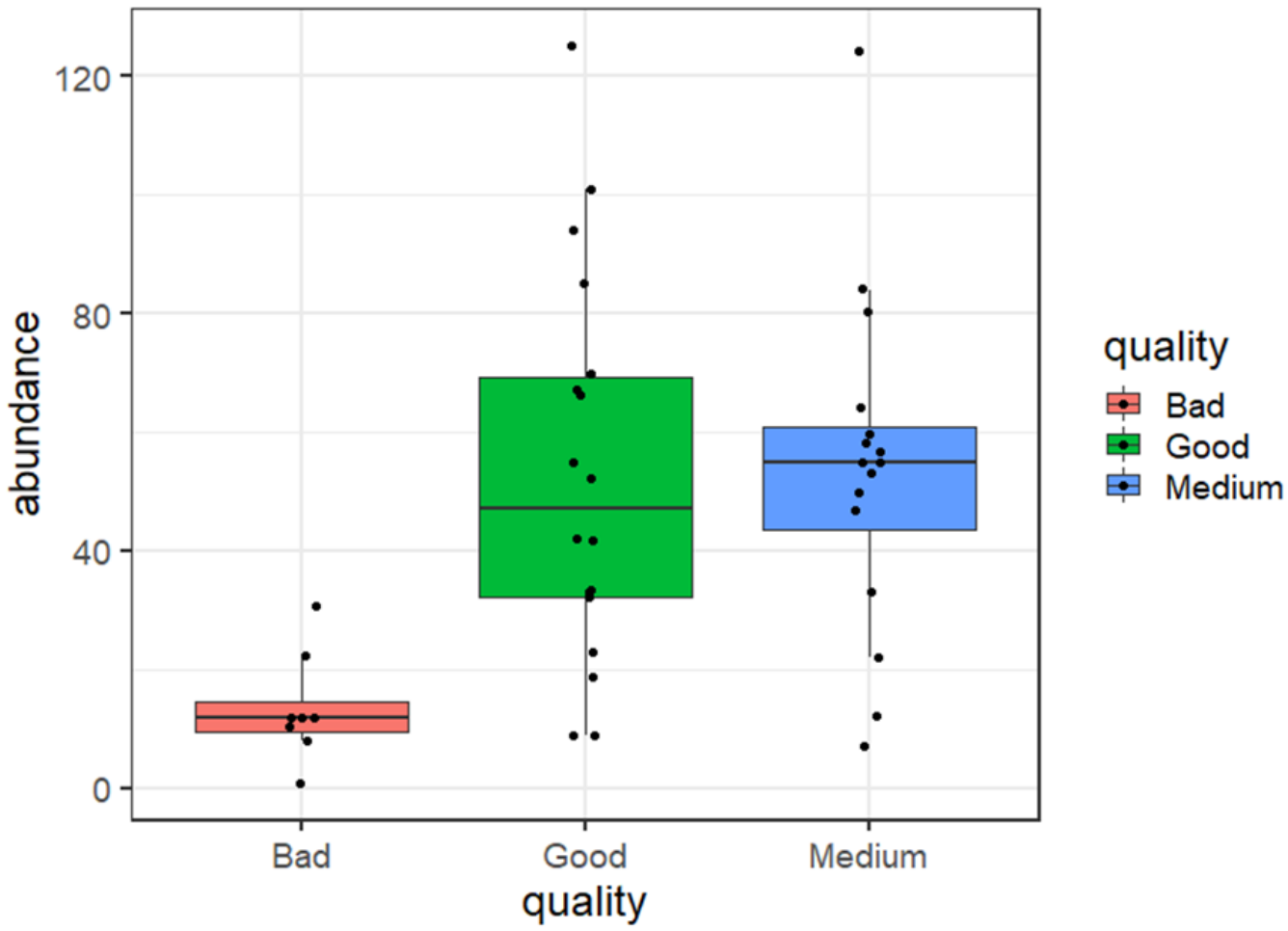


Figure 87. Total abundance of fish recorded per replicate video based upon the subjectively defined video quality.

Marine Protected Species Management

Sea Turtle Distribution and Habitat Use

Location: NBG **Period of Performance:** AUG2018 - SEP2021

Project Objective

- Conduct marine turtle surveys and in-water captures of green turtles (*Chelonia mydas*) and hawksbill turtles (*Eretmochelys imbricata*) in the nearshore waters of Guam and CNMI.
- Captured turtles are weighed, measured, biopsied, and tagged (i.e., flipper, PIT, satellite tracking) in an effort to expand our knowledge of the population demographics, population structure, and fine-scale habitat use of the turtles.
- Blood samples are also collected for two studies: 1) hormone analysis to determine population sex ratios, and 2) metabolite analysis to determine nutritional/feeding state.

Conservation Benefit

- To understand the movements of Guam and CNMI foraging populations of sea turtles to maintain or increase sea turtle populations and enhance and restore habitat.
- To collect data on the morphology and genetics of the nearshore sea turtle population.

FY19 Status

- This work is conducted through an Interagency Agreement (NMFS-PIC-18-007) between NOAA-PISF and JRM. The original agreement was from August 2016 – July 2019. The new agreement extends to September 2021.
- Twenty-four satellite tags were deployed on green and hawksbill turtles during small boat-based marine turtle surveys of Apra Harbor, Orote Point, Glass Breakwater, Dadi, and Tipalao conducted in 2016 through 2018.
- The small boat based surveys and deployed satellite tags provide information on general habitat use, home range, and core area for turtles tagged in each location.
- Deployed tags also record information on dive depth and temperature use which will be provided in the reports.

- In June 2019 a total of 12 satellite tags were deployed in the areas of Apra Harbor/Orote Point and Double Reef on foraging turtles (Table 12, Figure 88).
- A final report will be available in February 2020.

EPR: 1 S CP MAR NBG Sea Turtle Distribution and Habitat Use; 61755NR815

2019 JRM INRMP Reference:

Table 12. Summary of in-water survey effort, observations, captures, and satellite tags deployed in June 2019.

			Observations				**Captures**		**Sat. Tags**	
Date	**Island**	**Location**	***Cm***	***Ei***	***Unk***	***Cet.***	***Cm***	***Ei***	***Cm***	***Ei***
6/4	Guam	Apra Harbor/Orote Point	15	2	0	0	4	2	4	2
6/5	Guam	Apra Harbor/Orote Point	11	2	0	0	4	1	3	0
6/7	Guam	Double Reef	4	2	2	0	0	2	0	2
6/8	Guam	Double Reef/Haputo	6	2	0	0	1	0	1	0
6/9	Guam	Double Reef/Haputo	6	3	0	0	0	0	0	0
Totals			42	11	2	0	9	5	8	4
TURTLES			**55 observations**				**14 captures**		**12 sat. tags**	

Cm = green turtle (Chelonia mydas). Ei = hawksbill turtle (Eretmochelys imbricata).
Unk. = unknown turtle species (either Cm or Ei). No cetaceans (Cet.) were observed during these surveys.

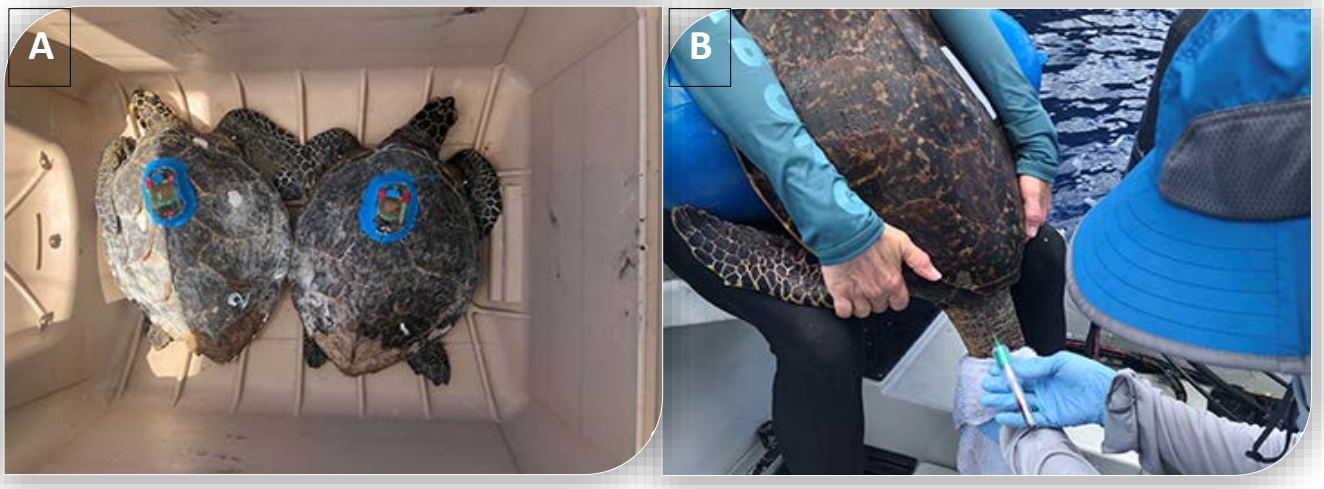


Figure 88. A: Two hawksbills captured and equipped with satellite tags at Double Reef, along the northwest coast of Guam. B: Drawing blood from a hawksbill turtle onboard the research vessel.

Detection of Scalloped Hammerhead Sharks in Apra Harbor and Adjacent Nearshore Waters using Environmental DNA (eDNA)

Location: NBG **Period of Performance:** SEP2017 - SEP2020

Project Objective

- Collect and filter marine water samples at five targeted locations within Apra Harbor and Orote ERA.
- Develop primers designed to amplify only scalloped hammerhead shark DNA.
- Assess ability to extract and detect shark DNA, and other threatened fish species (e.g., humphead wrasse and bumphead parrotfish) through targeted quantitative Polymerase Chain Reactions and metabarcoding analyses.
- Analyze eDNA results to determine the spatial and temporal presence of scalloped hammerhead sharks in Apra Harbor and Orote ERA.

Conservation Benefit

- Increase habitat for ESA-listed species (e.g., scalloped hammerhead shark).

- Support habitat areas of particular concern which align with Magnuson-Stevens Fishery Conservation Act for Essential Fish Habitat and the Marianas Fishery Ecosystem Plan.

FY19 Status

- Samples are being collected and preliminary eDNA is being extracted by the UOG Marine Lab; purified DNA samples are sent to James Cook University for analyses.
- Exercised option year one (12 months) to increase sample size(s) and complete analyses.

EPR: 1 S MAR NBG Scalloped Hammerhead Shark (*Sphyrna lewini*) Survey; 61755NR891

2019 JRM INRMP Reference: MPS-1; 8-65

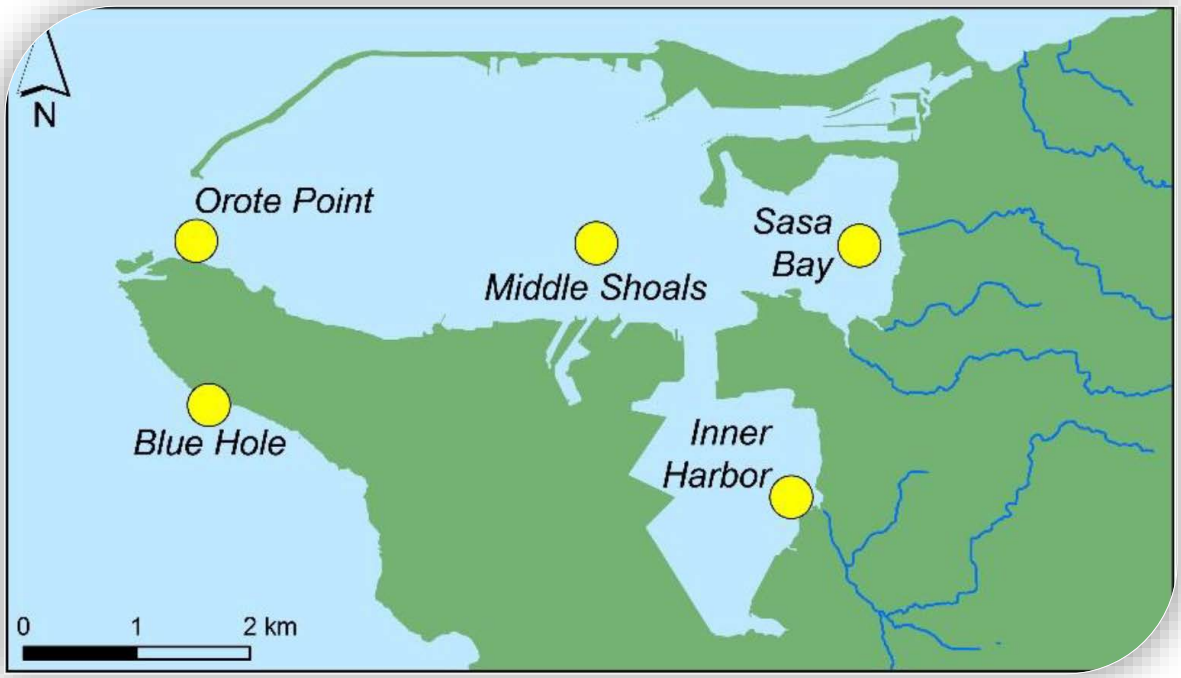


Figure 89. Proposed sampling locations for the detection of scalloped hammerhead eDNA within Apra Harbor and Orote ERA.

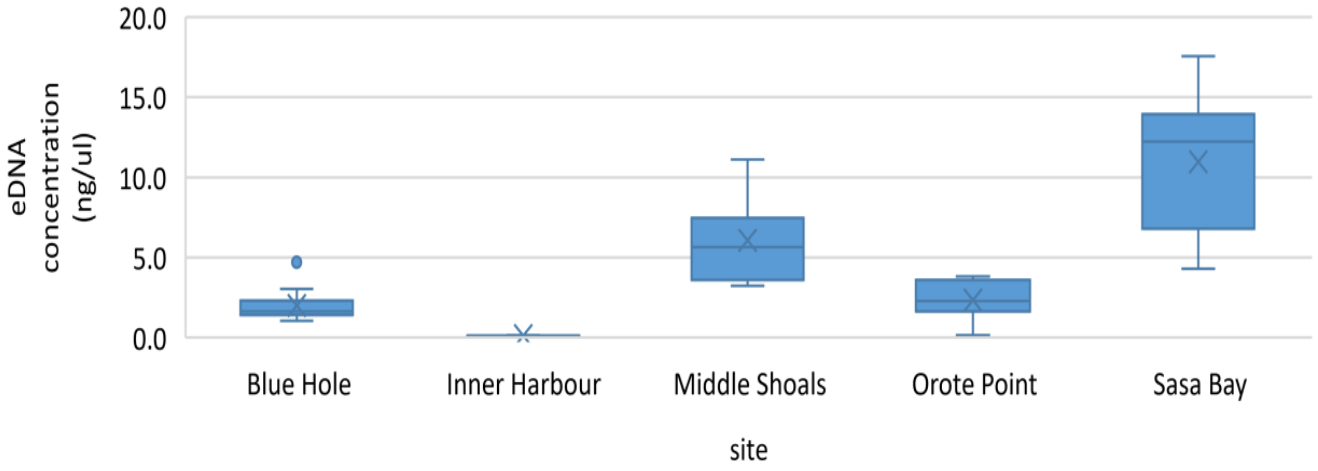


Figure 90. Mean total eDNA concentration for the Jul 2019 samples for each study site. Note: Inner Harbor samples were not collected in July.



Figure 91. Total eDNA concentration for each field sample (BH: Blue Hole, IH: Inner Harbor, MS: Middle Shoals, OP: Orote Point, SB: Sasa Bay) for the Apr 2019 samples for each study site.

Sea Turtle Aerial Surveys in FDM Nearshore Waters

Location: FDM **Period of Performance:** SEP2018 - MAR2020

Project Objective

- Design aerial transect surveys to determine sea turtle and marine mammal abundances and distributions in the nearshore waters surrounding FDM.
- Conduct aerial surveys for sea turtle and marine mammal identifications, abundances, and distributions in the nearshore waters surrounding FDM.
- Analyze sea turtle and marine mammal identifications, abundances, and distributions in the nearshore waters surrounding FDM.

Conservation Benefit

- Increase habitat for ESA-listed species (e.g., sea turtles and marine mammals).
- Support habitat areas of particular concern which align with Magnuson-Stevens Fishery Conservation Act for Essential Fish Habitat and the Marianas Fishery Ecosystem Plan.

FY19 Status

- Surveys were postponed due to Typhoon Yutu which hit the CNMI on OCT2018
- First successful survey completed on SEP2019.
- Continue with one survey per month; increase to two surveys per month by JAN2020.

EPR: CNMI Ecosystem and Protected Species Monitoring and Management: Sea Turtle Distribution and Habitat Use in FDM Nearshore Waters (emergent); 61128NR851

2019 JRM INRMP Reference: MPS-1; 12-41

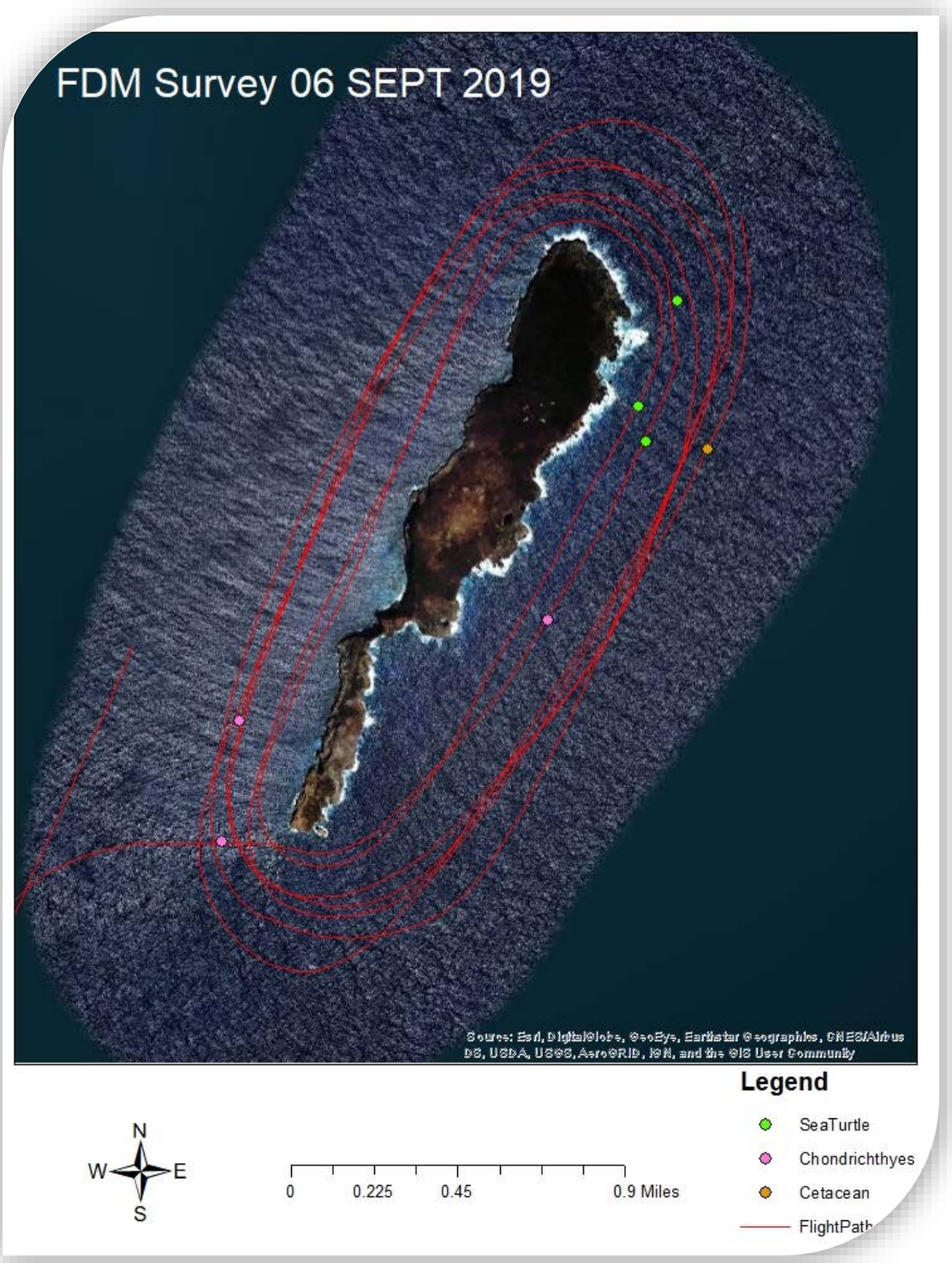


Figure 92. Map of FDM depicting pre-planned transects (green) and actual location of the aircraft during the survey at pre-determined reference points.

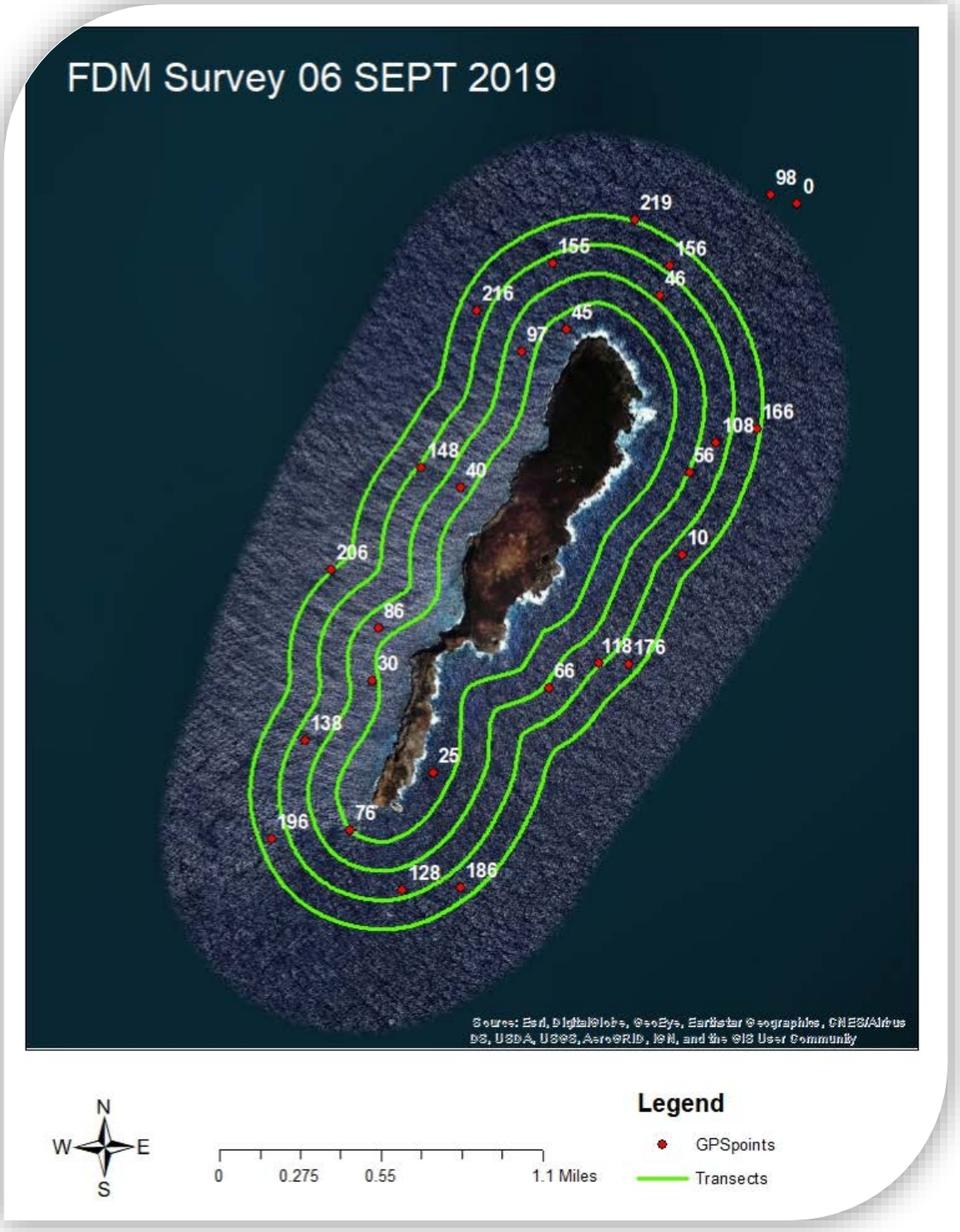


Figure 93. Map of FDM depicting the approximate location of marine fauna around the island.

Horeg, Jennifer A CIV USN NAVFAC

Subject:	FY19 JRM INRMP Guam Metrics Meetings 15-16 October - Call-in number: 1-210-280-4353 or 1-866-423-7391, Participant Code: 4645531#
Location:	Outrigger Guam Resort - Fort Santa Cruz Room
Start:	Tue 10/15/2019 8:00 AM
End:	Wed 10/16/2019 4:00 PM
Show Time As:	Tentative
Recurrence:	(none)
Meeting Status:	Not yet responded
Organizer:	Horeg, Jennifer A CIV USN NAVFAC
Required Attendees:	'tinoaguon'; Diane L. Vice; 'Chelsa.MunaBrecht@doag.guam.gov'; 'Joseph S. Mafnas'; 'raina92@gmail.com'; 'Laura Duenas'; Jeffrey S. Quitugua; Jay T. Gutierrez; Weisenberger, Lauren; 'Jacqueline Flores'; CJ Cayanan; 'Brent Tibbatts'; Suzanne Medina; Galsim, Ferdinand; Heather Benedict; 'Katherine Mullett'; Kevin Brindock - NOAA Federal (kevin.brindock@noaa.gov); Anthony Montgomery; Stephen Miller; Tyler Willsey; Toni Mizerek; 'Arlene Pangelinan'; 'steven.mckagan@noaa.gov'; 'Summers, Tammy'; 'Donmoyer, Kevin'; 'benton_pang@fws.gov'; Lujan, Dana T CIV USN NAVFACMAR; Hanser, Sean F CIV NAVFAC PAC, EV (sean.hanser@navy.mil); Moon, Edward E CIV USN NAVFAC; jeffrey.laitila@us.af.mil; Lambrecht, Jeffrey L CIV USN NAVFACMAR; Rice, Jacqueline D I&L, MCICOM; Garcia, Shermaine Nicole A CIV USN NAVFAC; Alig, Franklin J CIV USN NAVFAC; Reyes, Andres J CIV USN NAVFAC; Hall, Marc A CIV USN NAVFAC; Parker, Megan A CIV USN NAVFAC; Mosher, Stephen M CIV NAVFAC; Santos, Maria L. CIV USN NAVFACMAR; 'RIEFFANAUGH, AARON M GS-12 USN PACAF 36 CES/CEV'; 'christopher.kane.13@us.af.mil'; 'BRUNSON, CATHERINE E GS-12 USN PACAF 36 CES/CEV'; 'ARCEO, CANDICE S GS-05 USAF PACAF 36 CES/CEV'; Vogt, Scott R. CIV USN NAVFACMAR (Scott.Vogt@fe.navy.mil); Colt, Ann M CIV USN NAVFAC; Gutierrez, Lauren E CIV USN NAVFAC; Tareyama, Sheeka A CIV USN NAVFAC; Loerzel, Adrienne M CIV USN NAVFAC; Mendiola, Bertina M CIV NAVFAC; 'Salas, Joshua J CIV USN NAVFAC'; Foster, Phatchanuch W CIV USN NAVFAC; 'Olmsted, Nicole M CIV USN NAVFAC PAC PEARL HI (USA)'; Brasuell, Timothy CIV USN JRM; Sablan, Randel L CIV USN JRM
Optional Attendees:	Vinch, Joseph M CIV USN NAVFACMAR; 'Conkle, Tamara S CIV NAVFAC HQ, EV'; 'Oelke Farley, Jennifer L CIV NAVFAC HQ, EV'; 'Juola, Frans A CIV NAVFAC Pacific, EV (frans.juola@navy.mil)'; 'Kieran-Vast, Angela CIV USN NAVFAC PAC PEARL HI (USA)'; 'Cobb, Coralie H CIV USN (USA)'; Banes, Rolfe G CIV USN NAVFACMAR; Borja, Albert T CIV USN NAVFACMAR; Burrell, Noah S CIV USN NAVFAC

Hafa Adai Resource Partners,

The FY19 JRM INRMP Guam Metrics Meetings will be held October 15 and 16 at the Outrigger Guam Resort in the Fort Santa Cruz Room from 8:00 am to 4:00 pm. Please see the attached draft agenda.

For those who cannot be present during the meetings, please use the following telecom information:

- Call-in number: 1-210-280-4353 or 1-866-423-7391, Participant Code: 4645531#

The FY19 JRM INRMP Project Summary Report, Metrics Partner Report, and project presentation slides are forthcoming.

Please forward this to anyone I may have missed. If you have any questions feel free to contact me. Thank you and I look forward to seeing you all soon!

Best,

Jennifer Cruce Horeg
Conservation Resources Program Manager
Joint Region Marianas - NAVFACMAR
(671) 339-2573

The Natural Resources Conservation Metrics is a DoD requirement to review and gather information on the Natural Resources Program and the Integrated Natural Resources Management Plan.
- Ensures each region or installation is preparing, maintaining, and implementing its Integrated Natural Resources Management Plan.
- Support Endangered Species Act (ESA) expenditure reporting to Congress and other media related data collection.
- Inform and contribute to information collected for the Defense Environmental Program Annual Report to Congress.
- Data collected during the Metrics informs DoD and Navy chains of command regarding the status of the Navy's Natural Resources Programs.



FY19 JRM INRMP GUAM METRICS

FORT SANTA CRUZ ROOM

OUTRIGGER GUAM RESORT

16-17 OCTOBER 2019
ALL TIMES ARE CHAMORRO STANDARD TIME

Conference Call Information: 1-210-280-4353 or 1-866-423-7391
Participant Code: 4645531#

SIGN-IN
16 OCTOBER 2019

	NAME	AGENCY	Phone #	Email
1	HALL, Marc	NAVFACMAR	339-2349	Marc.hall@fe.navy.mil
2	BURRELL, NOAH	NAVFACMAR	339-5310	noah.burrell@fe.navy.mil
3	LOERZEL, ADRIENNE	MCAG	355.3420	adrienne.loerzel@fe.navy.mil
4	Tareyama, Sheeka	MCAG	355.3420	sheeka.tareyama@fe.navy.mil
5	REYES, ANDRES J	NFM	333-1104	andres.reyes@gmail.com
6	Vogt Scott	Navfacmar	339-2198	scott.vogt@fe.navy.mil
7	Aaron Rieffanaugh	Andersen AFB	366-5058	aaron.rieffanaugh@us.af.mil
8	Cat Brunson	AAFB	366-5012	catherine.brunson@us.af.mil
9	CHRIS KANE	NAVFAC MAR	366-5078	CHRISTOPHER.KANE.13@US.AF.MIL
10	ARCEO, CANDICE	AAFB	366-2726	candice.arceo@us.af.mil
11	PARKER, MEGAN	NAVFACMAR	339-2344	MEGAN.PARKER@FE.NAVY.MIL
12	ALIG, FRANK	NAVFACMAR	339-5621	FRANKLIN.ALIG@FE.NAVY.MIL
13	Garcia, Shermaine	NAVFACMAR	339-5620	shermaine.garcia@fe.navy.mil
14	Teo Aguon	DAWR	735-0283	Celestino.Aguon@dawr.gov.gu
15	Thomas Flores	Agriculture	735-0281	Thomas.FloresJr@doag.gu
16	LAUREN GUTIERREZ	MCAG	355-8050	lauren.gutierrez@fe.navy.mil
17	MARIO SANTOS	NFM	339-5148	Maria.santos@fe.navy.mil
18	Kevin Brindock	NOAA-NMFS	808-725-5146	kevin.brindock@noaa.gov
19	Stephen Mosher	NAVFAC MAR	671-349-2349	stephen.mosher@fe.navy.mil
20	JACQUELINE FLORES	USFWS - MARIANAS	671-989-6744	jacqueline-flores@fws.gov

FY19 JRM INRMP GUAM METRICS

SIGN-IN
16 OCTOBER 2019

	NAME	AGENCY	Phone #	Email
21	JOHN WEBER	USFWS	808-792-9400	John_S_Weber@fws.gov
22	JOE MAFNAS	Guam DoAg FSAD	300-7975	or file
23	Laura Duenas	DOAg - DAWR	735-3997/8	Laura.Duenas@doag.guam.gov
24	Tano Aguon	DAWR	735-0283	Celestino.guon@doag.guam.gov
25	DIANE VICE	DAWR	488-7245	dianevice@doag.guam.gov
26	Tammy Summers	USFWS	747-7560	tammy-summers@fws.gov
27	Chelsa Muña-Brecht	DOAG	488-8384	chelsa.munabrecht@doag.guam.gov
28	Suzanne Med	Ag DAWR	735-3998	Medinasuzanne@gmail.com
29	Jeff Quitugua	DAWR	735-0294	jeffrey.quitugua@doag.guam.gov
30	Jennifer Horeg	NAVFACMAR	339-7348	Jennifer.horeg@fenavy-f
31	DANA LUJAN	NAVFACMAR	333-1185	dana.lujan@fe.navy.mil
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FY19 JRM INRMP GUAM METRICS

FORT SANTA CRUZ ROOM

OUTRIGGER GUAM RESORT

16-17 OCTOBER 2019
ALL TIMES ARE CHAMORRO STANDARD TIME

Conference Call Information: 1-210-280-4353 or 1-866-423-7391
Participant Code: 4645531#

SIGN-IN
17 OCTOBER 2019

	NAME	AGENCY	Phone #	Email
1	Akimi King	USFWS	483-1044	akimi_king@fws.gov
2	Cat Branson	NAVFAC/AAFB	366-5012	catherine.branson@us.af.mil
3	Candice Arceo	NAVFAC	366-2726	candice.arceo@us.af.mil
4	CHRIS KANE	NAVFAC	366-5078	CHRISTOPHER.KANE.13@us.af.mil
5	Scott Vogt	NAVFAC	339-2198	scott.vogt@fe.navy.mil
6	Adrienne Loerzel	MCAG	355. 8420	adrienne.loerzel@fe.navy.mil
7	Sheeka Tareyama	MCAG	3558420	sheeka.tareyama@fe.navy.mil.
8	Aaron Rieffenaugh	NAVFAC	366-5058	aaron.rieffenaugh@us.af.mil
9	FRANK MCLG	NAVFAC	339-5621	franklin.alig@FE.NAVY.MIL
10	Celestino Agaon	DAWR	735-0283	Celestino.Agaon@doag.guam.gov
11	Thomas Flores	Agriculture	735028/	Thomas.floresjr@doag.guam.gov
12	Megan Parker	NAVFACMAR	339-2344	megm.parker@fe.navy.mil
13	HALL, MARC	NAVFACMAR	339-2349	marc.hall@fe.navy.mil
14	Stephen Mosher	NAVFACMAR	349-2349	stephen.mosher@fe.navy.mil
15	BURRELL, NOAH	NAVFACMAR	339-5310	noah.burrell@fe.navy.mil
16	Kevin Brindack	NOAA-NMFS	808-725-5146	kevin.brindack@noaa.gov
17	JOHN WEBER	USFWS	808-792-9490	JOHN_S_WEBER@FWS.GOV
18	JACQUELINE FLORES	USFWS	671-989-6744	jacqueline_flores@fws.gov
19	[illegible]	DAWR	735-3958	[illegible]
20	Nathaniel Martin	DAWR	735-0291	nathanemartin@hotmail.com

NOT FIRST

FY19 JRM INRMP GUAM METRICS

SIGN-IN

17 OCTOBER 2019

	NAME	AGENCY	Phone #	Email
21	DIANE VICE	DAWR	488-7245	diane.vice@dawg.guam.g
22	Jennifer Horeg	NAUFACMAR	339-7348	Jennifer.horeg@fe.navy.mi
23	DANA LUJAN	NAUFACMAR	ON FILE	ON FILE
24	MARIO SANTOS	NFM	339-5148	maria.santos@fe.navy.mil
25	Shermaine Garcia	NFM	339-5620	shermaine.garcia@fe.navy.
26	ANDRES J. REYES	NFM	333-1104	andres.reyes@fe.navy.mi
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Horeg, Jennifer A CIV USN NAVFAC

From: Horeg, Jennifer A CIV USN NAVFAC
Sent: Tuesday, October 22, 2019 4:18 PM
To: Tyler Willsey; Stephen Miller; benton_pang@fws.gov; Anthony Montgomery; steven.mckagan@noaa.gov; Arlene Pangelinan; james stubbs (james.stubbs@noaa.gov); Katherine Mullett; Jacqueline Flores; Toni Mizerek; Donmoyer, Kevin; Kevin Brindock - NOAA Federal (kevin.brindock@noaa.gov)
Cc: Weber, John; Conkle, Tamara S CIV NAVFAC HQ, EV; Ruszala, Brad E CIV USN JRM; Brasuell, Timothy CIV USN JRM; Hanser, Sean F CIV NAVFAC PAC, EV (sean.hanser@navy.mil); Juola, Frans A CIV NAVFAC Pacific, EV (frans.juola@navy.mil); Alig, Franklin J CIV USN NAVFAC; Mosher, Stephen M CIV NAVFAC; Santos, Maria L. CIV USN NAVFACMAR; Moon, Edward E CIV USN NAVFAC; Burrell, Noah S CIV USN NAVFAC; Lujan, Dana T CIV USN NAVFACMAR; Kieran-Vast, Angela CIV NAVFAC Pacific, EV; Vinch, Joseph M CIV USN NAVFACMAR; Reyes, Andres J CIV USN NAVFAC; Sablan, Randel L CIV USN JRM
Subject: FY19 JRM INRMP CNMI Metrics Meeting - Rescheduled 7 NOV 2019
Attachments: FDM FY19 JRM INRMP Metrics Partner Report.pdf; Tinian FY19 JRM INRMP Metrics Partner Report.pdf
Signed By: jennifer.horeg@fe.navy.mil

Importance: High

Hello Resource Partners,

We would like to reschedule the FY19 JRM INRMP CNMI Metrics Meeting in Saipan on Thursday, 7 November 2019. I will send an update with the meeting location. The call-in number will be: 1-210-280-4353 or 1-866-423-7391, Participant Code: 4645531#

I have also attached the FY19 JRM INRMP Metrics Partner Reports for your review and input. Each year we provide an annual update to ensure that we are meeting our commitment to implement the goals and objectives of the INRMP. The Annual Metrics meeting evaluates performance in the following focus areas:

- INRMP Implementation
- Listed Species and Critical Habitat
- Sikes Act Cooperation (Partnership Effectiveness)
- Recreational Use and Access
- Team Adequacy
- Natural Resources Management (Ecosystem Integrity)
- INRMP (Natural Resources Program) Support of the Installation Mission

Our natural resources (NR) managers have input answers into our NR Metrics website. We kindly ask that you review these assessments, which are the attached FY19 JRM INRMP Metrics Partner Reports for Tinian and FDM, and provide us your input. The reports show all possible responses, with the NR managers responses provided. To meet our annual deadlines, I ask that you provide any feedback by COB Thursday 14 November. If you have any questions

please feel free to call or email me.

I realize how busy you all are with your own programs and appreciate any feedback you area able to provide. Thank you and hope to see you at the meeting!

Best,

Jennifer Cruce Horeg
Conservation Resources Program Manager
NAVFAC Marianas
(671) 339-7348
Jennifer.horeg@fe.navy.mil

-----Original Message-----
From: Lujan, Dana T CIV USN NAVFACMAR
Sent: Saturday, October 19, 2019 5:15 PM
To: Horeg, Jennifer A CIV USN NAVFAC <Jennifer.Horeg@fe.navy.mil>; Tyler Willsey <tyler_willsey@fws.gov>; Stephen Miller <Stephen_E_Miller@fws.gov>; benton_pang@fws.gov; Anthony Montgomery <tony_montgomery@fws.gov>; steven.mckagan@noaa.gov; Arlene Pangelinan <arlene.pangelinan@noaa.gov>; james stubbs (james.stubbs@noaa.gov) <james.stubbs@noaa.gov>; Katherine Mullett <katherine_mullett@fws.gov>; Kieran-Vast, Angela CIV NAVFAC Pacific, EV <angela.kieranvast@navy.mil>; Reyes, Andres J CIV USN NAVFAC <Andres.Reyes@fe.navy.mil>; Santos, Maria L. CIV USN NAVFACMAR <maria.santos@fe.navy.mil>; Burrell, Noah S CIV USN NAVFAC <Noah.Burrell@fe.navy.mil>; Mosher, Stephen M CIV NAVFAC <Stephen.Mosher@fe.navy.mil>; Alig, Franklin J CIV USN NAVFAC <Franklin.Alig@FE.navy.mil>; Moon, Edward E CIV USN NAVFAC <Edward.Moon@fe.navy.mil>; Sablan, Randel L CIV USN JRM <Randel.Sablan@fe.navy.mil>; Hanser, Sean F CIV NAVFAC PAC, EV (sean.hanser@navy.mil) <sean.hanser@navy.mil>; Juola, Frans A CIV NAVFAC Pacific, EV (frans.juola@navy.mil) <frans.juola@navy.mil>; Conkle, Tamara S CIV NAVFAC HQ, EV <Tamara.Conkle@navy.mil>; Brasuell, Timothy CIV USN JRM <Timothy.Brasuell@fe.navy.mil>; Ruszala, Brad E CIV USN JRM <Brad.Ruszala@fe.navy.mil>; Vinch, Joseph M CIV USN NAVFACMAR <Joseph.Vinch@fe.navy.mil>; Jacqueline Flores <jacqueline_flores@fws.gov>; Toni Mizerek <toni_mizerek@fws.gov>; Donmoyer, Kevin <kevin_donmoyer@fws.gov>; Kevin Brindock - NOAA Federal (kevin.brindock@noaa.gov) <kevin.brindock@noaa.gov>
Cc: Weber, John <john_s_weber@fws.gov>
Subject: RE: FY19 JRM INRMP CNMI Metrics Meeting - Call-in number: 1-210-280-4353 or 1-866-423-7391, Participant Code: 4645531#

Good Afternoon Resource Partners,

Due to the potential impacts of Tropical Depression 22W and based on its current projection to be in the vicinity of the southern Mariana Islands on 21-22 Oct as a Category 1 typhoon, we have decided to postpone the Metrics meeting on 22 Oct. My apologies for any inconvenience this may have caused and we hope that if the storm does hit, it only impacts the Marianas

minimally.

We will be contacting our Partners for an alternative date.

Thank you.

v/r,

Mr. Dana T. Lujan

EV2, Conservation & Planning

NAVFACMAR/JRM

(671)333-1185

<<...>>

-----Original Appointment-----
From: Horeg, Jennifer A CIV USN NAVFAC
Sent: Friday, October 18, 2019 6:30 PM
To: Tyler Willsey; Stephen Miller; benton_pang@fws.gov; Anthony Montgomery; steven.mckagan@noaa.gov; Arlene Pangelinan; james stubbs (james.stubbs@noaa.gov); Katherine Mullett; Kieran-Vast, Angela CIV NAVFAC Pacific, EV; Reyes, Andres J CIV USN NAVFAC; Lujan, Dana T CIV USN NAVFACMAR; Santos, Maria L. CIV USN NAVFACMAR; Burrell, Noah S CIV USN NAVFAC; Mosher, Stephen M CIV NAVFAC; Alig, Franklin J CIV USN NAVFAC; Moon, Edward E CIV USN NAVFAC; Sablan, Randel L CIV USN JRM; Hanser, Sean F CIV NAVFAC PAC, EV (sean.hanser@navy.mil); Juola, Frans A CIV NAVFAC Pacific, EV (frans.juola@navy.mil); Conkle, Tamara S CIV NAVFAC HQ, EV; Brasuell, Timothy CIV USN JRM; Ruszala, Brad E CIV USN JRM; Vinch, Joseph M CIV USN NAVFACMAR; Jacqueline Flores; Toni Mizerek; Donmoyer, Kevin; Kevin Brindock - NOAA Federal (kevin.brindock@noaa.gov)
Cc: Weber, John
Subject: FY19 JRM INRMP CNMI Metrics Meeting - Call-in number: 1-210-280-4353 or 1-866-423-7391, Participant Code: 4645531#
When: Tuesday, October 22, 2019 8:30 AM-4:00 PM (UTC+10:00) Guam, Port Moresby.
Where: Saipan Army Reserve Center

Hafa Adai Resource Partners,

The meeting is still on schedule for Tuesday 22 October; however, the venue has been moved to the Saipan Army Reserve Center. I will provide presentation slides and an updated agenda prior to the meeting. Please let me know if you have any questions. Thank you and we look forward to seeing you soon!

Best,

Jennifer Cruce Horeg

Conservation Resources Program Manager

Joint Region Marianas - NAVFACMAR

(671) 339-2573

Hafa Adai Resource Partners,

The FY19 JRM INRMP CNMI Metrics Meetings will be held on Tuesday October 22 at the Hyatt Regency Saipan in the Chamolinian Room from 8:15 am to 4:00 pm. Please see the attached draft agenda.

For those who cannot be present during the meetings, please use the following telecom information:

- Call-in number: 1-210-280-4353 or 1-866-423-7391, Participant Code: 4645531#

The FY19 JRM INRMP Project Summary Report, Metrics Partner Report, and project presentation slides are forthcoming.

Please forward this to anyone I may have missed. If you have any questions feel free to contact me. Thank you and we look forward to seeing you all soon!

Best,

Jennifer Cruce Horeg

Conservation Resources Program Manager

Joint Region Marianas - NAVFACMAR

(671) 339-2573

The Natural Resources Conservation Metrics is a DoD requirement to review and gather information on the Natural Resources Program and the Integrated Natural Resources Management Plan.

- Ensures each region or installation is preparing, maintaining, and implementing its Integrated Natural Resources Management Plan.

- Support Endangered Species Act (ESA) expenditure reporting to Congress and other media related data collection.

- Inform and contribute to information collected for the Defense Environmental Program Annual Report to Congress.

- Data collected during the Metrics informs DoD and Navy chains of command

regarding the status of the Navy's Natural Resources Programs.

<< File: FY19 JRM INRMP CNMI Metrics Agenda 22 OCT 2019.pdf >>

FY19 JRM INRMP CNMI METRICS

GIOVANNI'S ROOM

HYATT REGENCY SAIPAN

7 NOVEMBER 2019
ALL TIMES ARE CHAMORRO STANDARD TIME

Conference Call Information: 1-210-280-4353 or 1-866-423-7391
Participant Code: 4645531#

SIGN-IN
7 NOVEMBER 2019

	NAME	AGENCY	Phone #	Email
1	ANDRES J. REYES	NAVFAC MAR	671-333-1104	andres.reyes@fe.navy.mil
2	Stephen Mullin	DFW	670-285-9482	Smullin.cnmi.dfw@gmail.com
3	STEVE McKAGAN	NOAA	670 234-0004	STEVEN.MCKAGAN@NOAA.GOV
4	Emilie Kohler	DFW	6707630471	Kohler.dfw@gmail.com
5	BRAD RUSZAKA	JRM	670 287-2723	brad.ruszaka@fe.navy.mil
6	Gil Birnbrich	Gov/CNMI	783-4152	gil.birnbrich@gov.mp
7	MICHAEL NOAH	JRM	349-1104	michael.noahe fe.navy.mil
8	Harry Elliott	JRM	349-2021	harry.elliotte fe.navy.mil
9	Michael Tenorio	CNMI-DFW	664-6044	mtenorio_dfw@live.com
10	Trey Dunn	CNMI DFW	6646044	Tdunn.dfw@gmail.com
11	Shane Abbara	CNMI DFW	4839793	Sabbara.cnmidfw@gmail.com
12	Lisa Szteiter	DLNR		
13	Noah Burrell	NAVFACMAR	685-4580	noah.burrell@fe.navy.mil
14	Dane Lujan	NAVFACMAR	671-333-1185	dane.lujan@fe.navy.mil
15	FRANK ALIG	NAVFACMAR	671-339-5621	franklin.alig@fe.navy.mil
16	Jennifer Horeg	NAVFACMAR	671-339-7348	Jennifer.horeg@fe.navy.mil
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D2 2020 Annual Report

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DEPARTMENT OF THE NAVY
JOINT REGION MARIANAS
PSC 455 BOX 211
FPO AP 96540-1000

5090
Ser J4/0073
25 Jan 21

From: Commander, Joint Region Marianas

Subj: FISCAL YEAR 2020 NATURAL RESOURCES/INTEGRATED NATURAL RESOURCES MANAGEMENT PLAN METRICS SUMMARY REPORT

Ref: (a) OPNAV-M-5090.1
(b) OPNAVINST 5090.1E

Encl: (1) FY 2020 Natural Resources INRMP Metrics Results
(2) JRM INRMP Summary of FY20 Projects
(3) FY 2020 Natural Resources INRMP Metrics Invitation and Attendee List

1. In accordance with reference (a), Navy installations are required to submit an annual report summarizing the recent Natural Resources/Integrated Natural Resources Management Plan (INRMP) Metrics meeting and status of the INRMP.

2. The Fiscal Year (FY) 20 Joint Region Marianas (JRM) Natural Resources/INRMP Metrics meeting for Commonwealth of the Northern Mariana Islands (CNMI) resource partners was held virtually on September 18, 2020 and the JRM INRMP Metrics meeting for Guam resource partners was held virtually on September 22 and 23, 2020 via MS Teams. Enclosures (1) through (3) are provided for your review.

3. The Final 2019 JRM INRMP was finalized and signed by partner agencies (US Fish and Wildlife Service, National Marine Fisheries Service, Guam Department of Agriculture, and CNMI Department of Land and Natural Resources-Division of Fish and Wildlife) between June - August 2019. Annual updates are conducted each calendar year which began in 2020. A 5-year review for operation and effect will be conducted in 2024 per sections 670a-f of reference (b). The FY20 JRM INRMP Update will be completed and distributed by 31 January 2021.

4. Thank you for your participation in our Natural Resources/INRMP Metrics meeting and for your support of the JRM Natural Resources Program. If you have any questions, please contact Jennifer Horeg, Conservation Resources Program Manager, at 671-339-1275 or via e-mail at Jennifer.horeg@fe.navy.mil.

J. V. MENONI

Subj: FISCAL YEAR 2020 NATURAL RESOURCES/INTEGRATED NATURAL RESOURCES MANAGEMENT PLAN METRICS SUMMARY REPORT

Distribution:

Ms. Mary Abrams
Acting Field Supervisor
U.S. Department of the Interior
U.S. Fish and Wildlife Service
Pacific Islands Fish and Wildlife Office
300 Ala Moana Boulevard, Room 3-122 Box 5008
Honolulu, HI 96816

Mr. Michael Tosatto
Regional Administrator
National Marine Fisheries Service
Pacific Islands Regional Office
1845 Wasp Blvd., Bldg 176
Honolulu, Hawaii 96818

Ms. Chelsa Muna-Brecht
Director
Guam Department of Agriculture
163 Dairy Road
Mangilao, Guam 96913

Mr. Anthony Benavente
Director
CNMI Department of Land and Natural Resources
P.O. Box 10007
Saipan, MP 96950

Programmatic Division U.S. Fish and Wildlife Service
Pacific Islands Fish and Wildlife Office
Marianas Office, U.S. Fish and Wildlife Service, Pacific Islands Fish and Wildlife Office
300 Ala Moana Boulevard, Room 3-122 Box 5008
Honolulu, HI 96816

Mariana Islands Refuges and Monument Complex
P.O. Box 8134, MOU-3
Dededo, Guam 96912

U.S. Fish and Wildlife Service
Ecological Services
P.O. Box BT
Hagatna, Guam 96932

CNIC Washington DC (N45) NAVFACENGCOM Washington DC (EV2)

2020 Natural Resources Annual Report: NSA ANDERSEN

Summary Score

Focus Area	Score
1 - Natural Resources Management	0.54
2 - Listed Species Critical Habitat	0.67
3 - Recreation Use and Access	0.81
4 - Sikes Act Cooperation	0.85
5 - Team Adequacy	0.48
6 - INRMP Implementation	0.83
7 - Support of Installation Mission	0.59
NSA ANDERSEN - Overall Score	0.68

2020 Natural Resources Annual Report: NB Guam

Summary Score

Focus Area	Score
1 - Natural Resources Management	0.70
2 - Listed Species Critical Habitat	0.80
3 - Recreation Use and Access	0.95
4 - Sikes Act Cooperation	0.89
5 - Team Adequacy	0.66
6 - INRMP Implementation	0.91
7 - Support of Installation Mission	0.64
NB Guam - Overall Score	0.79

2020 Natural Resources Annual Report: Tinian MLA

Summary Score

Focus Area	Score
1 - Natural Resources Management	0.54
2 - Listed Species Critical Habitat	0.52
3 - Recreation Use and Access	0.83
4 - Sikes Act Cooperation	0.88
5 - Team Adequacy	0.64
6 - INRMP Implementation	0.92
7 - Support of Installation Mission	0.68
Tinian MLA - Overall Score	0.72

2020 Natural Resources Annual Report: Farrallon de Medinilla FDM

Summary Score

Focus Area	Score
1 - Natural Resources Management	0.65
2 - Listed Species Critical Habitat	0.28
3 - Recreation Use and Access	N/A
4 - Sikes Act Cooperation	0.86
5 - Team Adequacy	0.84
6 - INRMP Implementation	1.00
7 - Support of Installation Mission	0.68
Farrallon de Medinilla FDM - Overall Score	0.72

2020 Natural Resources Annual Report: OVERALL SCORE SUMMARY

Summary Score

Focus Area	Score
1 - Natural Resources Management	0.61
2 - Listed Species Critical Habitat	0.57
3 - Recreation Use and Access	0.86
4 - Sikes Act Cooperation	0.87
5 - Team Adequacy	0.66
6 - INRMP Implementation	0.92
7 - Support of Installation Mission	0.65
Overall Score Summary (Farrallon de Medinilla FDM, NB Guam, Tinian MLA, NSA ANDERSEN)	0.73

2020

Joint Region Marianas Integrated Natural Resources Management Plan Summary of FY20 Projects

SEPTEMBER 2020

NAVFAC Naval Facilities Engineering Command

COMMANDER JOINT REGION MARIANAS
Libettåt Ginen Inetnon

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Joint Region Marianas
Integrated Natural Resources Management Plan
Summary of FY20 Projects

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Acronyms and Abbreviations

AAFB	Andersen Air Force Base
ADS	Automated Delivery System
AOR	Area of Responsibility
BO	Biological Opinion
BTS	Brown Treesnake
CESU	Cooperative Ecosystem Studies Units Network
CEMML	Center for Environmental Management of Military Lands
CIS	Center for Island Sustainability
CNMI	Commonwealth of the Northern Mariana Islands
COMPACFLT	Commander, U.S. Pacific Fleet
CP	Closed Population
CRB	Coconut Rhinoceros Beetle
CRU	Cooperative Research Unit
CSU	Colorado State University
DNM	Dead Neonatal Mice
DoD	Department of Defense
EOD	Explosive Ordnance Disposal
ERA	Ecological Reserve Area
ESA	Endangered Species Act
FDM	Farallon de Medinilla
ft	foot/feet
FY	Fiscal Year
GIS	Geographic Information System
GMK	Guam Micronesian Kingfisher
GNWR	Guam National Wildlife Refuge
GPEPP	Guam Plant Extinction and Prevention Program
GDOAg	Guam Department of Agriculture
ha	hectare(s)
HACCP	Hazard Analysis and Critical Control Points
HMU	Habitat Management Unit
ISU	Iowa State University
INRMP	Integrated Natural Resources Management Plan
IRP	Installation Restoration Program
JRM	Joint Region Marianas
LFA	Little fire ant

Acronyms and Abbreviations

LFTRC	Live Fire Training Range Complex
m	meter(s)
MCAG	Marine Corps Activity Guam
MCB	Marine Corps Base
MIRC	Mariana Islands Range Complex
MITT	Mariana Islands Training and Testing
MLA	Military Lease Area
MOA	Memorandum of Agreement
MSA	Munitions Storage Area
NAVFAC	Naval Facilities Engineering Command
NBG	Naval Base Guam
NBGTS	Naval Base Telecommunications Site
NMS	Naval Base Guam Naval Munitions Site
NNE	Non-Nesting Emergence
NWF	Northwest Field
NWRC	National Wildlife Research Center
PACOM	Pacific Command
PIERC	Pacific Island Ecosystems Research Center
QA/QC	Quality Assurance/Quality Control
RFMP	Range Fire Management Plan
RBP	Regional Biosecurity Plan for Micronesia and Hawaii
UOG	University of Guam
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
USDA-WS	United States Department of Agriculture- Wildlife Services

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Marine Habitat Management

Water Quality Monitoring on Joint Region Marianas Submerged Lands

Location: NBG **Period of Performance:** SEP2018 - DEC2020

Project Objective

- Install, deploy, and maintain four conductivity-temperature-depth (CTD) mounting frames and four pH sensor mounting frames at four locations in Apra Harbor (e.g., Sasa Bay, Inner Harbor, Middle Harbor, and Outer Harbor), one CTD mounting frame and one pH sensor mounting frame at one location in Orote Peninsula ERA (e.g., Spanish Steps), one CTD mounting frame and one pH sensor mounting frame at one location in Haputo ERA (e.g., Double Reef), and one CTD mounting frame and one pH sensor mounting frame at one location in Naval Support AAFB (e.g., Pati Point Marine Preserve Area).
- Install, deploy, and maintain four CTD and four pH sensors at four locations in Apra Harbor (e.g., Sasa Bay, Inner Harbor, Middle Harbor, and Outer Harbor), one CTD and one pH sensor at one location in Orote Peninsula ERA (e.g., Spanish Steps), one CTD and one pH sensor at one location in Haputo ERA (e.g., Double Reef), and one CTD and one pH sensor at one location in AAFB (e.g., Pati Point Marine Preserve Area).
- Analyze water quality results, and examine the spatial and/or seasonal (temporal) variations in Apra Harbor, Orote Peninsula ERA, Haputo ERA, and AAFB.

Conservation Benefit

- Increase habitat for ESA-listed corals (e.g., *A. globiceps, A. retusa,* and *S. aculeata*)
- Support habitat areas of particular concern which align with Magnuson-Stevens Fishery Conservation Act for Essential Fish Habitat and the Marianas Fishery Ecosystem Plan

FY20 Status

- Abbreviated consultation (NOAA-NMFS) completed on 30MAY2019 and ACOE permits obtained 10 June 2019.
- No-cost extension until DEC2020
- All CTD and pH sensors have been retrieved for maintenance
- Draft final report has been received and will be available OCT2020

EPR: 1 S MAR JRM Marine Ecosystem Monitoring and Coral Reef Indicators (CHS); 61128NR168

2019 JRM INRMP Reference: MHM-1 (5-98)



Figure 1. Conductivity-depth-temperature sensor mounted on a stainless steel frame.



Figure 2. SeaFET sensor mounted on a stainless steel frame.

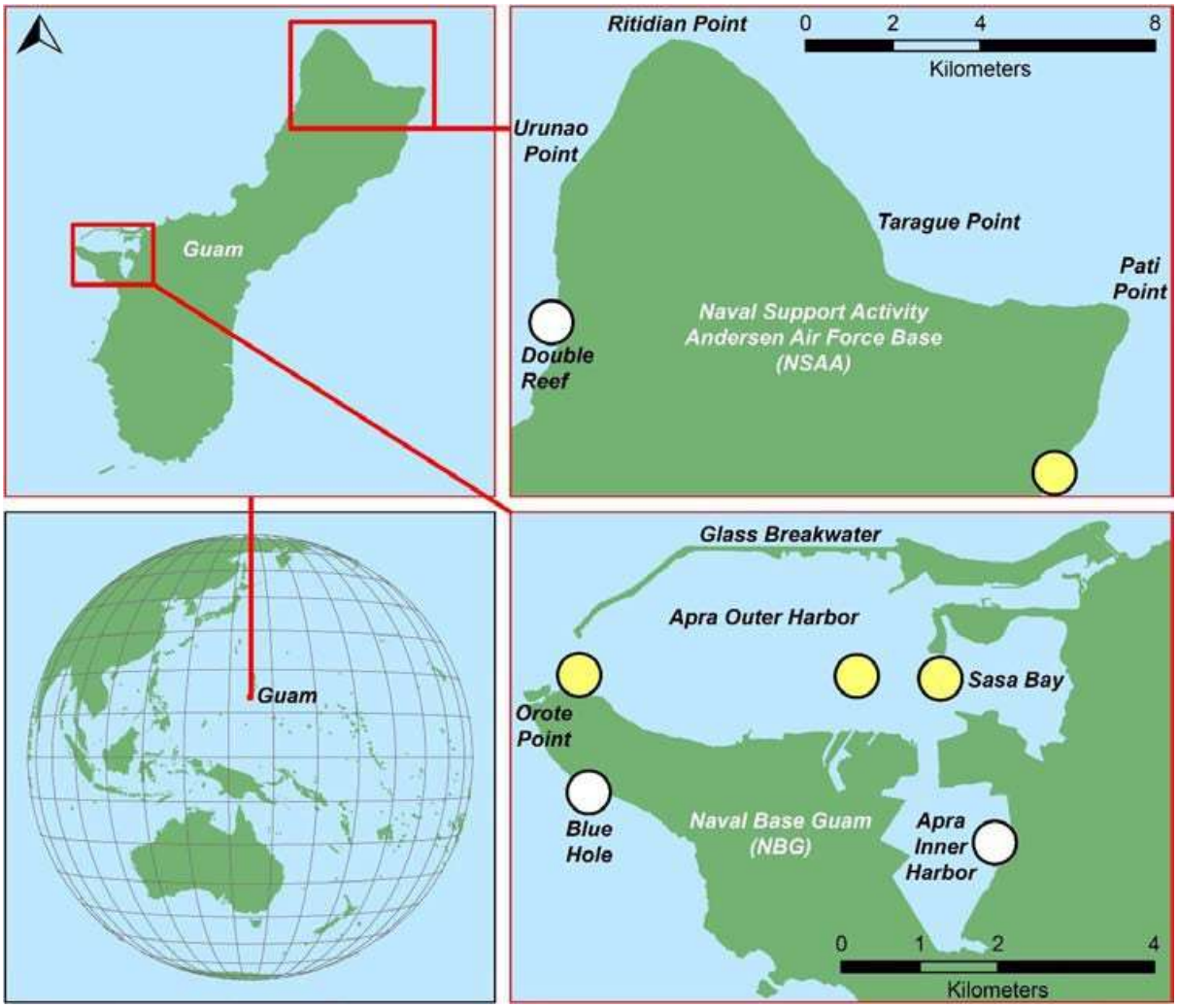


Figure 3. Deployment locations of water quality loggers. Yellow circles indicate sites for which previous water quality data is available and at which mounting frames are installed. White circles represent new monitoring stations.

Evaluate Mangrove Functionality in the Atantano Watershed

Location: NBG **Period of Performance:** SEP2018 - SEP2021

Project Objective

- Conduct an ecological assessment of the terrestrial and marine environments within Abo Cove.
- Identify an area within Abo Cove for a mangrove restoration demonstration project.
- Design a restoration project suited for the Abo Cove shoreline.

Conservation Benefit

- Increase habitat for ESA-listed species (e.g., sea turtles and scalloped hammerhead shark).
- Support habitat areas of particular concern which align with Magnuson-Stevens Fishery Conservation Act for Essential Fish Habitat and the Marianas Fishery Ecosystem Plan.

FY20 Status

- Field work (terrestrial and marine surveys) completed DEC2018
- Final report available

EPR: CHS JRM Evaluate and Enhance Mangrove Functionality of the Atantano Watershed to Protect Essential Fish Habitat and Coral Reefs; 61128NR656

2019 JRM INRMP Reference: MHM-3 (5-100)



Figure 4. Map depicting the Abo Cove shoreline and location of the advanced feasibility study area.

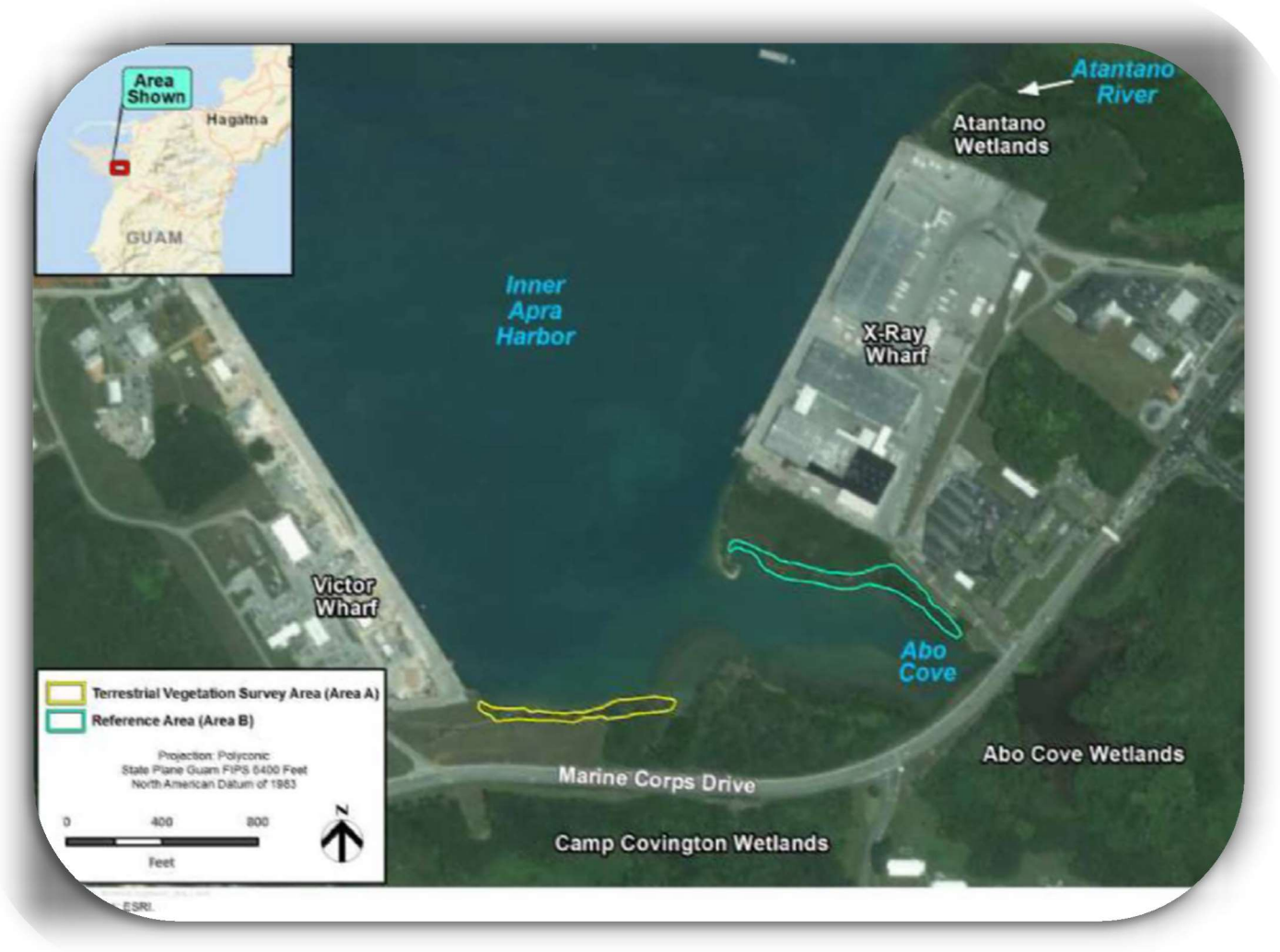


Figure 5. Map depicting locations of terrestrial vegetation surveys.

Coral Protection and Mooring Buoy Installation - NBG

Location: NBG **Period of Performance:** SEP2019 - SEP2020

Project Objective

- Determination of suitable anchor placement sites, procurement and assembly of apparatus, and installation of Shallow Water Mooring Systems (SWMS) within Apra Harbor, Orote Peninsula, and Outer Breakwater sites.
- Provide secure vessel attachment points at popular SCUBA/snorkel/fishing locations used by recreation and commercial boaters.

Conservation Benefit

- Increase habitat for ESA-listed corals (e.g., *A. globiceps, A. retusa*, and *S. aculeata*).
- Support habitat areas of particular concern which align with Magnuson-Stevens Fishery Conservation Act for Essential Fish Habitat and the Marianas Fishery Ecosystem Plan.

FY20 Status

- Installation of 20 mooring buoys complete (Figure 83).
- Annual maintenance and inspections.

EPR: 1 CP MAR NBG Coral Protection Buoys; 61755NR849

2019 JRM INRMP Reference: MHM-1 (5-98); MHM-4 (5-100)



Figure 6. Map depicting locations of mooring buoys in and around Outer Apra Harbor, NBG.

Monitoring and Control of Acute Impacts on Coral Reefs in Outer Apra Harbor and Orote Peninsula and Haputo Ecological Reserve Areas (ERAs)

Location: NBG; NBG TS **Period of Performance:** SEP2017 SEP2019

Project Objective

- Host crown of thorns starfish (COTS) training workshops for Navy EXWC and NBG Dive Locker divers, JRM/NBG Natural Resource Marine Specialists, and Guam. COTS Response Team partners lead by a COTS expert; one classroom and one in- water skills COTS training workshop to include overview of COTS ecology and history on Guam, pre-culling surveillance methods, culling guidelines, and post- culling monitoring techniques.
- Implement a monitoring program for the detection of coral stressors and COTS/marine nuisance species control within Outer Apra Harbor, and Orote and Haputo ERAs.

Conservation Benefit

- Increase habitat for ESA-listed corals (e.g., *A. globiceps*, *A. retusa*, and *S. aculeata*).
- Support habitat areas of particular concern which align with Magnuson-Stevens Fishery Conservation Act for Essential Fish Habitat and the Marianas Fishery Ecosystem Plan.

FY20 Status

- COTS classroom and in-water skills training completed with NBG Dive Locker and NAVFAC Marianas Marine Resources SMEs on FEB2019.
- Final report available

EPR: 1 S MAR NBG Marine Ecosystem Monitoring and Coral Reef Indicators (CHS); 61755NR168

2019 JRM INRMP Reference: MHM-1 (5-98)

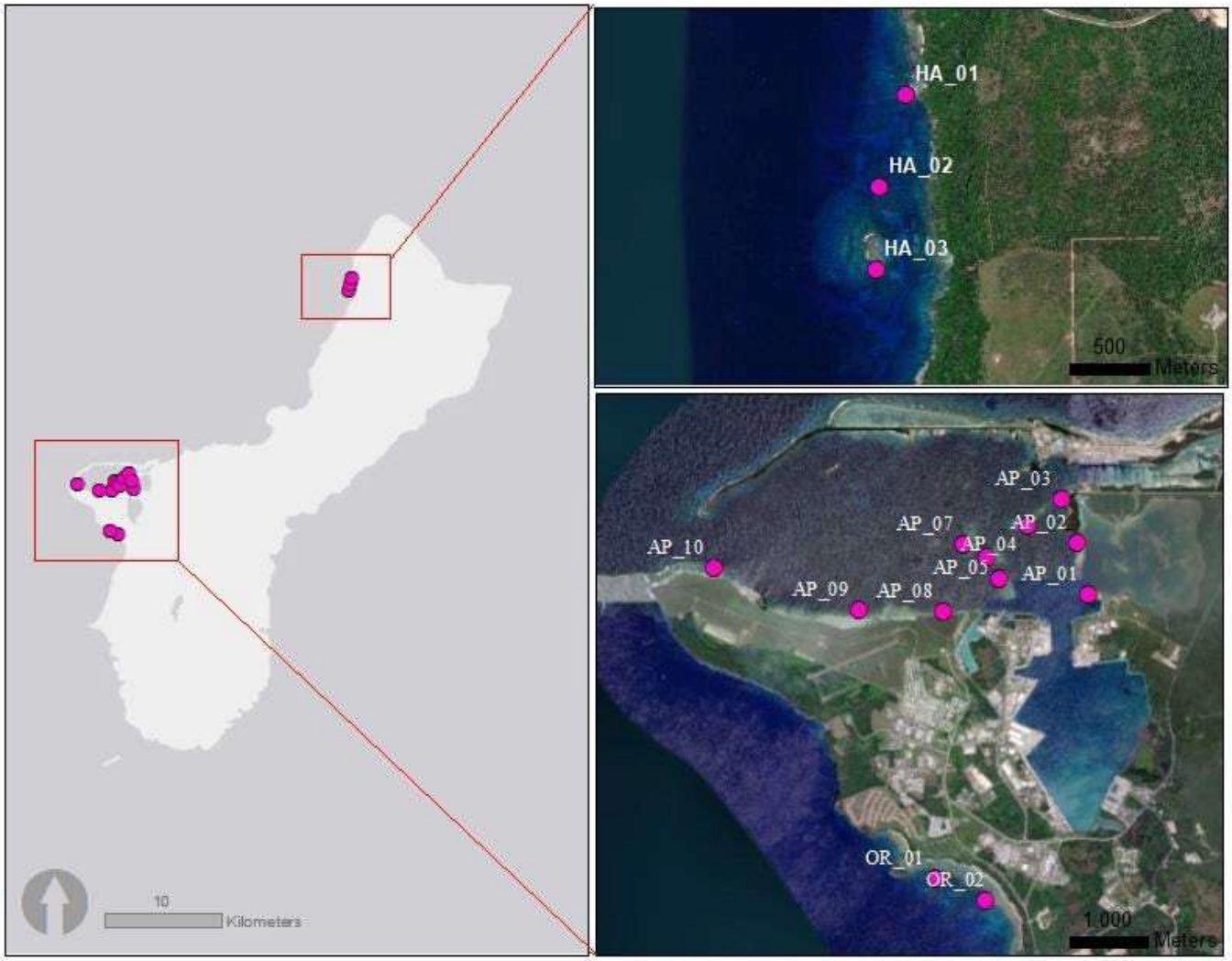


Figure 7. Map depicting survey sites at Apra Harbor, Orote ERA, and Haputo ERA.

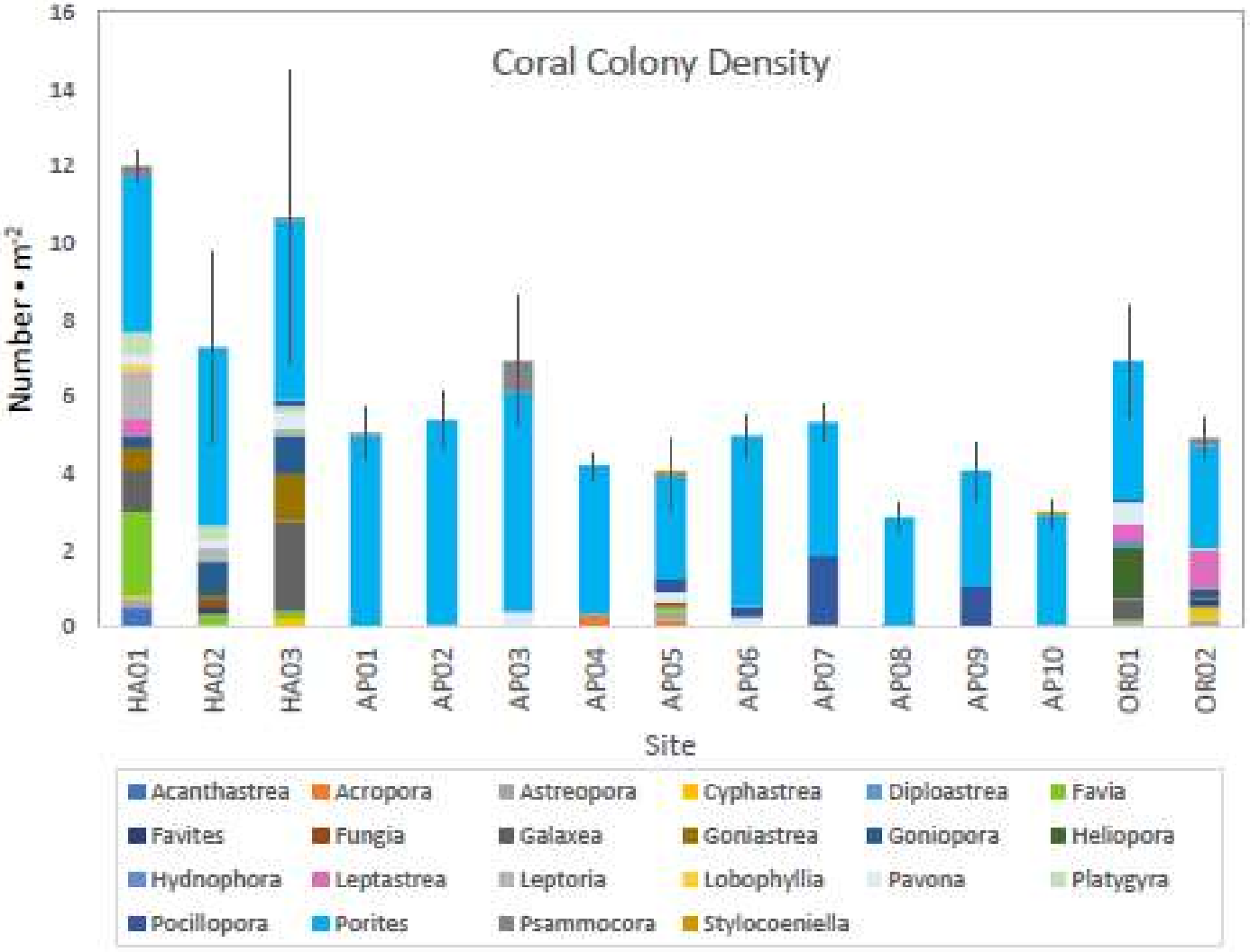


Figure 8. Mean coral colony density for each survey site. Error bars represent standard error for the overall coral density at each site.

Survey and Monitoring of Seagrass Beds at Dadi Beach, NBG

Location: NBG **Period of Performance:** SEP2017 – JAN2020

Project Objective

- Designate permanent monitoring transect locations.
- Determine and document the biodiversity of marine plants and macroinvertebrates.
- Determine the current health of the seagrass bed by quantifying nutrient composition in seagrass blades and in sediments, the abundance of epiphytic plants on seagrass and the abundance and biodiversity of macroalgae and any additional relevant information that may affect the ecosystem health of the seagrass bed.

Conservation Benefit

- Increase habitat for ESA-listed species (e.g., sea turtles, *A. globiceps*, *A. retusa*, and *S. aculeata*) and marine mammals.
- Support habitat areas of particular concern which align with Magnuson-Stevens Fishery Conservation Act for Essential Fish Habitat and the Marianas Fishery Ecosystem Plan.

FY20 Status

- Final report available

EPR: 1 S MAR JRM Marine - Ecosystem Monitoring and Coral Reef Indicators (CHS); 61128NR168

2019 JRM INRMP Reference: MHM-1 (5-98); MHM-2 (5-99)

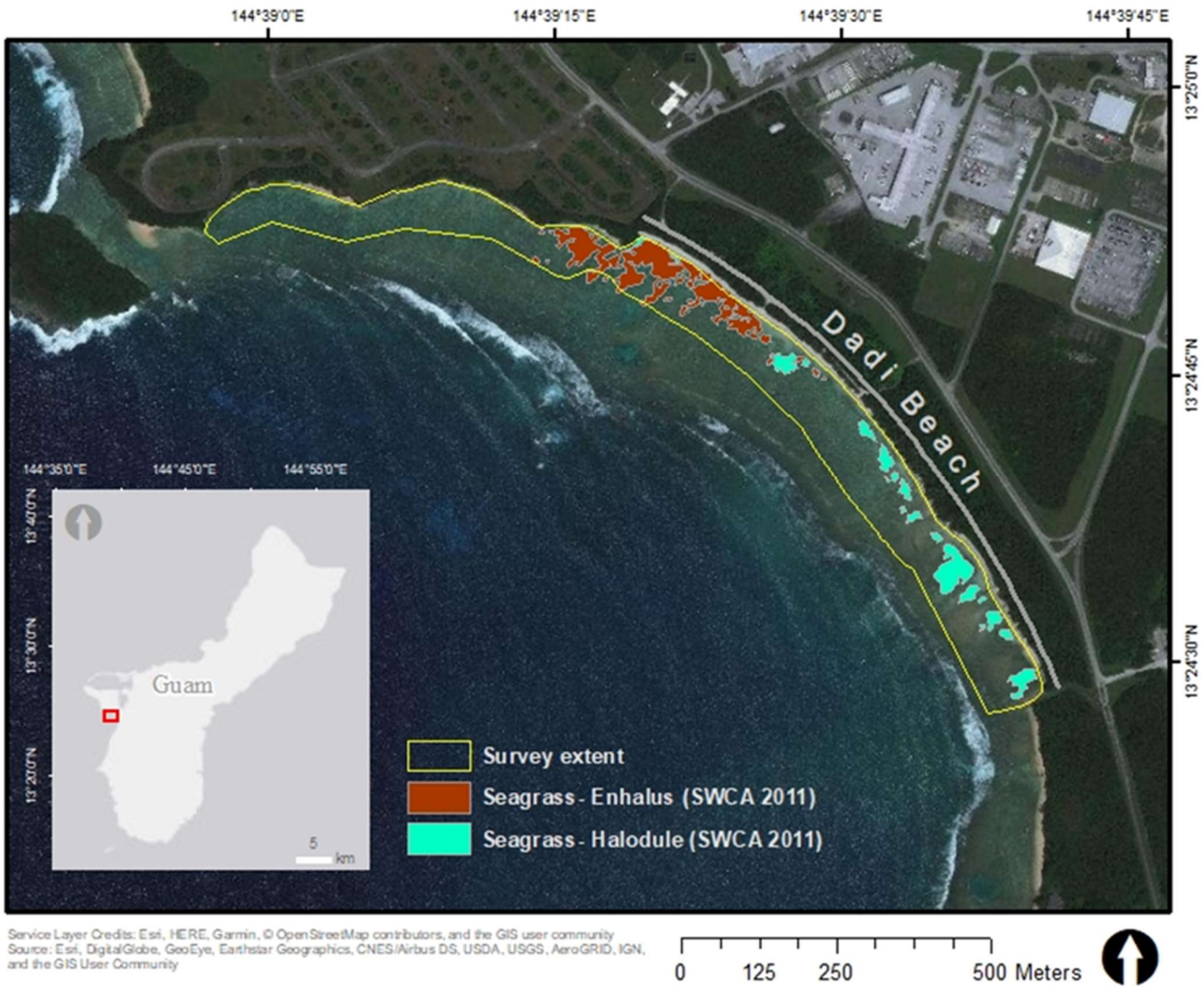


Figure 9. Map of the survey extent for this project and the seagrass habitat layers produced by SWCA (2011). Survey extent and habitat layers were provided by NAVFAC Marianas.

Characterization of Marine Benthic Habitats in Outer Apra Harbor Guam

Location: NBG **Period of Performance:** SEP2019 - SEP2023

Project Objective

- Process existing remotely sensed imagery
- Collect in situ information for habitat model and map development
- Collect in situ information to evaluate habitat model performance and map accuracy
- Outreach

Conservation Benefit

- Increase habitat for ESA-listed species (e.g., sea turtles, *A. globiceps*, *A. retusa*, and *S. aculeata*) and marine mammals.
- Support habitat areas of particular concern which align with Magnuson-Stevens Fishery Conservation Act for Essential Fish Habitat and the Marianas Fishery Ecosystem Plan.

FY20 Status

- Interagency agreement established SEP2019
- Fieldwork was scheduled for JULY2020; postponed due to COVID-19

EPR: 1 CP MAR NBG Benthic Habitat and Coral Mapping and Management (CHS); 61755NR818

2019 JRM INRMP Reference: MHM-1 (5-98); MHM-2 (5-99); MHM-6 (5-101); MEDU-2 (5-105)

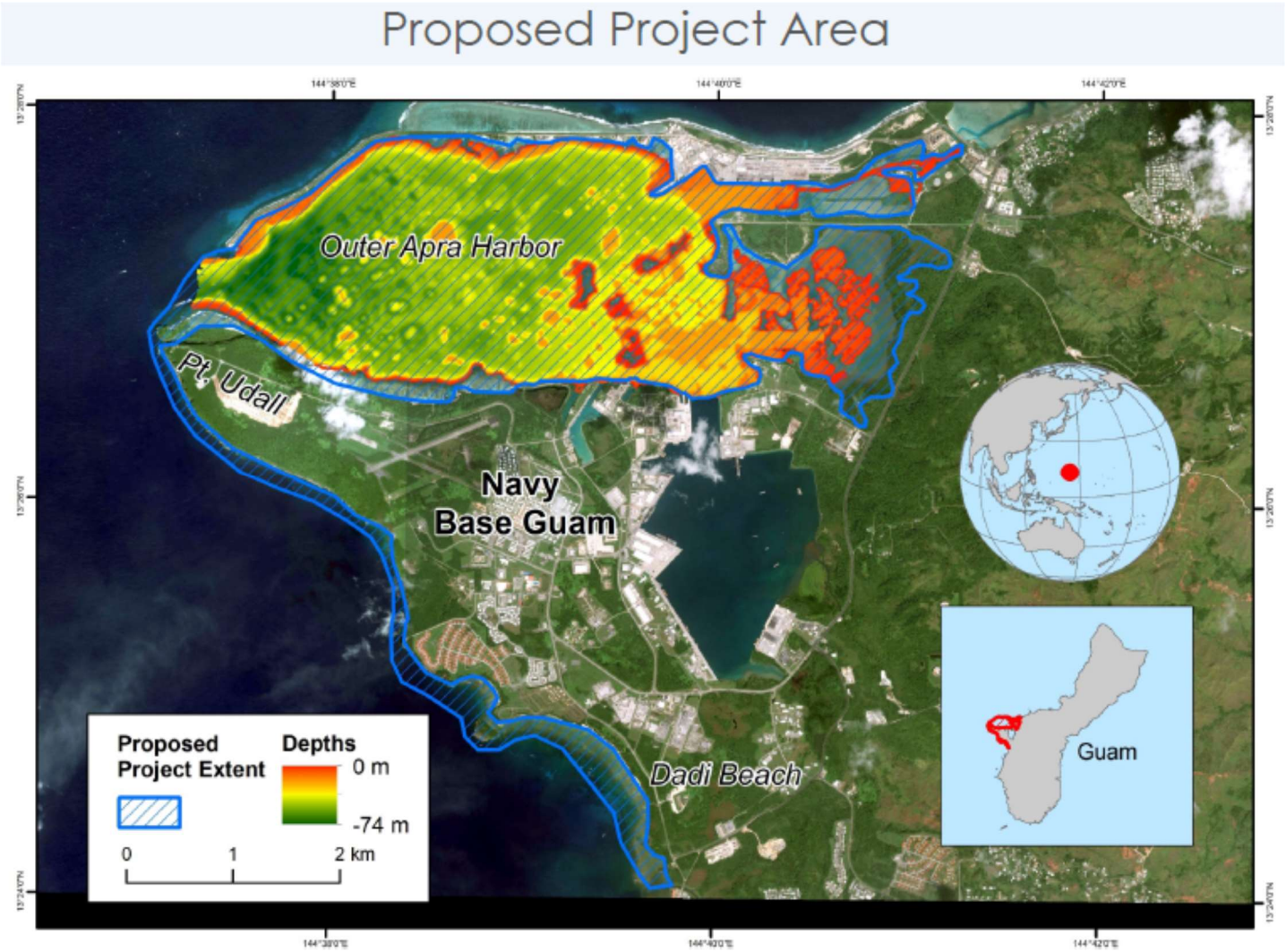


Figure 10. Proposed project area in Apra Harbor and Orote ERA for the characterization of marine benthic habitats.

Marine Protected Species Management

Sea Turtle Distribution and Habitat Use

Location: NBG **Period of Performance:** AUG2018 - SEP2021

Project Objective

- Conduct marine turtle surveys and in-water captures of green turtles (*Chelonia mydas*) and hawksbill turtles (*Eretmochelys imbricata*) in the nearshore waters of Guam and CNMI.
- Captured turtles are weighed, measured, biopsied, and tagged (i.e., flipper, PIT, satellite tracking) in an effort to expand our knowledge of the population demographics, population structure, and fine-scale habitat use of the turtles.
- Blood samples are also collected for two studies: 1) hormone analysis to determine population sex ratios, and 2) metabolite analysis to determine nutritional/feeding state.

Conservation Benefit

- To understand the movements of Guam and CNMI foraging populations of sea turtles to maintain or increase sea turtle populations and enhance and restore habitat.
- To collect data on the morphology and genetics of the nearshore sea turtle population.

FY20 Status

This work is conducted through an Interagency Agreement (NMFS-PIC-18-007) between NOAA-PISF and JRM. The original agreement was from August 2016 – July 2019. The new agreement extends to September 2021.

- Twenty-four satellite tags were deployed on green and hawksbill turtles during small boat-based marine turtle surveys of Apra Harbor, Orote Point, Glass Breakwater, Dadi, and Tipalao conducted in 2016 through 2018.
- The small boat based surveys and deployed satellite tags provide information on general habitat use, home range, and core area for turtles tagged in each location.
- Deployed tags also record information on dive depth and temperature use which will be provided in the report
- In June 2019 a total of 12 satellite tags were deployed in the areas of Apra

- Harbor/Orote Point and Double Reef on foraging turtles (Table 1, Figure 11).

- In-water fieldwork scheduled in May and September 2020 has been postponed due to COVID-19 travel restrictions. When possible sea turtles nesting at Spanish Steps will be satellite tagged and tracked through this project.
- A final report was provided in January 2020

EPR: 1 S CP MAR NBG Sea Turtle Distribution and Habitat Use; 61755NR815

2019 JRM INRMP Reference: MPS-2 (5-103)

Table 1. Summary of in-water survey effort, observations, captures, and satellite tags deployed in June 2019.

			Observations				**Captures**		**Sat. Tags**	
Date	**Island**	**Location**	***Cm***	***Ei***	***Unk***	***Cet.***	***Cm***	***Ei***	***Cm***	***Ei***
6/4	Guam	Apra Harbor/Orote Point	15	2	0	0	4	2	4	2
6/5	Guam	Apra Harbor/Orote Point	11	2	0	0	4	1	3	0
6/7	Guam	Double Reef	4	2	2	0	0	2	0	2
6/8	Guam	Double Reef/Haputo	6	2	0	0	1	0	1	0
6/9	Guam	Double Reef/Haputo	6	3	0	0	0	0	0	0
Totals			42	11	2	0	9	5	8	4
TURTLES			**55 observations**				**14 captures**		**12 sat. tags**	

Cm = green turtle (Chelonia mydas). Ei = hawksbill turtle (Eretmochelys imbricata).
Unk. = unknown turtle species (either Cm or Ei). No cetaceans (Cet.) were observed during these surveys.



Figure 11. NOAA photos from June of 2019 field work. Top Left: NOAA researchers' work with the DAWR enforcement vessel/crew to transport captured turtles to the shore-based processing station. Top Right: Program collaborators working at the shore-based turtle processing station at Seaplane Ramp. Bottom Left: A green turtle equipped with a SPLASH satellite tag. Bottom Right: Release of a hawksbill turtle equipped with a satellite tag.

Detection of Scalloped Hammerhead Sharks in Apra Harbor and Adjacent Nearshore Waters using Environmental DNA (eDNA)

Location: NBG **Period of Performance:** SEP2017 - OCT2020

Project Objective

- Collect and filter marine water samples at five targeted locations within Apra Harbor and Orote ERA.
- Develop primers designed to amplify only scalloped hammerhead shark DNA.
- Assess ability to extract and detect shark DNA, and other threatened fish species (e.g., humphead wrasse and bumphead parrotfish) through targeted quantitative Polymerase Chain Reactions and metabarcoding analyses.
- Analyze eDNA results to determine the spatial and temporal presence of scalloped hammerhead sharks in Apra Harbor and Orote ERA.

Conservation Benefit

- Increase habitat for ESA-listed species (e.g., scalloped hammerhead shark).
- Support habitat areas of particular concern which align with Magnuson-Stevens Fishery Conservation Act for Essential Fish Habitat and the Marianas Fishery Ecosystem Plan.

FY20 Status

- Samples are being collected and preliminary eDNA is being extracted by the UOG Marine Lab; purified DNA samples are sent to James Cook University for analyses.
- Exercised option year one (12 months) to increase sample size and complete analyses.
- No-cost extension until OCT2020

EPR: 1 S MAR NBG Scalloped Hammerhead Shark (*Sphyrna lewini*) Survey; 61755NR891

2019 JRM INRMP Reference: MPS-1 (5-103)

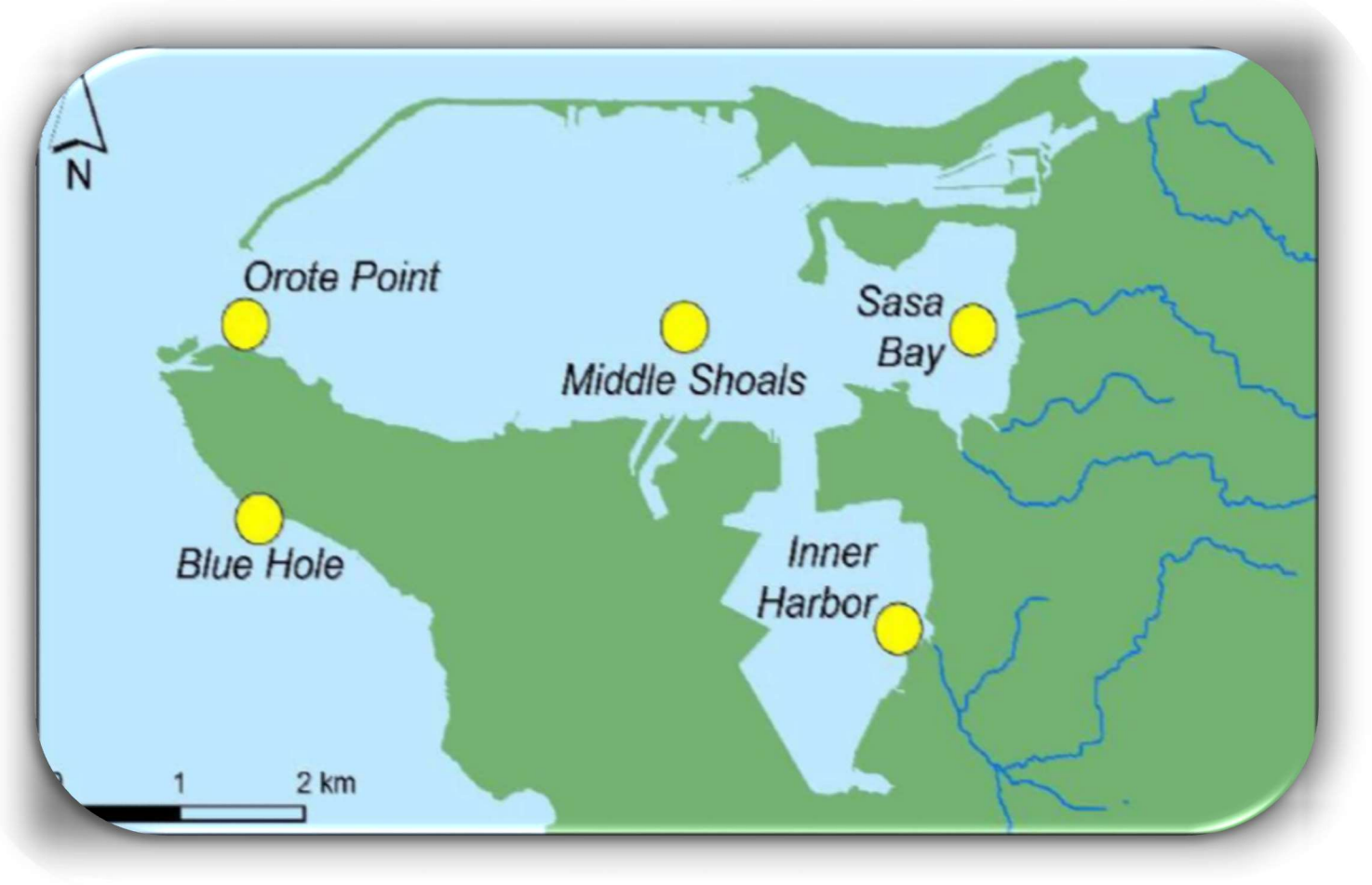


Figure 12. Proposed sampling locations for the detection of scalloped hammerhead eDNA within Apra Harbor and Orote ERA.

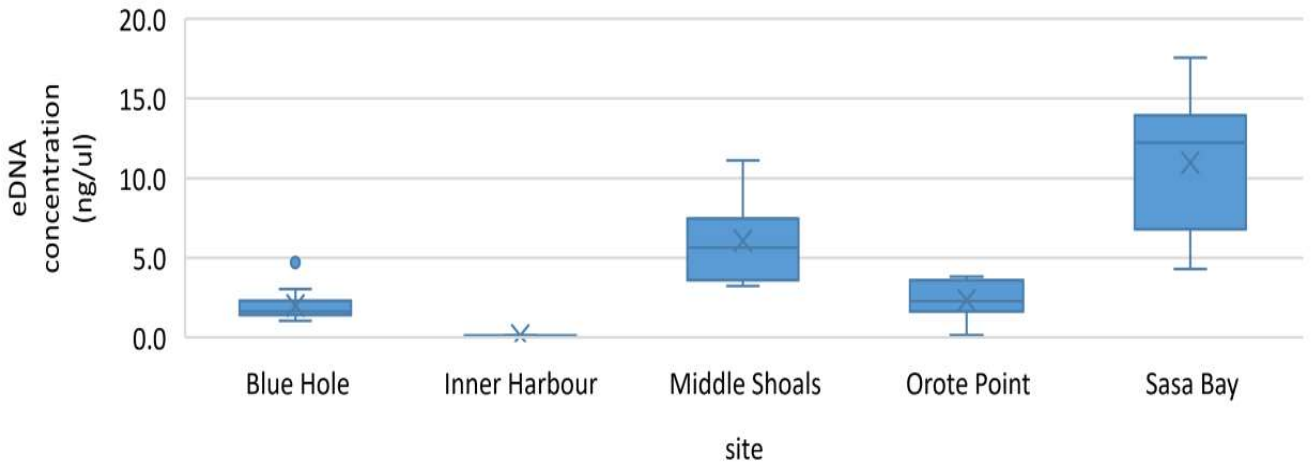


Figure 13. Mean total eDNA concentration for the Jul 2019 samples for each study site. Note: Inner Harbor samples were not collected in July.

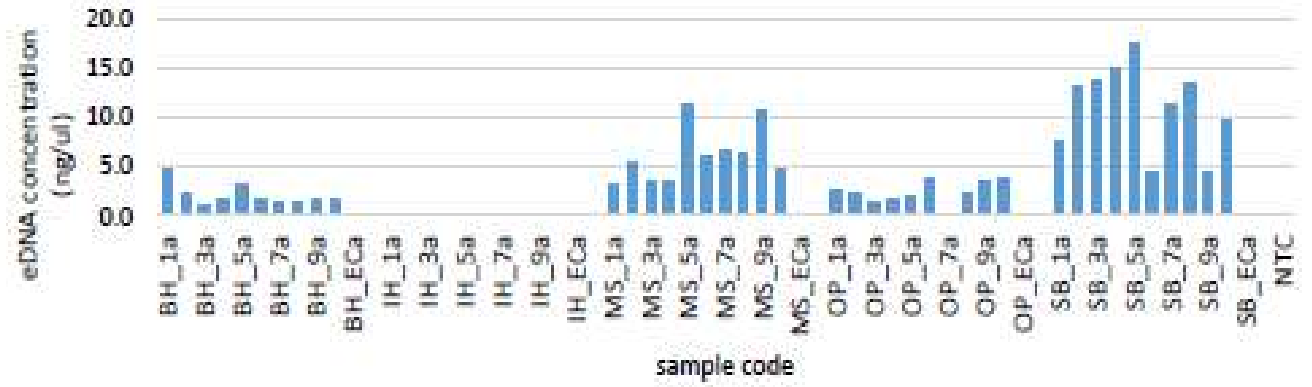


Figure 14. Total eDNA concentration for each field sample (BH: Blue Hole, IH: Inner Harbor, MS: Middle Shoals, OP: Orote Point, SB: Sasa Bay) for the Apr 2019 samples for each study site.

Sea Turtle Aerial Surveys in FDM Nearshore Waters

Location: FDM **Period of Performance:** SEP2018 - SEP2020

Project Objective

- Design aerial transect surveys to determine sea turtle and marine mammal abundances and distributions in the nearshore waters surrounding FDM.
- Conduct aerial surveys for sea turtle and marine mammal identifications, abundances, and distributions in the nearshore waters surrounding FDM.
- Analyze sea turtle and marine mammal identifications, abundances, and distributions in the nearshore waters surrounding FDM.

Conservation Benefit

- Increase habitat for ESA-listed species (e.g., sea turtles and marine mammals).
- Support habitat areas of particular concern which align with Magnuson-Stevens Fishery Conservation Act for Essential Fish Habitat and the Marianas Fishery Ecosystem Plan.

FY20 Status

- Surveys were postponed due to Typhoon Yutu which hit the CNMI on OCT2018
- First successful survey completed on SEP2019; continue with one survey per month; last survey on 27AUG2020
- No-cost extension until SEP2020
- Final report will be available SEP2020

EPR: CNMI Ecosystem and Protected Species Monitoring and Management: Sea Turtle Distribution and Habitat Use in FDM Nearshore Waters (emergent); 61128NR851

2019 JRM INRMP Reference: MPS-1 (12-41)

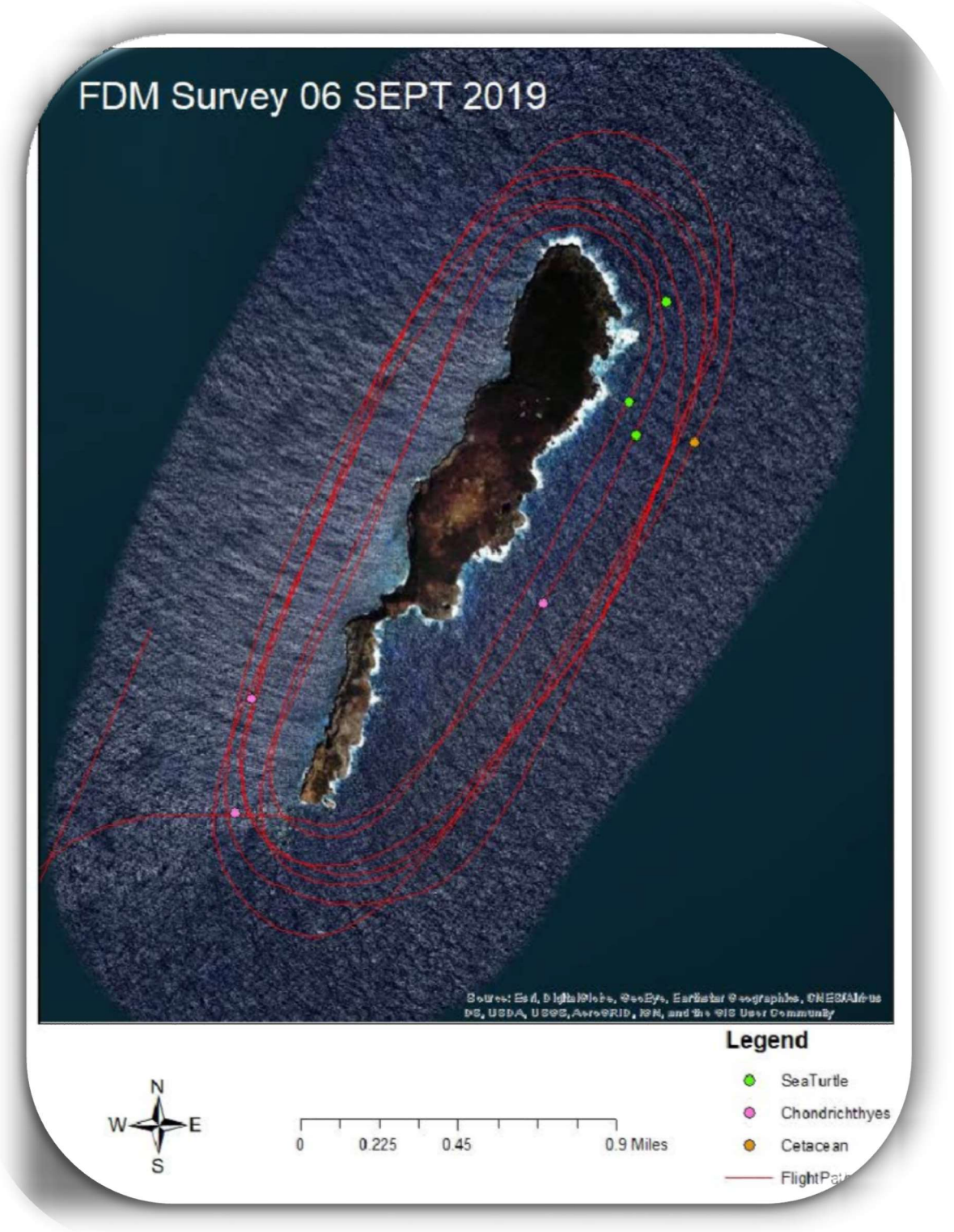


Figure 15. Map of FDM depicting the approximate location of marine fauna around the island.



Figure 16. Map of FDM depicting pre-planned transects (green) and actual location of the aircraft during the survey at pre-determined reference points

Geographic Information Systems (GIS) and Data Management

Digital Orthography Lidar and Planimetric Data – CNMI

Location: FDM; Saipan; Tinian **Period of Performance:** SEP2018 - SEP2020

Project Objective

- Obtain aerial imagery of Tinian, Saipan, and FDM
- Obtain lidar data for bathymetric products at FDM

Conservation Benefit

- Increase habitat for ESA-listed species (e.g., corals, sea turtles, marine mammals).
- Support habitat areas of particular concern which align with Magnuson-Stevens Fishery Conservation Act for Essential Fish Habitat and the Marianas Fishery Ecosystem Plan.

FY20 Status

- GIS data capture (aerial imagery for Tinian, Saipan, and FDM; and lidar for FDM) completed JULY2019 and all raw data received FEB2020.
- Coordinating with NOAA NCCOS on analyses.

EPR: 1 CP MAR JRM GIS Database Management; 61128NR200

2019 JRM INRMP Reference: TGIS-1 (11-69); TGIS-1 (12-36); MGIS-1 (11-78); MGIS-1 (12-43)

Terrestrial Exotic and Invasive Species Management

Developing a Framework for Coordinated Management of Vertebrate Restoration and Brown Treesnake Control on Guam

Location: JRM **Period of Performance:** SEP2019 – MAR2021

Project Objective

This project will consist of developing a decision-analytic framework to guide coordinated brown treesnake control and vertebrate species restoration on Guam. The intent is to establish a collaborative process involving management agencies, stakeholders, and scientific experts and use a workshop model to bring these groups together for the purpose of framework development.

Conservation Benefit

This is an indirect way towards operational management decisions through a decision analysis process to engage in a more robust planning phase. This can include prioritization, management application, and collaboration to manage long-tern, costly complex conservation problems.

FY20 Status

- Funded via an interagency agreement with USGS – CRU: Washington University Extension.
- Project in workshop phase – with discussions on site and species selection to develop a planning framework.
- Group members in DoN; CNMI DLNR; USFWS; USGS; UoG; DAWR; The Nature Conservancy; Massey University, New Zealand
- Final framework/guidance document anticipated April 2021

EPR: 1 RP JRM Brown Tree Snake Eradication and Control to Support Recovery of ESA-Listed Birds; 61128NR202

2019 JRM INRMP Reference: TIS-3; 9-72

Review, Evaluation, and Assessment of Reintroduction Programs as Related to Reintroduction of Guam Micronesian Kingfisher on Joint Region Marianas (JRM) Lands

Location: JRM **Period of Performance:** JUL2019 – JAN2021

Project Objective

The Guam Micronesian Kingfisher (GMK) Reintroduction evaluation CESU will provide the following: 1) evaluation of reintroduction of GMKI within limited (unbounded) BTS-controlled areas of JRM lands, 2) review and evaluate other reintroduction programs on Department of Defense (DoD) lands to identify mission compatibility successes, and 3) evaluate reintroduction performance criteria utilized within other reintroduction programs and provide recommendations for Joint Region Marianas performance criteria for future reintroduction programs with an emphasis on mission compatibility.

Conservation Benefit

The collation of success and failures of reintroduction programs, an assessment of JRM preparedness and capabilities will be vital to reducing risk and increasing success when considering reintroducing avian species in the future. This review, evaluation, and assessment will help to minimize the learning curve, improve reintroduction outcomes, and provide JRM guidance in planning its' conservation goals.

FY20 Status

- Agreement via CESU network to the University of Tennessee – Knoxville.
- Project in data gathering and compilation phase.
- Final framework/guidance document anticipated February 2021

EPR: 1 RP JRM Brown Tree Snake Eradication and Control to Support Recovery of ESA-Listed Birds; 61128NR202

2019 JRM INRMP Reference: TIS-3; 9-72

Monitoring to Evaluate Effectiveness of HACCP Plan Implementation at Construction Sites

Location: Various locations: AAFB, NBG, NBGTS, AAFB NWF
Period of Performance: Various, multiple project awards

Project Objective
Long-term monitoring program for terrestrial vegetation to aid in evaluating the success of implemented HACCP plans.

Conservation Benefit
To minimize the spread and effects of invasive plant species due to construction activities.

FY20 Status
Ongoing previous FY contract awards for construction activities:

- J-001B Finegayan Utilities and Site Improvements Phase 1
- J-006 Apra Medical Clinic
- J-007 Waterfront Head Quarters
- J-200 IV Utilities
- J-755 Urban Combat Training
- P-102 Power Upgrade-Harmon.
- P-103 Water Phase 2
- P-295 Ordnance Ops.
- P-715 Live-Fire Training Range Complex Known Distance Ranges

Results
No new species recorded on Guam

EPR: DPRI: Marine Corps Relocation 2017/2018 amendment to 2015 BO, Conservation Measures to Contribute to the Recovery of Listed Species.

Implementation of the Regional Biosecurity Plan of Micronesia and Hawaii

Location: JRM **Period of Performance:** JUL2017 – JUL2021

Project Objective

Update Attachment M (DoD Biosecurity Recommendations) of the Regional Biosecurity Plan for Micronesia and Hawaii (hereafter: RBP), and implement various actions identified within the RBP aimed at: preventing the spread of invasive species into/out of JRM AOR; controlling, managing, and eradicating invasive and nuisance species on DoD lands within the JRM AOR; providing outreach and awareness to military personnel, contractors, and their respective dependents; and increasing coordination and collaboration with regional partners and DoD stakeholders regarding biosecurity and invasive species management.

Conservation Benefit

Protect native species, particularly those that are threatened and endangered from the threat of invasive species within the JRM AOR.

FY20 Status

- The RBP Attachment M update was submitted to Navy HQ in December 2019 after reviews were completed by DoD across JRM AOR, Hawaii, DoD stakeholders in the Pacific, and PACOM.
- Implementation of Quality Assurance/Quality Control (QA/QC) bio-sanitation inspections of military equipment and cargo offloaded on Naval Base Guam in support of DoD COVID-19 medical relief efforts. Bio-sanitation inspections were conducted for two movements of military equipment and cargo going to Tinian for public works projects.
- Continued interagency coordination and consultation regarding invasive species management and biosecurity concerns within the region.

EPR: CHS NISA MAR JRM Implementation of the Regional Biosecurity Plan; 61128NR860

2019 JRM INRMP Reference: TIS-4; 5-85, TIS-5; 6-44, TIS-5; 7-53, TIS-4; 8-51, TIS-6; 9-73, TIS-1; 11-62, TIS-1; 12-32, MIS-1; 5-102, MIS-1; 8-64, MIS-1; 9-87, MIS-1; 11-74, MIS-2; 11-74

Little Fire Ant (LFA), *Wasmannia auropunctata*, Surveys, Eradication, and Monitoring – Andersen South

Location: Andy South **Period of Performance:** AUG2017 – AUG2021

Project Objective

To eradicate LFA within the Andersen South property to reduce impacts to native ecosystems and military readiness activities.

Conservation Benefit

Enhance and restore habitats by prevention of the spread of the invasive LFA.

FY20 Status

- On-going delimiting surveys for newly discovered Site 7 area of LFA at Andy South
- 5 of the 7 known LFA sites have been successfully eradicated at the Andy South property
- Helicopter eradication project awarded 30 August 2020 with University Of Guam
- Some of the helicopter eradication treatments to be scheduled in conjunction with USDA-APHIS BTS Bait Drops to increase cost efficiencies of projects

EPR: DPRI: Marine Corps Relocation 2017 amendment to 2015 BO, Conservation Measures to Minimize the Effects of Invasive Species; CHS EO 13751 MAR Little Fire Ant Surveys and Eradication; 61128NR207

2019 JRM INRMP Reference: TIS-5; 5-86, TIS-5; 9-72

Little Fire Ant (LFA), *Wasmannia auropunctata*, Surveys, Eradication, and Monitoring

Location: DoD Lands on Guam **Period of Performance:** SEP2016 – JUL2021

Project Objective

To implement LFA Early Detection Surveys (EDS); control and eradicate LFA on DoD lands; coordinate and collaborate with resources partners; and provide outreach materials to reduce impacts to native ecosystems and military readiness activities.

Conservation Benefit

Enhance and restore habitats by prevention of the spread and establishment of the invasive LFA.

FY20 Status

Cooperative Agreement with University of Guam

- Naval Munitions Site - Eight (8) LFA insecticide treatments completed (June 2019 – February 2020) with post treatment monitoring July – September 2020 (Figures 17-18). Post treatment monitoring every 6 months for 2 years with border treatment.
- Eradication of LFA at NMS is being closely coordinated with our resource partners at GovGuam Biosecurity, who are jointly treating the adjacent acacia forest and engaging the adjacent neighborhood with plans to commence treatment soon.

Cooperative Agreement with Colorado State University Center for Environmental Management of Military Lands (CSU CEMML):

- Haputo ERA, NBG TS – Eight (8) LFA insecticide treatments completed (September 2019 – July 2020) with post treatment monitoring starting in August 2020 (Figure 19-20). Post treatment monitoring every 6 months for 2 years.
- LFA Early Detection Surveys initiated June 2019
    - 53 of 156 locations surveyed on AAFB (27) and NBG (26)
    - Three (3) LFA positive locations on NBG
    - Surveys conducted at South Finegayan site prior to construction of the COVID-19 expeditionary medical facility (No LFA detections)

- No LFA detected on AAFB

- Nimitz Hill, NBG – LFA detected in March 2020 at approximately 5 locations. Treatment initiated in April 2020 with three (3) of eight (8) insecticide treatments completed on 2.06 acres within the foot print of NBG sewer line replacement project (Figure 21). Delineation surveys pending funding approval.
- Dadi Beach, NBG – LFA detected in April 2020 on 9.95 acres with a treatment area of 14.5 acres (Figure 22). Eight (8) LFA insecticide treatments to start in October 2020.
- Polaris Point, NBG – LFA detected in June 2020 on 0.04 acres with a proposed treatment area 0.7 acres (Figure 23). Treatment pending funding approval.
- Developed LFA awareness signage for LFA infestation areas (Figure 24).

EPR CHS EO 13751 MAR Little Fire Ant Surveys and Eradication; 61128NR207
CHS NISA MAR JRM Implementation of the Regional Biosecurity Plan; 61128NR860
USMC HQ MITT Biological Opinion Conservation Measures Implement (FY20 Non-EPR)

2019 JRM INRMP Reference: TIS-5; 5-86, TIS-6; 6-44, TIS-4; 7-52, TIS-6; 8-52, TIS-5; 9-72

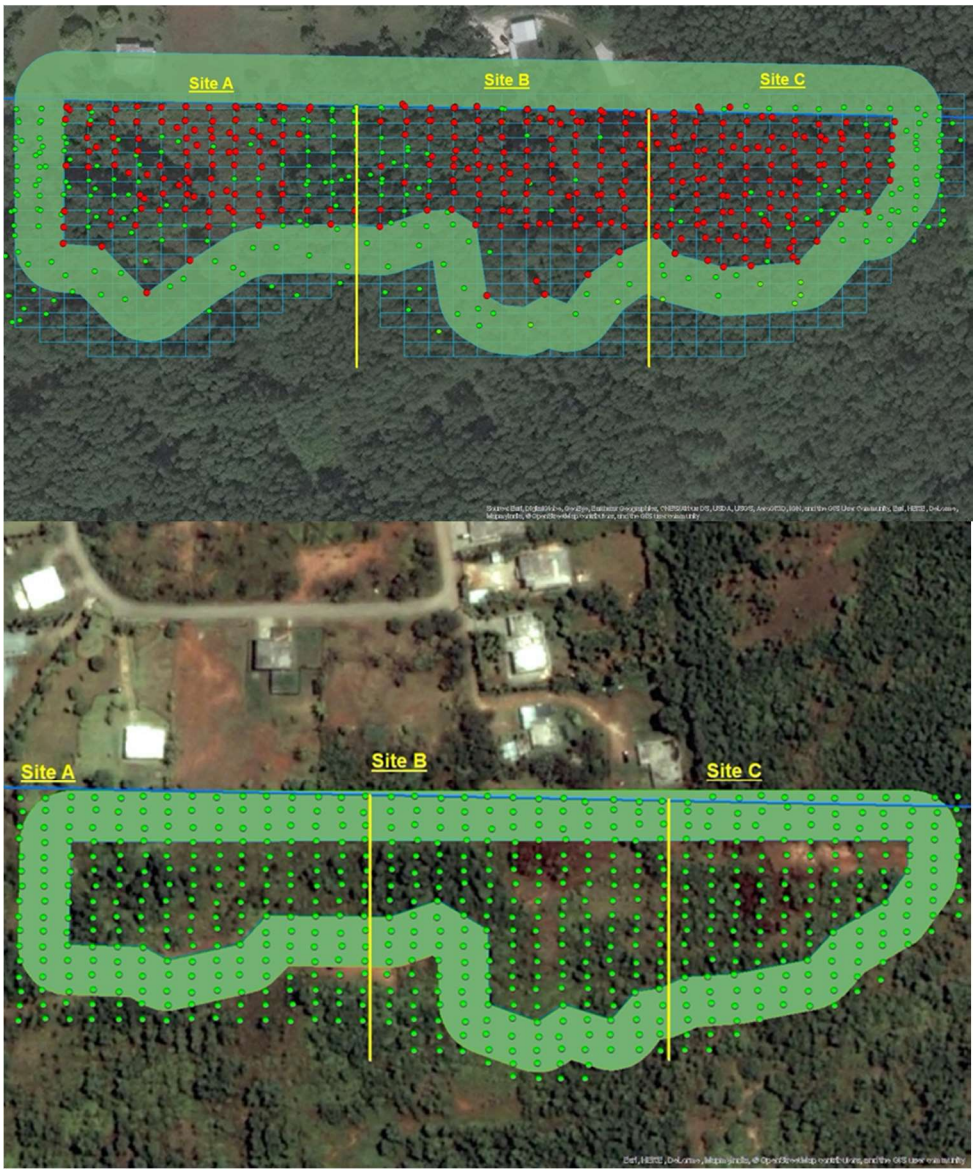


Figure 17. (A) Detail of the delimiting survey of the LFA infestation at NMS conducted as of April 2019. Green dots indicate no LFA detected and red dots indicate LFA detected during surveys. The green shaded area indicates a 20m wide buffer zone around the LFA infested area. (B) Post treatment monitoring results from July 2020 indicating no LFA detections as shown by green dots. Treatment period June 2019 – February 2020.

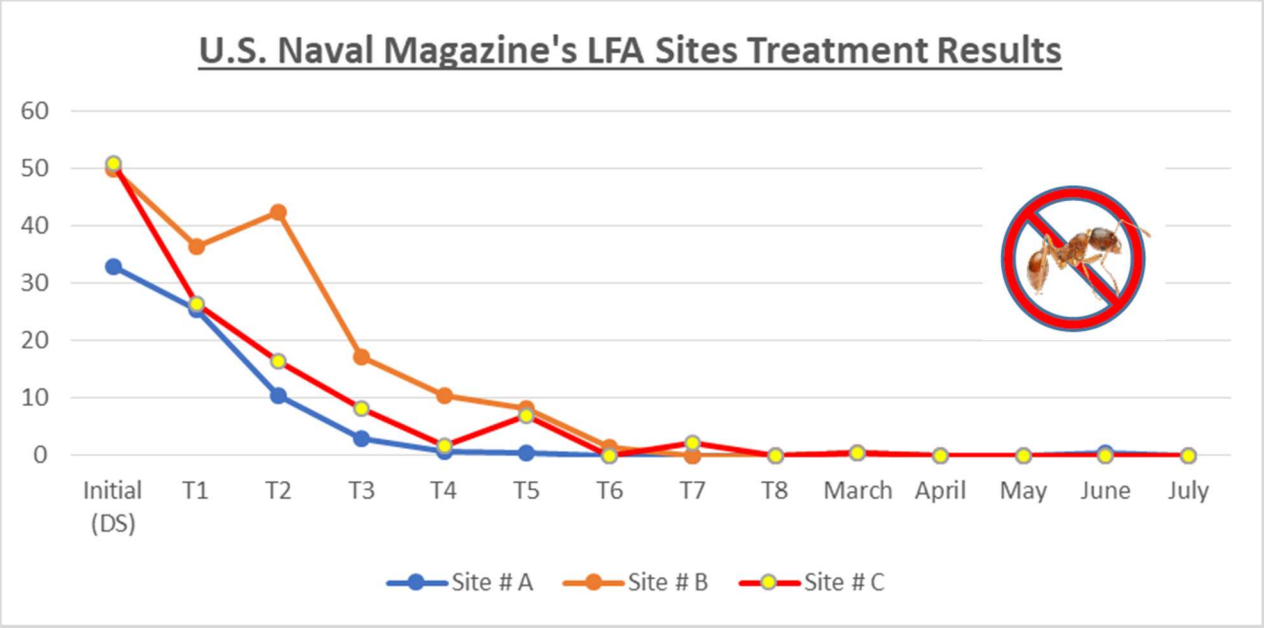


Figure 18. Survey results after each insecticide treatment and post treatment monitoring of LFA infestation within the NMS as of July 2020. Points indicate percent change in LFA detections during LFA monitoring efforts.

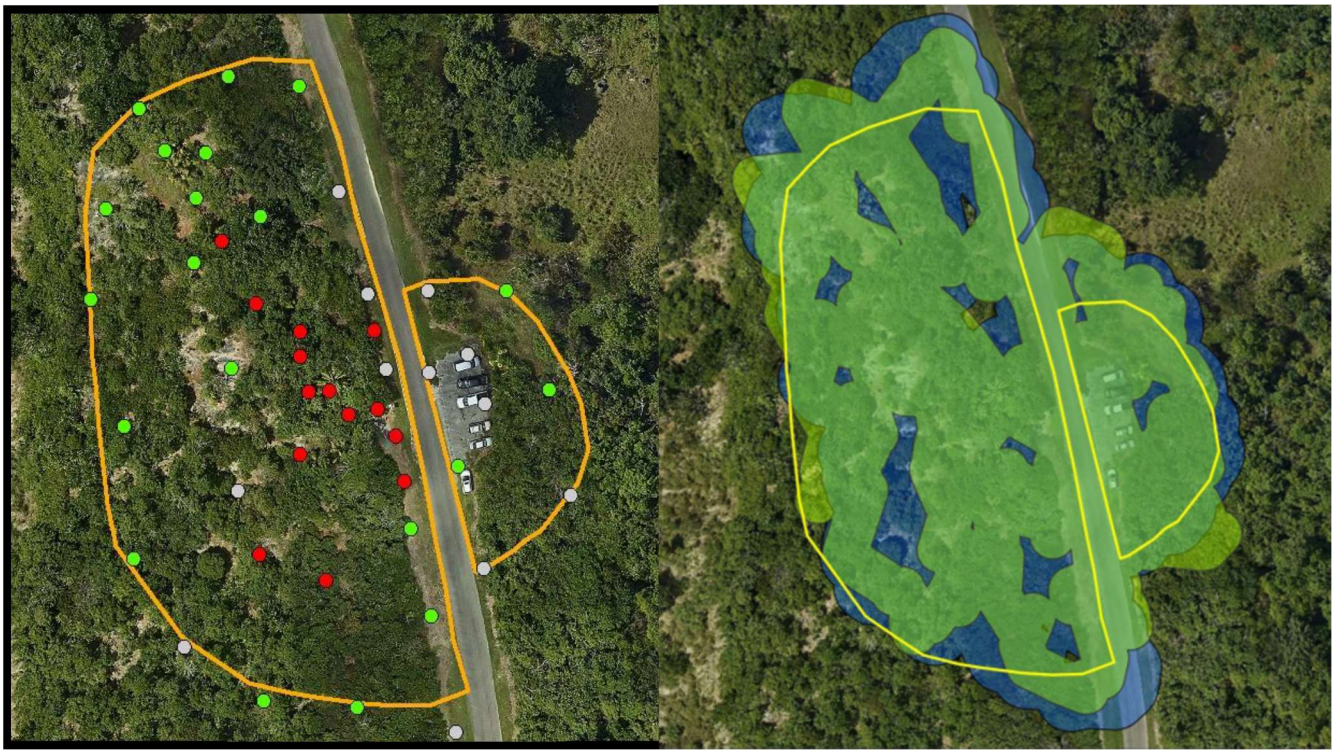


Figure 19. (A) Detail of the delimiting survey of the LFA infestation at Haputo Trailhead at NBG TS conducted as of August 2019. Green dots indicate no LFA detected and red dots

indicate LFA detected during surveys. (B) Indicates the track log of pesticide applicators applying Tango and Siesta insecticides within the LFA treatment area (1.86 acres) on the 8th treatment (July 2020). The green shading depicts the 5 meter buffer around the Siesta granular bait application and the blue shading depicts the 7.5 meter buffer around the Tango application used to calculate effective area treated. (CSU CEMML)

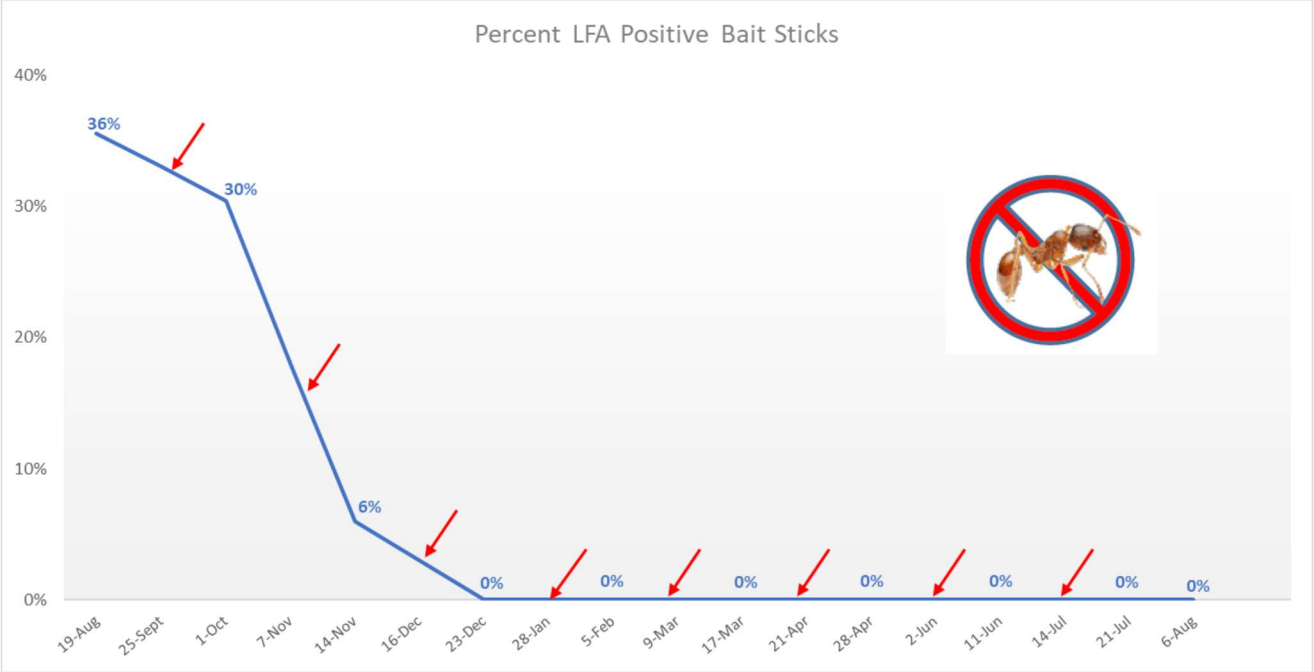


Figure 20. Reduction in the percentage of bait sticks that were positive for LFA at the Haputo Trailhead, NBG TS during surveys down to zero ants detected since December 23, 2019. Insecticide treatments indicated by red arrows. Treatment period September 2019 to July 2020. (CSU CEMML)

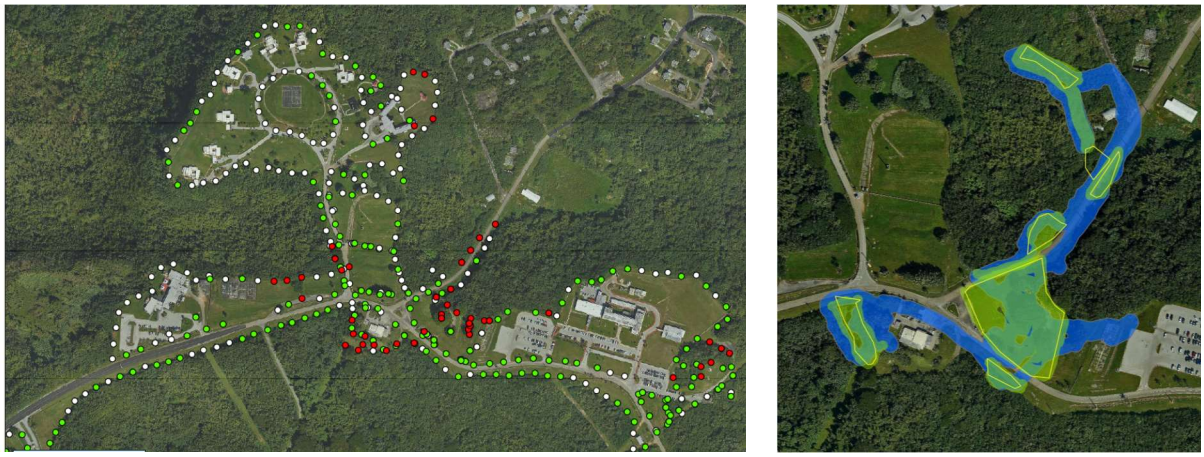


Figure 21. (A) Perimeter delimiting survey of the LFA infestation at Nimitz Hill, NBG conducted as of March 2020. Green dots indicate no LFA detected and red dots indicate LFA detected during surveys. (B) Indicates the track log of pesticide applicators applying Tango and Siesta insecticides within the LFA treatment area (2.06 acres) on the 2nd treatment (June 2020). The green shading depicts the 5 meter buffer around the Siesta granular bait application and the blue shading depicts the 7.5 meter buffer around the Tango application used to calculate effective area treated. (CSU CEMML)

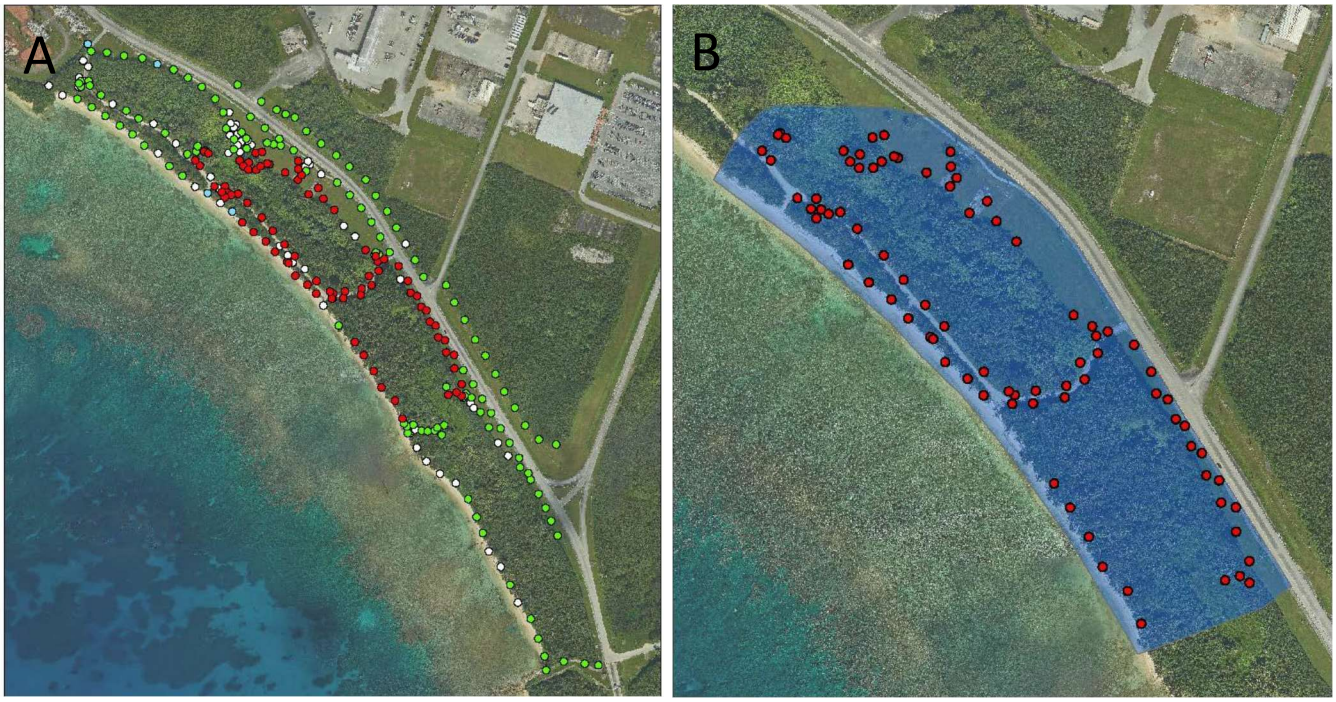


Figure 22. (A) Perimeter delimiting surveys of the LFA infestation at Dadi Beach, NBG conducted as of April 2020. Green dots indicate no LFA detected and red dots indicate LFA detected during surveys. (B) Depicts the proposed 14.5 acre LFA treatment area. (CSU CEMML)

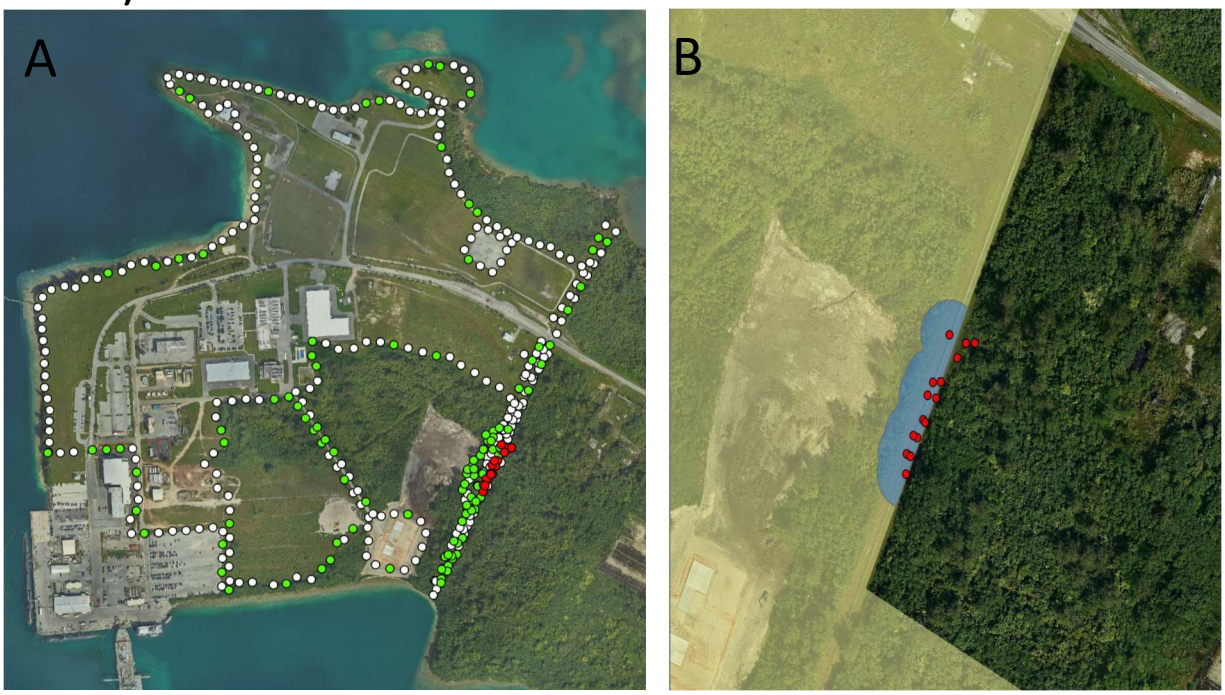


Figure 23. (A) Perimeter delimiting surveys of the LFA infestation at Dadi Beach, NBG conducted as of June 2020. Green dots indicate no LFA detected and red dots indicate LFA

detected during surveys. (B) Depicts the proposed 0.7 acre LFA treatment area. (CSU CEMML)



Figure 24. LFA awareness signage posted at installation locations with LFA infestations. Signage developed with resource partners.



Figure 25: Existing known LFA sites at Andy South (Green –Eradicated, Red – LFA infested)

Invasive Species Management within the Joint Region Marianas Area of Responsibility

Location: JRM **Period of Performance:** SEP2016 – JUL2021

Project Objective

In support of Mariana Islands Training & Testing (MITT) activities, 1) conduct Early Detection Surveys (EDS) non-native species at training and cargo staging locations within the JRM AOR (Guam and CNMI (Tinian Ports, Military Leased Area, Rota Ports); 2) develop and implement standard operating procedures for the control and removal of high-risk invasive species; 3) develop and implement invasive species rapid response protocols; 4) develop and implement bio-sanitation standards along with quality assurance/quality control standards; and 5) development of a programmatic pathway risk analysis for the movement of equipment and personnel within the JRM AOR; and 6) targeting high risk invasive arthropod species for control and eradication.

Conservation Benefit

Prevent the movement and establishment of invasive species into and out of Guam and the CNMI during training exercises.

FY20 Status

Ongoing cooperative agreement Colorado State University (CSU), Center for Environmental Management of Military Lands (CEMML).

Early Detection Surveys Conducted

- All-Taxa Surveys – AAFB: 9 of 24 sites; NBG: 11 of 27 sites
- Weed Surveys – AAFB: 11 of 28 sites; NBG: 16 of 48 sites
- No All-Taxa or Weed Surveys conducted in the CNMI during this reporting period

Development of SOPs for the Control/Eradication of High-Risk Species

- Red Imported Fire Ant (RIFA, *Solenopsis invicta*)
- Coqui Frog (*Eleutherodactylus coqui)*
- Mile-a-minute vine (*Mikania micrantha*)

Invasive Species Rapid Response

- No rapid response events occurred during FY20
- Five CSU CEMML personnel BTS Rapid Response certified

Bio-sanitation QA/QC Control Inspections during Military Training Events

- Two major training events (Cope North 20 / Valiant Shield 20)
- Two unit level training events
- 100's of items inspected arrival and departure to meet AFPMB TG-31 standards
- Bio-material interceptions (plant material, soil, insects, spiders, tree frog, etc.)(Figure 26)

Development of a Programmatic Pathway Risk Analysis for Movements into the Mariana Islands and between Islands

- Ongoing data collection to support the risk analysis

New FY20 Cooperative Agreement awarded to CSU CEMML (Jul2020 – Jul2021)

EPR: 2 BO MAR Mariana Islands Training and Testing (MITT) Implementation; 61128NR218
CHS NISA MAR JRM Implementation of the Regional Biosecurity Plan; 61128NR860
USMC HQ MITT Biological Opinion Conservation Measures Implement

2019 JRM INRMP Reference: TIS-6; 5-86, TIS-7; 6-44, TIS-6; 7-53, TIS-5; 8-51, TIS-7; 9-73, TIS-2; 11-62, TIS-1; 12-32; TIS-2; 12-33



Figure 26. Biosecurity interceptions during bio-sanitation QA/QC inspections during Cope North 2020 cargo/equipment arrival inspections on Guam (GU), Saipan (SP), and Tinian (TI). Clockwise from top left, Red-backed spider (Latrodectus hasseltii) from Australia (GU), Brown widow spider (Latrodectus geometricus) from mainland U.S. (GU), unidentified snail species from Japan (GU), Australian Green tree frog (Ranoidea caerulea) from Australia (GU), Kudzu vine seed pod (Pueraria montana) from South Korea (SP), and Mud wasp nest (Species not identified) from Guam (TI).

Coconut Rhinoceros Beetle (CRB; *Oryctes rhinoceros*) Surveys, Interdiction, and Monitoring - Guam

Location: DoD Lands on Guam **Period of Performance:** SEP2016 – SEP2021

Project Objective

To implement CRB best management practices: 1) identify and remove breeding sites, 2) implement interdiction and sentinel trapping, and 3) implement CRB awareness; coordinate and collaborate with resources partners, and provide outreach materials to installation and military training participants to reduce impacts to native ecosystems and military readiness activities.

Conservation Benefit

Enhance and restore habitats by prevention of the spread and establishment of the invasive CRB.

FY20 Status

- CRB Best Management Practices
    - Colorado State University (CSU) Center for Environmental Management of Military Lands (CEMML) implementing CRB management
    - 111 dead palm trees and 41 green waste and/or mulch piles removed across NBG/AAFB at the start of the FY20
    - Received $100K USFS/DoD grant for Forest Pest Suppression to remove CRB breeding sites on NBG/AAFB
    - Conducted biannual CRB breeding site surveys on NBG/AAFB
    - 282 CRB sentinel/interdiction traps deployed on NBG and AAFB (August 2020) (Figure 27)
- Coordination with regional partners (GovGuam Dept. Ag. & CNMI DLNR)

EPR: 2 BO MAR Mariana Islands Training and Testing (MITT) Implementation; 61128NR218
CHS NISA MAR JRM Implementation of the Regional Biosecurity Plan; 61128NR860
USMC HQ MITT Biological Opinion Conservation Measures Implement

2019 JRM INRMP Reference: TIS-5; 5-86, TIS-6; 5-87, TIS-6; 6-44, TIS-7; 6-45, TIS-4; 7-53, TIS-6; 7-53, TIS-5; 8-52, TIS-6; 8-52, TIS-5; 9-72, TIS-7; 9-73, TIS-1; 11-62, TIS-2; 11-63, TIS-1; 12-32, TIS-2; 12-33

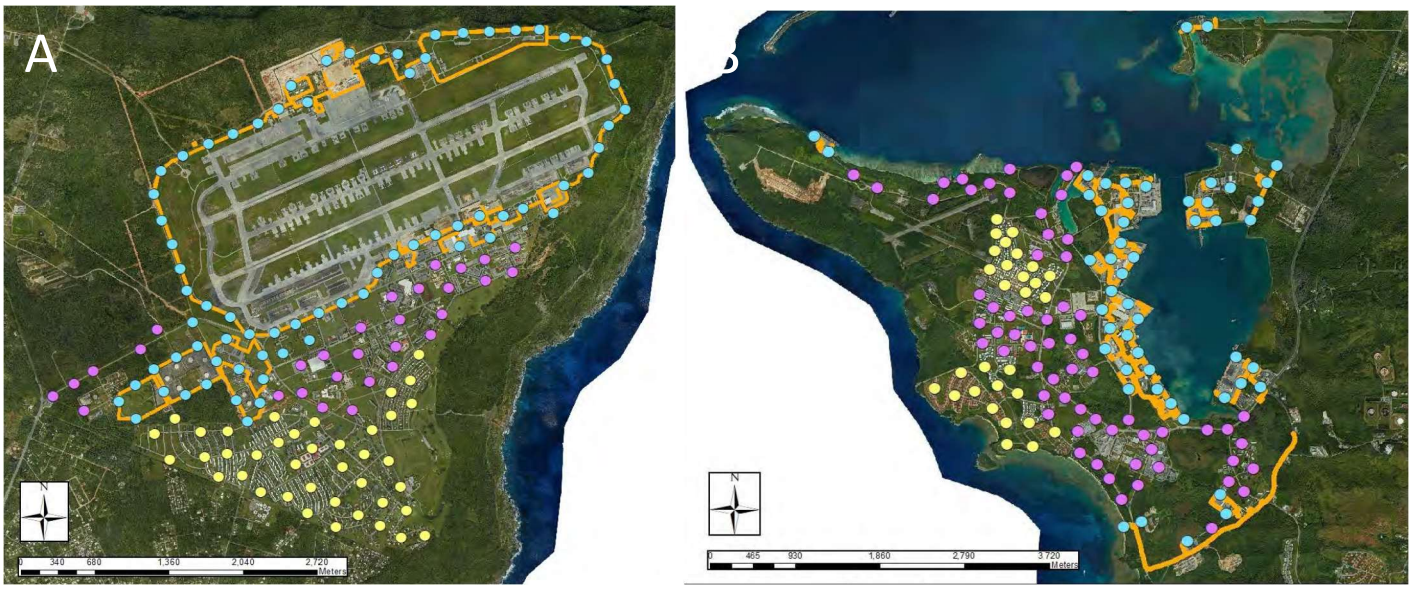


Figure 27. (A) CRB black panel trap deployment locations at Andersen AFB. (B) CRB black panel trap deployment locations at Naval Base Guam. Blue dots indicate Priority 1 Areas adjacent to flightline and piers/wharves, Purple dots are Priority 2 Areas within industrialized areas, and Yellow dots are Priority 3 Areas associated with housing areas. (CSU CEMML)

BTS Control at Mariana Swiftlet Caves

Location: NBG; NMS **Period of Performance:** OCT2018 – Ongoing

Project Objective

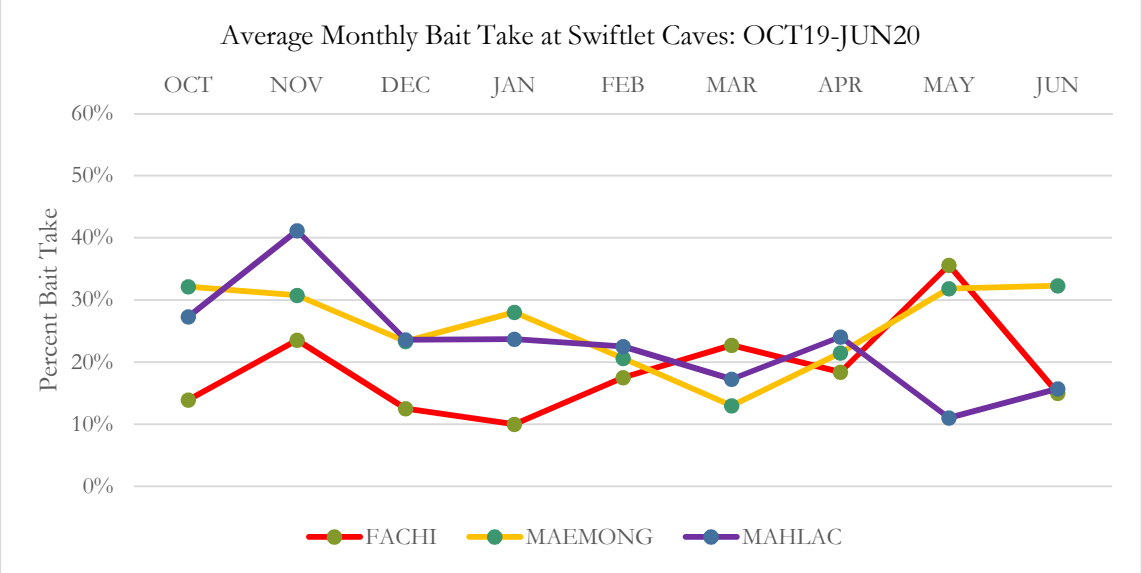
Ongoing long-term BTS protection of the Mariana Swiftlet (*Aerodramus bartschi*). Protection consists of oral toxicants for BTS around the areas surrounding Mahlac, Fachi, and Maemong caves, NMS.

Conservation Benefit

Maintain or increase swiftlet population and enhance or restore habitat by reducing predation by BTS.

FY20 Status

- Ongoing project with Center for Management of Military Lands (CEMML)
- 100% bait tubes since October 2019
- Baiting once per week to reduce disturbance
- 3710 baits deployed since October 2019
- Average annual toxicant take rate FY15-20 = 597 (13.9%)
- FY20 average bait take rate to date = 23%



*Bait Taken does not mean taken by a BTS as other animals may take the bait.

Figure 28. Average monthly bait take at Swiftlet caves.

EPR: 1 MAR NBG Mariana Swiftlet Population Protection: BTS Trapping
2019 JRM INRMP Reference: TIS-2; 6-43

Evaluation of BTS Control to Improve Management of Guam's Remnant Mariana Swiftlet Population

Location: NMS **Period of Performance:** SEP2018 – MAR2020

Project Objective

Estimate Mariana swiftlet (*Aerodramus bartschi*) population size derived from thermal videography recordings coupled with estimates of movement patterns in and out of the caves. Evaluate the effect of bait type (bird/mammal) on targeting snakes entering swiftlet caves to help inform capture efficacy and management strategies.

Conservation Benefit

As one of two remaining forest birds on Guam, protection of Mariana Swiftlets is an import conservation goal for JRM. Data gathered from the study will help in designing different methods or strategies for reducing BTS populations in and around occupied and unoccupied caves. Accurate counts of swiftlets will help improve reporting and understanding population dynamics to develop/refine management goals.

FY20 Status

- Funded with an interagency agreement with USGS – Fort Collins and USGS – Pacific Island Ecosystems Research Center (PIERC); project complete
- Five visual searches yielded three (3) in cave BTS (Average SVL: 905mm).
- Thermal counts appear lower than entrance counts but similar to counts with night vision goggles
- Diet history, snake size influence bait preference, and highlights the likely need for a multi-tool approach to BTS control

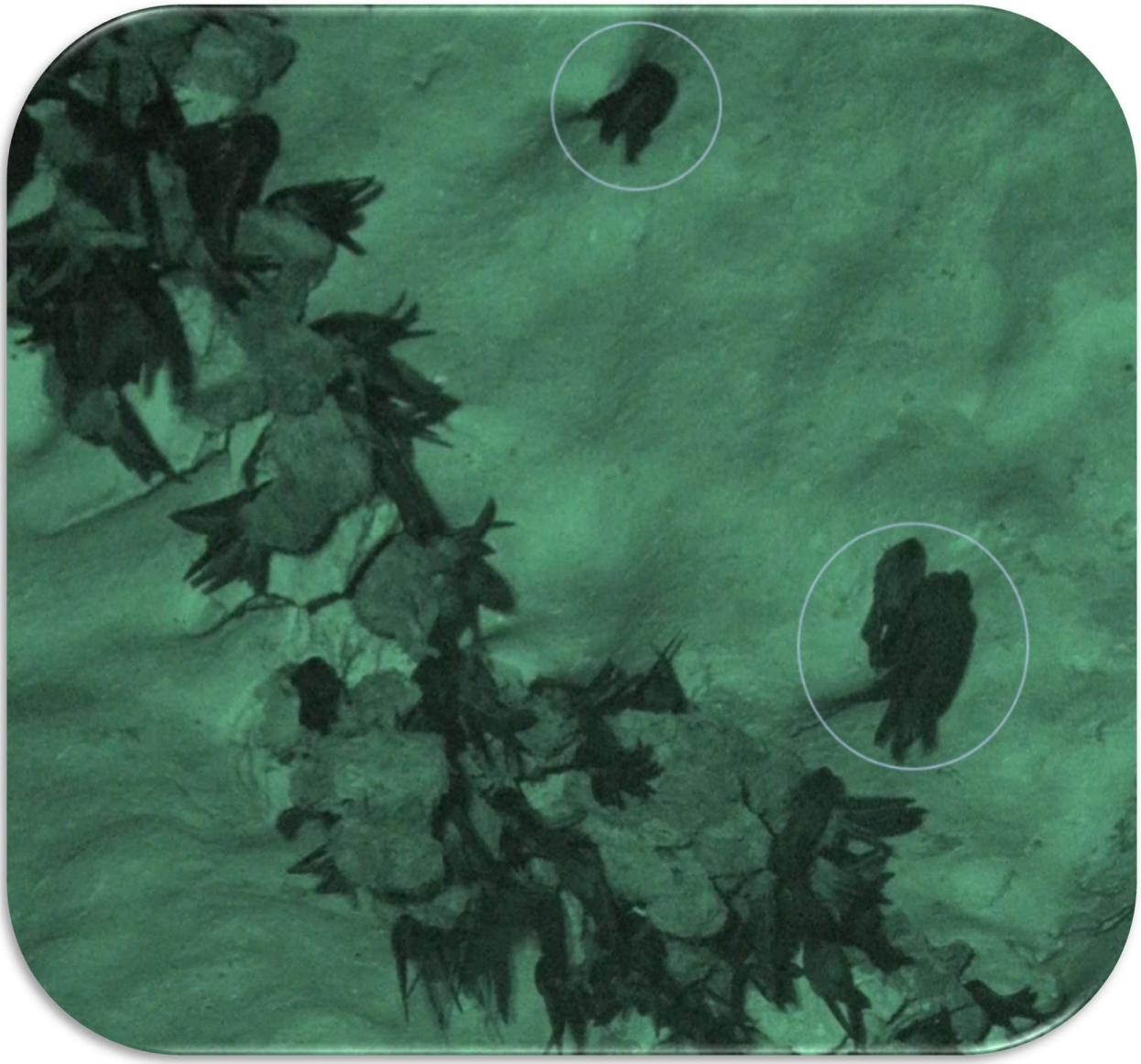


Figure 29. Night roosting swiftlets can be associated with nests (nesting adults and attenders) or roost away from the nest (non-nesting roosters [white circles])

EPR: 1 RP JRM BTS Eradication and Control to Support Recovery of ESA- Listed Birds; 61128NR202

2019 JRM INRMP Reference: TIS-3; 6-43

Feral Dog and Cat Control and Management – NBG

Location: NBG; NMS **Period of Performance:** SEP2018 – SEP2020

Project Objective

Determine the population numbers of feral dogs and cats on the NMS and NBG Main Base. Trail cameras are utilized for a mark/re-sight methodology to estimate the feral dog and cat populations. Development of a management plan for the best method for feral dog and cat control, and implementation of that plan in the coming years.

Conservation Benefit

Control invasive species that directly or indirectly impact native species.

FY 20 Status

- USDA will begin feral dog and cat control on NMS during September/October 2020
- NBG main base camera surveys completed by Sundance EA Inc. FY 2020.
- A total of 64 stations, 2 zones of 32 stations each, were sampled for 6 weeks for each zone (see Figure 30).
- There were not enough feral dog detections (4 individuals) for a population estimate
- Feral cat estimate is 34 cats (95% confidence interval 30- 50).
- Feral dog and cat control on NBG will proceed in FY 2021 and continue on NMS dependent on funding

EPR: CHS MAR NBG Feral Dog and Cat Control and Management; 61755NR358

2020 JRM INRMP Reference: TIS-4; 6-43

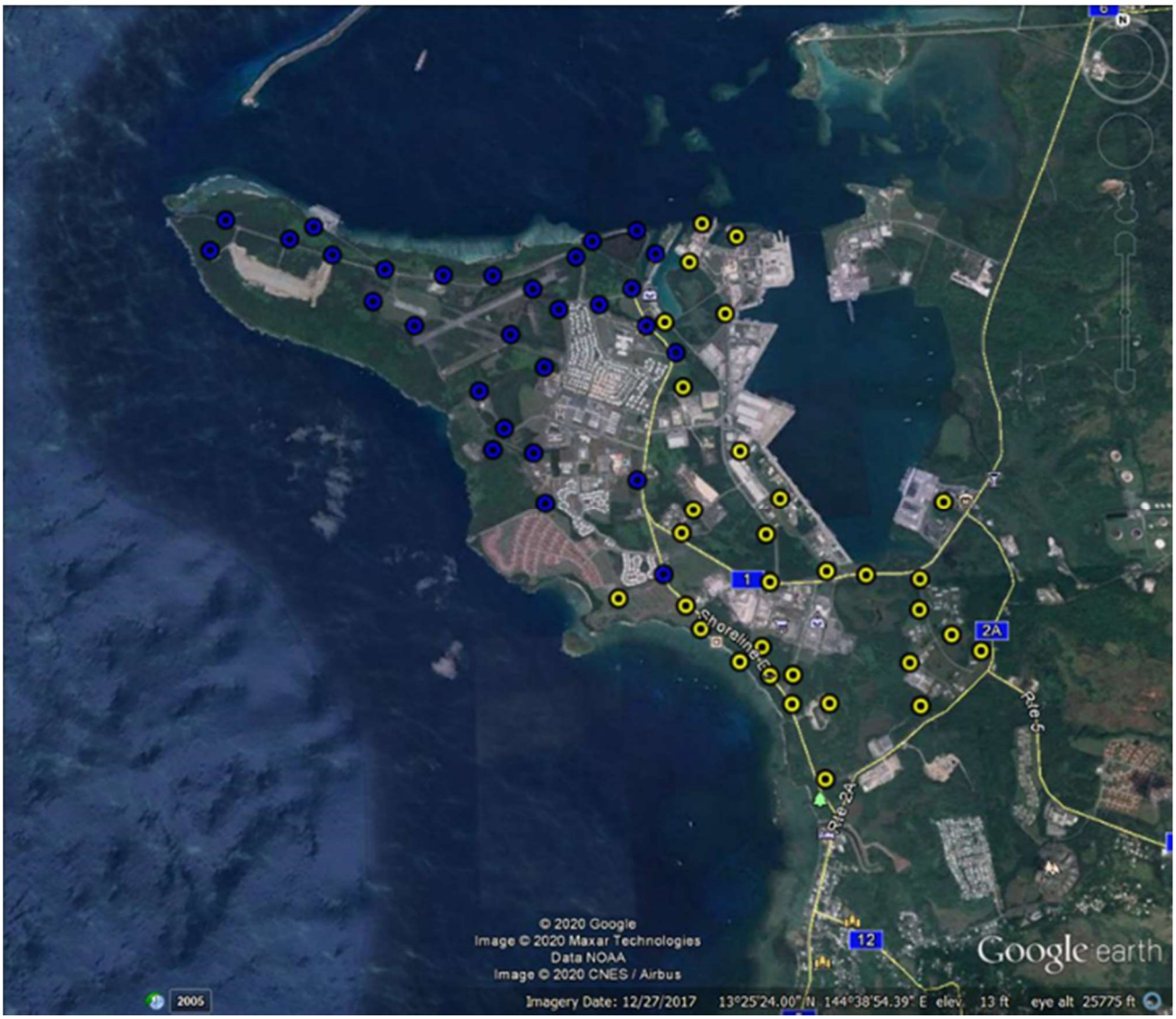


Figure 30. Locations (yellow and blue dots) where trail cameras monitored for feral cats and dogs on the NBG during FY20

Ungulate Management Population Control – NBG

Location: NBG; NMS; NBG T **Period of Performance:** AUG2019 – OCT2019

Project Objective

Conduct population surveys of the Guam Navy lands to determine locations and estimate numbers of feral animals, review accepted control measures, control ungulates in fenced and unfenced areas.

Conservation Benefit

Enhance and restore native habitats and increase populations of native species, particularly threatened and endangered species.

FY 20 No work was done for ungulate control; however, FY 19 work continued briefly into FY 2020

- Deer (10) and pigs (4) were removed by White Buffalo Inc. through a Cooperative Agreement from inside the second fenced area (60 acres) on NMS in August-October 2019.

EPR: 1 RP MAR NBG Ungulate Management Population Control; 61755NR807

2020 JRM INRMP Reference: TIS-6; 6-44

Brown Treesnake Interdiction to Prevent the Spread Via the DOD Transportation Network Originating On Guam

Location: JRM **Period of Performance:** OCT2019 – SEP2020

Project Objective

To prevent the spread of BTS to other Pacific islands including the CNMI and Hawaii, this JRM project is funded to conduct BTS control and interdiction efforts on Navy Base Guam (NBG) and Andersen AFB (AAFB) to prevent snakes from getting into the DoD transportation network. Methods include BTS trapping, toxicants, nighttime visual fence line searches, and canine inspections of outbound items. The BTS Interdiction program also supports training events occurring in the region that originate from Guam. Joint Region Marianas develops BTS control and interdiction plans for each training exercise that requires the movement of personnel and assets to the CNMI from Guam. Additional BTS inspections and control measures are implemented in the CNMI when determined necessary by the stakeholders.

Conservation Benefit

Preventing the spread of BTS via the military transportation network keeps BTS on Guam and from establishing in other ecologically sensitive areas in the Pacific region where vulnerable island species would be susceptible to BTS predation.

FY20 Status

- Ongoing and enduring JRM requirement
- Interdiction support provided to COPE NORTH 2020 and Valiant Shield 2020
- 7 missed Inspection (99.99%)
- No BTS detections in outbound cargo

Table 2. BTS Take and K9 Inspections OCT2019 – JUL2020. * Trap nights = 304 days X number of traps, CPUE = number of BTS/total traps nights per installation.

	Number Traps	Trap Captures	Capture Per Unit Effort* (Trap Nights)	Spotlight Captures	Number Baits	Number Bait Takes	% Bait Take			
AAFB	892	1306	1 BTS per 208 nights	251	35,640	7158	20%			
NBG	429	793	1 BTS per 167 nights	74	48,222	4379	9%			
	ITEM				**DESTINATION**					
	Cargo	**Aircraft**	**Vehicles**	**HHG**	**Navy Vessel**	**Hawaii**	**Other Pacific**	**Other**	**CONUS**	**CNMI**
AAFB K9	29,798	1202	436	652	1368	2463	7704	16,858	3538	157
NBG K9	57,691	1890	1571	1298	47,352	585	4071	6113	2892	1437
Total	***87,489***	***3092***	***2007***	***1950***	***48,720***	***3048***	***11,775***	***22,971***	***6430***	***1594***

EPR: Project is funded by facilities maintenance dollars, no conservation funding for this project.

2019 JRM INRMP Reference: TIS-1; 5-84, 6-42; 7-51, 8-50, 9-70

Aerial Baiting Operations and Ground Support for Suppression in the HMU, Andersen AFB

Location: JRM **Period of Performance:** JAN2020 – AUG2021

Project Objective

To provide operational helicopter support, to include a pilot, mechanic, and technical support, to support on-site monitoring of bait drops during 9 aerial baiting applications within the HMU, AAFB

Conservation Benefit

The advent of aerial baiting, demonstrates the potential for meaningful impacts on BTS populations at the landscape level. Dropping aerial baits in the HMU will provide data and insight into BTS responses to aerial baiting over time. Aerial baiting increases the amount of landscape that can be targeted for BTS suppression and control. Landscape level control would likely improve DoD conservation efforts in support of the recovery of listed species on JRM lands and assist with interdiction efforts.

FY20 Status

- Funded via an interagency agreement with USDA –WS; project ongoing
- Delayed due to COVID-19 – travel restrictions
- Three (3) drops in February 2019 = 19, 946 baits
- Further drops tentatively scheduled for October
- Constant quality assurance improvements



Figure 31. USDA/WS helicopter conducting aerial baiting transect over HMU, AAFB, Guam

EPR: 1 RP JRM BTS Eradication and Control to Support Recovery of ESA- Listed Birds; 61128NR202

2019 JRM INRMP Reference: TIS-1, TIS-2, TIS-3; 5-85, 6-43; 7-52, 8-50-51, 9-71

Brown Treesnake Monitoring in HMU Post Aerial Delivery System Drops

Location: JRM **Period of Performance:** NOV2019 – MAY2021

Project Objective

To collect data to monitor take rates of DNM between ADS drops using randomized bait tube transects, provide field tech support for data collection of field projects related to BTS surveillance studies, and to search for bait cartridges post drop to evaluate efficacy.

Conservation Benefit

The advent of aerial baiting, demonstrates the potential for meaningful impacts on BTS populations at the landscape level. Data collection of BTS responses between drops is an important need in evaluating overall effectiveness of aerial baiting. Aerial baiting increases the amount of landscape that can be targeted for BTS suppression and control. Landscape level control would likely improve DoD conservation efforts in support of the recovery of listed species on JRM lands and assist with interdiction efforts.

FY20 Status

- Funded via an Interagency Agreement with USDA–WS; project ongoing
- Supports ADS drop operations
- Constant quality assurance improvements
- No cost extension



Figure 32. Toxicant bait suspended on HMU barrier after drop.

EPR: No EPR - funded under the Guam Micronesian Kingfisher MOA.
2019 JRM INRMP Reference: TIS-1, TIS-2, TIS-3; 5-85, 6-43; 7-52, 8-50-51, 9-71

Habitat Management Unit Biomonitor Support and ESA Listed Species Identification Training

Location: AAFB **Period of Performance:** JAN20 – JAN2021

Project Objective

To provide biomonitor support during aerial baiting project by the ADS, to observe for presence of Mariana Fruit Bat (Pteropus mariannus mariannus, Fanihi) and observe for take.

Conservation Benefit

Allow for the continuance of the ADS project while monitoring for the presence of fanihi per requirements of the 2018 HMU ADS Biological Opinion.

FY20 Status

- Agreement via the CESU network with UOG – Center for Island Sustainability (CIS).
- HMU Biomonitor support on hold due to delay of aerial baiting drops.
- 2 bats observed over three scheduled drops (Feb 19, 22, and 25 2020), no interactions with helicopter occurred – all transient flights over the HMU. –
- 2 Trainings for ESA listed species surveys conducted with 18 attendees from resource partner agencies

EPR: 1 RP JRM BTS Eradication and Control to Support Recovery of ESA- Listed Birds; 61128NR202

2019 JRM INRMP Reference: TIS-2, TIS-3; 5-85, 6-43; 7-52, 8-50-51, 9-71

Artificial Toxic Bait for Landscape-scale BTS Suppression – AAFB

Location: AAFB **Period of Performance:** JUL2018 – DEC2019

Project Objective

To develop an artificial bait matrix with similar take rates as dead neo-natal mice and deployable by aerial delivery. To transfer bait production knowledge and capacity to National Wildlife Research Center (NWRC) facilities in Hilo, HI, collaborate with USDA-Agricultural Research Service-Eastern Regional Research Center (USDA-ARS-ERRC) to refine the bait formulation to permit attachment of the artificial bait to the Automated Delivery System (ADS) cartridge.

Conservation Benefit

Development of artificial bait to replace the standard dead neo-natal (DNM) mouse is significant technological goal to reduce overall cost and maintain the same level of impact to BTS populations. If the bait component of the aerial bait cartridge can be achieve, cost savings would keep costs lower but increase the amount of landscape covered by toxicants. Aerial baiting on a landscape scale is a critical tool to support recovery goals for listed species on Guam.

FY20 Status

- Funded via an interagency agreement with USDA–NWRC; project complete
- Artificial lipid formulation have high takes rates >75% - lower than mice (98%)
- Artificial baits last up to 14 days, mice (DNM) decompose in 5 days
- Re-funded to refine production, more field trials, test formulation/palatability, and toxicity.
- New period of performance SEP2020 – MAR2022

Table 3. Six baits used in trial to determine if cheaper sources of lipids could be used in the bait formulation.

Bait #	Artificial Mouse Fat	Mass of Pork Fat (g)	Per Unit Cost
BE-34	"Original"	210	$0.27
BE-37	Evening Primrose Oil (EPO) substitution	209	$0.11
BE-38	Natural fats substitution	209	$0.03
BE-36*	"Original"	0	$0.23
BE-39	Evening Primrose Oil (EPO) substitution	0	$0.10
BE-40*	Natural fats substitution	0	$0.03

***BE-36 and BE-40 demonstrated the highest take rates for artificial lipids at the lowest price points**

EPR: No EPR - funded under the Guam Micronesian Kingfisher MOA

2019 JRM INRMP Reference: TIS-1, TIS-2, TIS-3; 5-85, 6-43; 7-52, 8-50-51, 9-71

Monitoring of Reduction in BTS Abundance during Eradication Activities in the HMU and Evaluation of Alternative Ground Baits for Large BTS

Location: JRM **Period of Performance:** SEP2019 – MAR2021

Project Objective

To continue monitoring BTS population levels after a series of 12 aerial baiting within the HMU and continue monitoring populations before, during, and after the next proposed series of drops. Abundance of BTS will be measured through analysis of non-toxic bait take, cameras captures. Additionally, a known-fate component will be conducted; BTS captured in the HMU will be radio-tagged and tracked. A bait trial for large BTS will be conducted to help assess the need for alternative baits for BTS not attracted by standard baits, additionally, well-water is being monitored for acetaminophen percolation.

Conservation Benefit

To increase effectiveness of large BTS control that currently have limited susceptibility to aerial bait application to enhance and restore habitat, and to assist in potential reintroduction of ESA listed species to the wild on Guam. Determining the level of impact from landscape scale BTS control is an essential requirement to evaluate success and future investment when considering species restoration on Guam.

FY20 Status

- Funded via an interagency agreement with USDA –NWRC; project in progress
- Non-toxic bait takes show increase after prolonged intervals between drops
- No detection of acetaminophen in ground water

EPR: No EPR - funded under the Guam Micronesian Kingfisher MOA.

2019 JRM INRMP Reference: TIS-1, TIS-2, TIS-3; 5-85, 6-43; 7-52, 8-50-51, 9-71

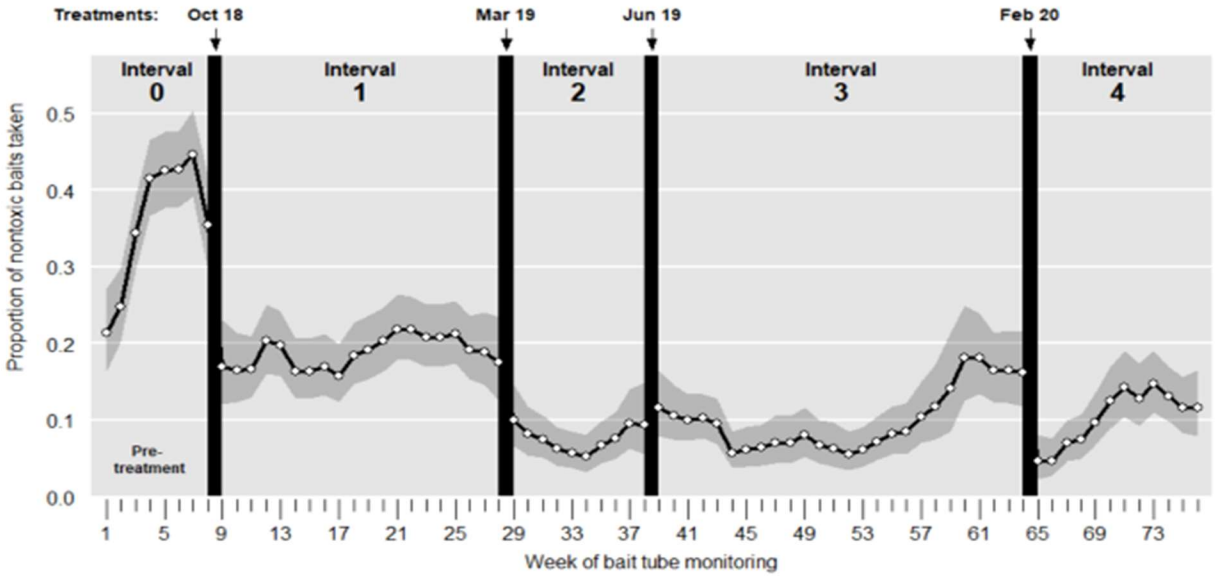


Figure 33. Weekly estimates of bait take rates, black bar represents a treatment period. The shaded area represents the 95% confidence interval for the estimate.

Assessment of BTS Fates after Toxicant Delivery to the Habitat Management Unit, AAFB

Location: AAFB; **Period of Performance:** MAY2018 – NOV2019

Project Objective

To determine the fate of known BTS based on demographics after a series of aerial baiting treatments in the HMU on AAFB. Two groups of BTS will be capture and have radio transmitters surgically implanted. Data will analyzed ad compared to previously collected data from a previous iteration of this project.

Conservation Benefit

Determining size-based susceptibility is essential for developing accurate demographic models to help inform suppression and eradication techniques. Moreover, identification of whether there is an upper threshold in susceptibility to ADS baits exists for large individuals will inform if complementary tools that better target large snakes are required during ADS application. Understanding the proportion of known individuals that are targeted by toxicants and their morphometrics prior to a toxicant drop is essential for methodological refinement and informing other suppression efforts. Understanding individual variation in susceptibility to ADS is also vital to prescribing toxicant application at an intensity and frequency that will result in effective suppression or eradication of BTS.

FY20 Status

- Funded via an interagency agreement with USGS – Fort Collins
- Some data lost due to problems with attaching transmitters
- 37% of tagged BTS (11/30) died post drop
- Size effect detected: smaller BTS (SVL $\leq$ 1040) showing higher death rate
- Data collection resumes after ADS drops in the HMU, estimated OCT2020
- Project complete□□new period of performance APR2020 – OCT2021

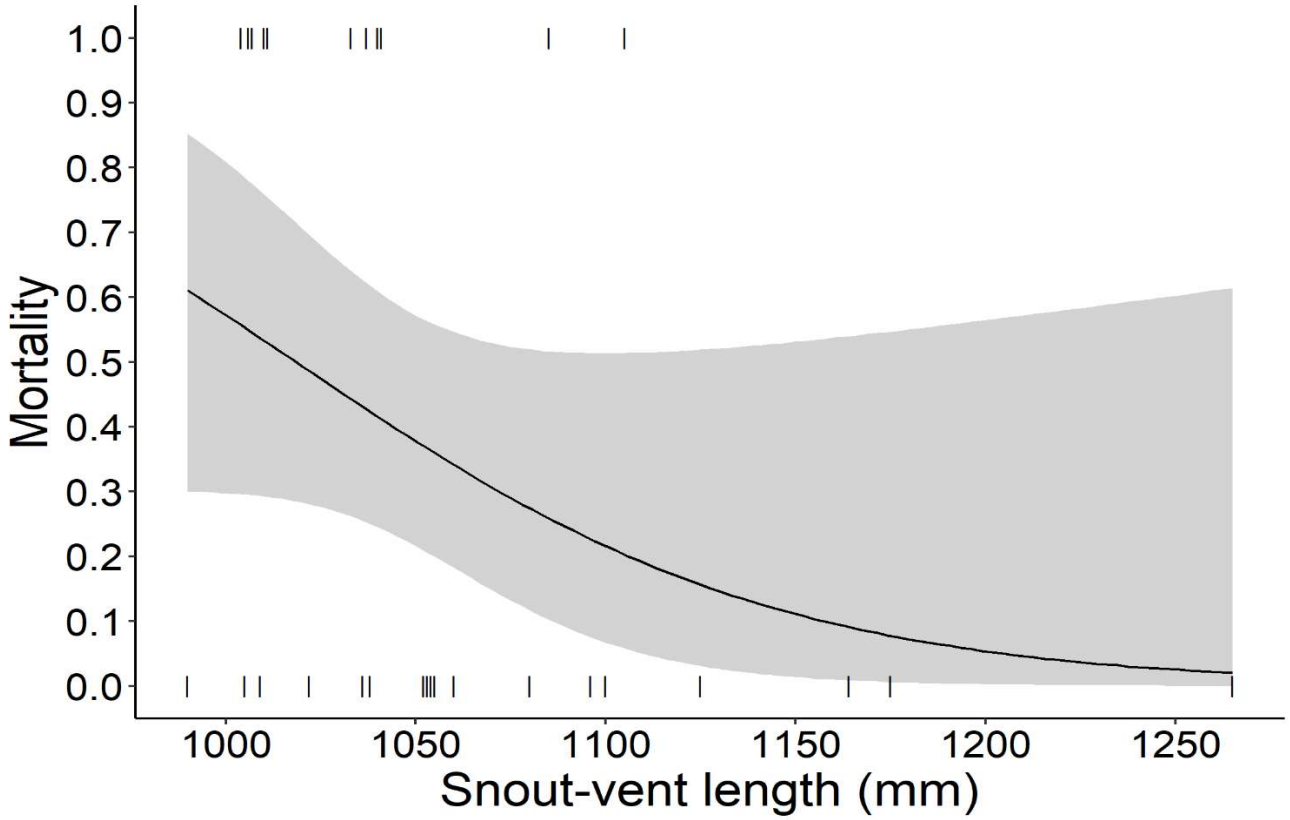


Figure 34. Effect of SVL on BTS mortality probabilities (lack line) surrounded by 95% confidence intervals (grey band) during two week treatment period. Tick marks indicate SVL of individual radio tagged snakes that survived (0.0) or died (1.0) during the treatment period (USGS-FORT).

EPR: 1 RP JRM BTS Eradication and Control to Support Recovery of ESA- Listed Birds; 61128NR202

2019 JRM INRMP Reference: TIS-2, TIS-3; 5-85, 6-43; 7-52, 8-50-51, 9-71

Monitoring Demographic and Ecological Effects of Sustained Automated Delivery System Treatment in The HMU, Andersen, AFB

Location: AAFB; **Period of Performance:** MAY2018 – NOV2019

Project Objective

Evaluate visual searching along minimally cleared transects versus trackless areas within 5 sub-plots; evaluate visual searching versus bait tubes and camera surveillance as a low density monitoring tool for BTS (compare with USDA/NWRC), and monitor demographic change in encounter frequency of BTS during visual searches.

Conservation Benefit

This will assess specific monitoring tools inform current structures of BTS populations and their small mammal prey, improved demographic inform and levels of suppression will inform future conservation efforts. Rodent prey have been determined to have strong effects on efficacy of snake suppression; monitoring their populations is likely to improve efficacy of individual landscape scale level applications. This project provide data to enhance and restore habitat, and to assist in potential reintroduction of ESA listed species to the wild on Guam.

FY20 Status

- Funded via an interagency agreement with USGS – Fort Collins
- Captures per unit effort (CPUE) declined across treatment periods
- Population structure shifted to smaller BTS after early drops
- Visual surveys and bait tube takes demonstrate decline in BTS population after baiting
- Size effect detected: smaller BTS (SVL $\leq$ 1040) showing higher death rate
- Project complete new period of performance APR2020 – OCT2021

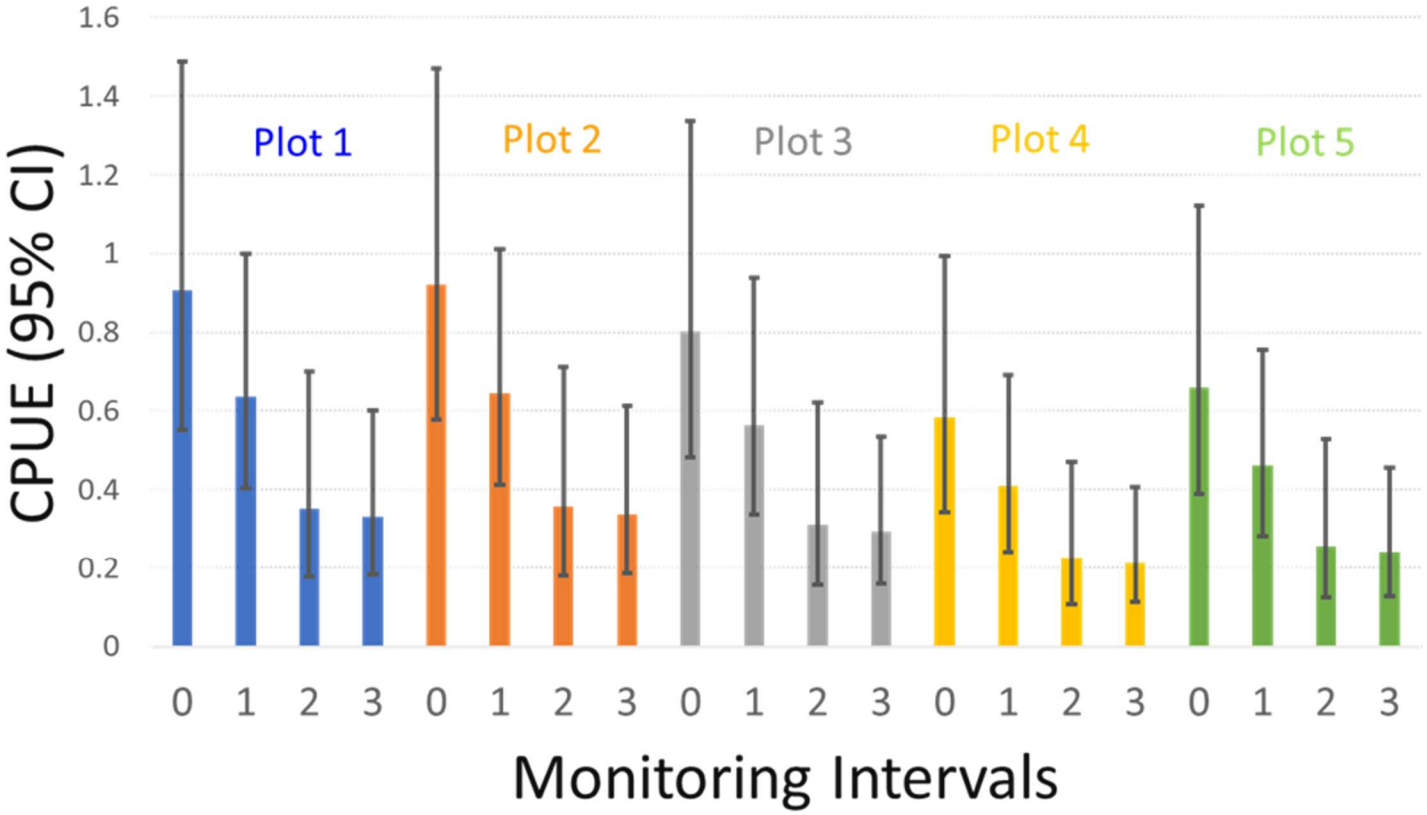


Figure 35. Habitat Management Unit (HMU, 55 ha) visual survey results for the 5 monitored sub plots over time (2018-2020). Automated Delivery System monitoring intervals are defined as: 0 = plot pre-toxicant treatment and numbers 1-4 indicate the time period immediately following the ordered toxicant treatments. Each plot shows a similar decline in snake captures over time.

EPR: 1 RP JRM BTS Eradication and Control to Support Recovery of ESA- Listed Birds; 61128NR202

2019 JRM INRMP Reference: TIS-2, TIS-3; 5-85, 6-43; 7-52, 8-50-51, 9-71

Long-term known fate monitoring of large snakes in conjunction with Closed Population Eradication – AAFB

Location: AAFB **Period of Performance:** SEP2018 – MAR2020

Project Objective

Identify effective supplementary control tools for large snakes that are refractory to ADS treatments; genetically identify which snakes are producing offspring during ADS suppression; assist with snake collection (via visual surveys or trapping) for snake Known Fate research.

Conservation Benefit

It is known that very small and very large BTS are not as susceptible to current mouse baits. This project seeks to collect data to in Increase effectiveness of large BTS control that currently have limited susceptibility to aerial bait application. Collecting genetic data will help with population demography. The ability to target large BTS is a critical goal to enhance and restore habitat, and to assist in potential reintroduction of ESA listed species to the wild on Guam.

FY20 Status

- Funded via an interagency agreement with USGS – Fort Collins□□project complete
- Baits alone 10-15 years for eradication; additional tools halve the time required
- Potential maternal effect in offspring survivability maybe by size/health of offspring
- Smaller BTS more susceptible to baits; M/F BTS equally vulnerable

EPR: 1 RP JRM BTS Eradication and Control to Support Recovery of ESA- Listed Birds; 61128NR202

2019 JRM INRMP Reference: TIS-1, TIS-2, TIS-3; 5-85, 6-43; 7-52, 8-50-51, 9-71

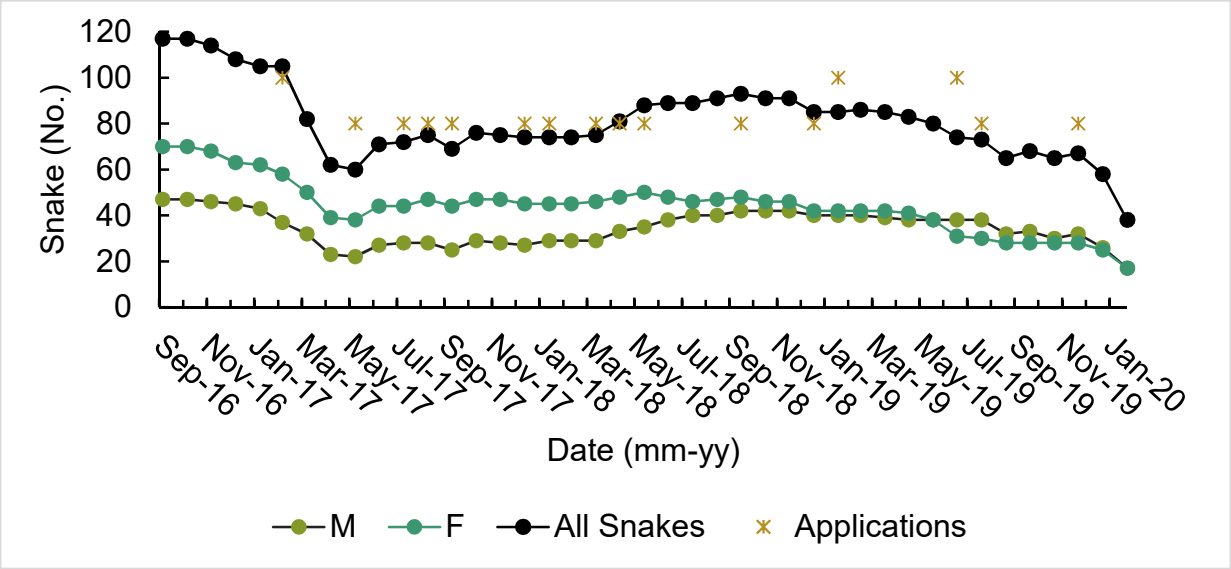


Figure 36. Population response of snakes to extended toxicant treatment in the 5 ha USGS Closed Population. USGS completed 20 applications across three years. The snake population was maintained at roughly 50% of the size prior to any treatments.

Evaluating Statistical Methods for Estimating Density of Invasive BTS from Camera Trapping Data – AAFB

Location: AAFB **Period of Performance:** SEP2018 – MAR2020

Project Objective

This project will evaluate several published models for their ability to provide robust estimates of BTS density by comparing know BTS populations numbers from Closed Population to results from analysis with the models. Data from 2015 will be used.

Conservation Benefit

Developing more robust monitoring is an important goal to help increase confidence in outcomes for landscape scale management for BTS. The ability to monitor suppressed BTS populations will be critical in determining success for reintroduction of avian populations. Low cost monitoring or robust population models can reduce costs and improve outcomes for propose reintroduction programs.

FY20 Status

- Funded via an interagency agreement with USGS –CRU; Washington University Extension project complete
- Current camera analysis methods poor at estimating BTS abundance.
- Current lure/bait methods bias the abundance estimate.
- Without ability to identify individual BTS, abundance estimation is a challenge.

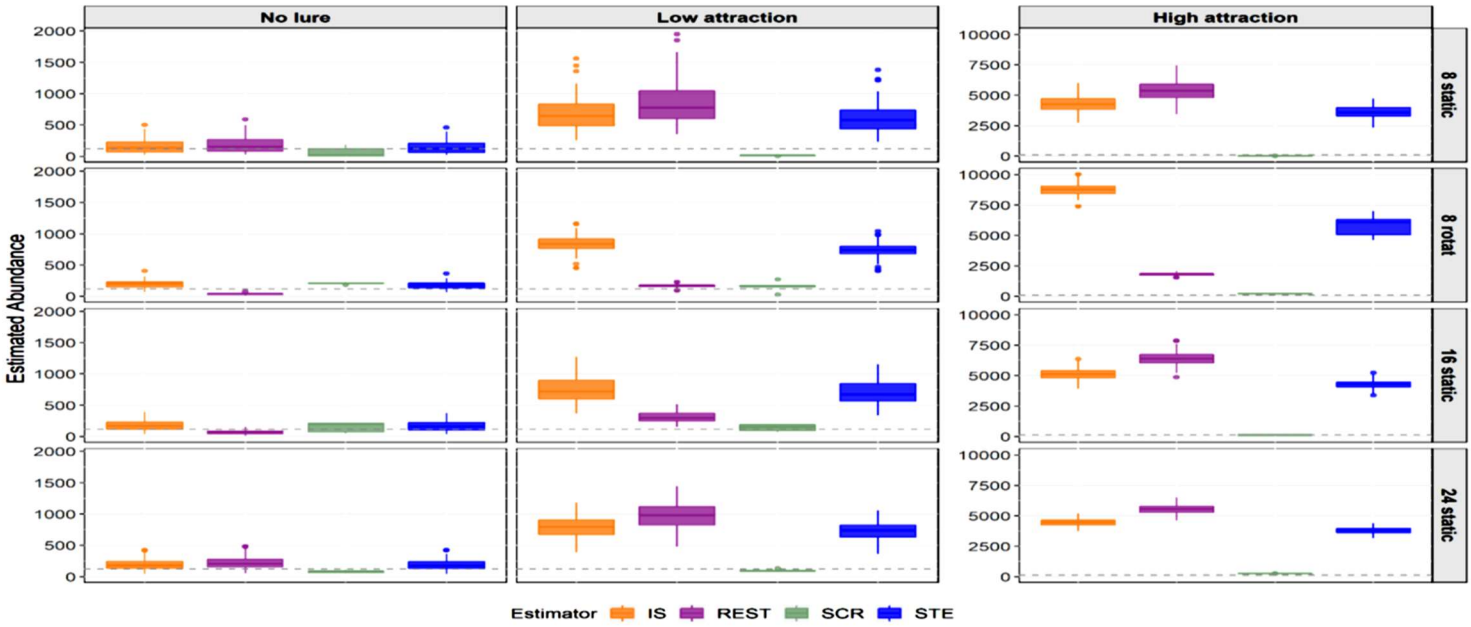


Figure 37. Comparison of estimator performance across each lure attraction (no, low, and high) and camera density (8 cameras rotating across 48 locations and 8, 16, and 24 static cameras) scenario. Boxplots of estimated snake abundance from 1000 simulations (except SCR unmarked models where only 5 simulations were used). Boxplots include median (darker line) abundance within the interquartile range (box), the range of values (whiskers), and outliers (points). True simulated abundance (120 snakes) is indicated as a dashed line.

EPR: 1 RP JRM BTS Eradication and Control to Support Recovery of ESA- Listed Birds; 61128NR202

2019 JRM INRMP Reference: TIS-2, TIS-3; 5-85, 6-43; 7-52, 8-50-51, 9-71

Estimation of Brown Treesnake Predation Threat Thresholds for Persistence of Reintroduced Birds on Guam – AAFB

Location: AAFB **Period of Performance:** SEP2019 – MAR2021

Project Objective

To evaluate the levels of snake suppression that might enable persistence of reintroduced birds under some acceptable level of BTS predation. It is unknown what snake density is tolerable when considering the reintroduction of avian species. The project will simulate nest contact rates with cameras and model the levels of nestling mortality that can be sustained while maintaining a stable or growing population of birds.

Conservation Benefit

It is widely recognized that eradication of BTS from Guam is not currently achievable, however, severe suppression is viewed favorably. Through considering avian species persistence in the presence of a suppressed BTS population it may help facilitate reintroductions in areas where management can be sustained and supported allowing for limited recovery of extirpated species.

FY20 Status

- Funded via an interagency agreement with USDA –NWRC; project in progress
- Species accounts being compiled for modeling data

EPR: No EPR - funded under the Guam Micronesian Kingfisher MOA.

2019 JRM INRMP Reference: TIS-2, TIS-3; 5-85, 6-43; 7-52, 8-50-51, 9-71

Using BTS Behavior and Movement to Refine Control on AAFB & for Improved Management of Native Forest Birds

Location: AAFB **Period of Performance:** SEP2019 – MAR2021

Project Objective

The goals of this project are to identify movement pathways used by BTS on AAFB, estimate abundance of BTS in relation to resources important to birds, and conduct a known-fate evaluation of BTS susceptibility to control based on size, sex, and food preference of snakes with radio-transmitters This project is one of four projects that will, collectively, further develop information on BTS behaviors related to predation and movement in the presence of abundant avian species.

Conservation Benefit

Better understanding of hotspots of BTS activity, travel pathways, and decision-making during foraging are critical to improve the coverage and efficacy of BTS control in a cost- effective manner. Additionally, population demographics that could be useful for supporting future avian restoration projects and controlling BTS in low density with competing food sources in the presence of control regimes. Knowledge of where snakes are located during foraging ensures that traps, bait tubes, and other lures used for snake suppression have the greatest impact by being placed where snakes occur naturally. The anticipated products include recommendations for spatial locations of control arrays to support cost-effective control of BTS on AAFB.

FY20 Status

- Funded via an interagency agreement with USGS –Fort Collins
- 70 BTS captured and tagged
- Data collection suspended for 8 weeks due to COVID-19
- Data collection has resumed



Figure 38. Brown treesnake consuming fairy tern on Andersen, AFB. Image courtesy of Nathan Sablan, CNT on behalf of USGS.

EPR: No EPR - funded under the Guam Micronesian Kingfisher MOA.

2019 JRM INRMP Reference: TIS-2, TIS-3; 5-85, 6-43; 7-52, 8-50-51, 9-71

Guam Micronesian Kingfisher Recovery Habitat MOA Program and Project Execution

Location: NBG TS and AAFB **Period of Performance:** JUN2015 – JUN 2025

Project Objective

To ensure a sufficient amount of suitable recovery habitat is conserved in northern Guam to support the reintroduction and recovery of the Guam Micronesian kingfisher and allow DON to meet the purpose and need for the proposed action to relocate U.S. Marines to Guam.

Conservation Benefit

The DON will work cooperatively with the USFWS to identify, develop and implement specific management activities and projects on these 5,234 acres to support the following:

1) brown treesnake (BTS) control and suppression to facilitate the larger goal of suppressing snake population levels that will ultimately support kingfisher survival and recovery;
2) support for BTS control and eradication methods development, focusing on tools and techniques needed for landscape level survival and recovery of the kingfisher;
3) ungulate fencing and eradication;
4) control or small mammalian predators;
5) invasive plant control and eradication;
6) native plant restoration; and,
7) localized control of introduced invertebrates that may negatively impact kingfisher nesting/fledging.

FY20 Status

- South Haputo Ecological Reserve Area fence (116 acres); 8,300-foot linear fence; task order awarded August 2020. In sequence with North Haputo fence.
- Structured Decision-making Workshop – postponed, consider in FY21
- Continuation of HMU Monitoring for FY20 ADS Drops
- Closed Population Fence Refurbishment
    - Replace the entire outer mesh material
    - Coat the internal chain-link fence.

EPR: DPRI: Marine Corps Relocation 2017/2018 amendment to 2015 BO, Other actions considered for the analysis

2019 JRM INRMP Reference: THM-1; 9-68

Multi-species Barrier Development Phase I – NBG TS

Location: NBG TS **Period of Performance:** APR2018 – OCT2019

Project Objective

The primary objective of this project is to develop and evaluate a multispecies barrier fence, estimate and itemize annual and long-term maintenance methods and costs and provide recommendations for multispecies barrier based on a review of the existing literature, visiting other sites with vertebrate barriers, testing results, and cost analysis.

Conservation Benefit

Closed Population has demonstrated that BTS can be effectively excluded using barrier fences, with the caveat that these require significant labor for maintenance Little research has been undertaken to promote creation of areas free of multiple species of invasive or predatory vertebrates that would be suitable for reintroduction or recovery of Guam's native fauna and flora.

FY20 Status

- Activities conducted to date:
  - Review of the existing literature
  - Visited other sites (New Zealand) with vertebrate barriers
  - Lab testing results

Figure 39. MSB Prototype at USGS Facility, AAFB.



Table 4. Summary table of brown treesnake arena trials.

Size class	Number of individuals	Number of trials	Number of Breaches	Number of breach attempts and height achieved on exclusion prototype wall			
					100cm	150cm	200cm
Large	19	25	0	402	50	0	0
Med-Lrg	25	25	0	484	0	0	0
Medium	26	26	0	368	0	0	0
Small	25	25	0	98	0	0	0
Small	16†	33	0	N/A	N/A	N/A	N/A

†Four of these individuals were previously trialed in the full-scale arena.

EPR: DPRI: Marine Corps Relocation 2017/2018 amendment to 2015 BO, Conservation Measures Brown Treesnake Control and Suppression.

2019 JRM INRMP Reference: TIS-3; 9-72

Coconut Rhinoceros Beetle (CRB; *Oryctes rhinoceros*) Surveys, Interdiction, and Monitoring - CNMI

Location: CNMI **Period of Performance:** SEP2016 – SEP2021

Project Objective

To implement CRB best management practices: 1) conduct CRB Early Detection Surveys in military training areas, 2) implement interdiction trapping during military exercises with cargo movements from Guam, 3) implement CRB awareness military personnel, and 4) implement CRB interdiction measures on Guam; and coordinate and collaborate with resources partners in the CNMI to prevent the movement of CRB to the CNMI via military cargo and transport while maintaining military readiness.

Conservation Benefit

Prevent the movement and establishment of CRB into the CNMI during military activities.

FY20 Status

- Conducted CRB Early Detection Surveys along roadways for CRB damaged coconut trees (Dec 2019)
    - No CRB damage detected
- Deployed and monitored CRB panels traps at North Field during Cope North exercise (Feb 2020) (Figure 40)
- Assisted CNMI DLNR CRB Interdiction Program in providing CRB tekken netting and panel trap supplies for Tinian and Rota Ports during Cope North 20 (Feb 2020)
- Provide military personnel with CRB awareness information and CRB sighting protocols during military training exercises (Dec 2019, Feb 2020)
- Biosecurity inspections were conducted on all cargo and equipment prior to transport from Guam to CNMI during military exercises to ensure all items were devoid of bio-material (including CRB)
- Coordinated CRB interdiction measures during Cope North 20 with CNMI natural resources partners

EPR: 2 BO MAR Mariana Islands Training and Testing (MITT) Implementation; 61128NR218
CHS NISA MAR JRM Implementation of the Regional Biosecurity Plan; 61128NR860
USMC HQ MITT Biological Opinion Conservation Measures Implement

2019 JRM INRMP Reference: TIS-5; 5-86, TIS-6; 5-87, TIS-6; 6-44, TIS-7; 6-45, TIS-4; 7-53, TIS-6; 7-53/54, TIS-5; 8-52, TIS-6; 8-52, TIS-5; 9-72, TIS-7; 9-73/74, TIS-1; 11-62, TIS-2; 11-63, TIS-1; 12-32, TIS-2; 12-33



Figure 40. Coconut Rhinoceros Beetle black panel trap deployed at Tinian North Field during Cope North 20 exercise (February 2020) as an interdiction measure.

Marianas Islands Training & Testing Biological Opinion Terms & Conditions 1.1 Compliance – CNMI

Location: CNMI **Period of Performance:** AUG2018 – SEP2022

Project Objective

To comply with the Mariana Islands Training & Testing (MITT) Biological Opinion (BO) Incidental Take Statement Terms and Conditions 1.1 (as amended 28 FEB 2016) to provide funding to the U.S. Fish & Wildlife Service for invasive vertebrate pest control to minimize the effect of take on the Micronesian megapode (*Megapodius laperouse*). DoD is not responsible for project implementation or the results thereof, per the MITT Biological Opinion (BO) amended Terms and Conditions 1.1.

Conservation Benefit

To ensure compliance with the Incidental Take Statement of the 2015 MITT BO to minimize the effect of take on the Micronesian megapode.

FY19 Status

- Interagency Agreement between Joint Region Marianas and the U.S. Fish & Wildlife Service established in August 2018.
- U.S Fish & Wildlife Service project currently in planning/implementation phase to complete Micronesian megapode habitat restoration on Aguiguan.

EPR: 2 BO MAR Mariana Islands Training and Testing (MITT) Implementation; 61128NR218

2019 JRM INRMP Reference: TPS-1; 12-34

Natural Resources Educational Outreach

Biosecurity Outreach and Education on Guam

Location: Various locations **Period of Performance:** SEPT 2020-SEPT 2021

Project Objective

The DON has initiated and will continue to implement a targeted, comprehensive outreach and education program for DoD and civilian populations for biosecurity focused on prevention.

Conservation Benefit

Minimize the effects of invasive species by educating DoD and civilian populations through prevention. Provide awareness of introduced and invasive species, the impacts of invasive species on native species and ecosystems, and what can be done to prevent and control invasive species.

FY20 Status

- Biosecurity outreach and education contract was awarded on 29 August 2019. Final report received August 2020. DON worked with Department of Agriculture Biosecurity division to link their homepage with video ads. The campaign yielded over 7,000+ clicks to the Department of Agriculture Biosecurity home page. Social media was the most successful component of the project. The completed views exceeded the requirements of the PWS.
- FY20 Biosecurity outreach and education contract scheduled award date 30 September 2020. DON to continue working with Department of Agriculture Biosecurity division to link their home page with video ads. Project to incorporate recommendations obtained via FY19 Final Report in an effort increase overall reach and effectiveness. Placement of ads to run on a 24-hour cycle for 7-days a week rather than only during certain timeframes.

EPR: DPRI: Marine Corps Relocation 2017/2018 amendment to 2015 BO, Conservation Measures to Minimize the Effects of Invasive Species.

Table 3. Total Ad Views

Table 3. Total Ad Views Viewing Time	**Target for FY19 Campaign**	**Total First Viewing Period**	**Percent of Campaign Target**
30 Seconds	300,000	135,224	45%
15 Seconds	400,000	235,394	59%
Viewing Time	**Target for FY19 Campaign**	**Total Second Viewing Period**	**Percent of Campaign Target**
30 Seconds	300,000	120,690	40%
15 Seconds	400,000	247,507	62%
Viewing Time	**Target for FY19 Campaign**	**Total Third Viewing Period**	**Percent of Campaign Target**
30 Seconds	300,000	106,841	36%
15 Seconds	400,000	146,030	36%
Viewing Time	**Target for FY19 Campaign**	**Total Campaign Period**	**Percent of Campaign Target**
30 Seconds	300,000	362,755	120%
15 Seconds	400,000	631,931	158%

Outreach and Education – NBG

Location: NBG **Period of Performance:** AUG2019 - SEP2020

Project Objective

This project will develop, design, and produce/print custom outreach materials and educational signs for Public Works EV, Naval Base Guam.

Conservation Benefit

Avoid and minimize adverse impacts from recreational activities to ESA-listed species and other marine natural resources.

FY20 Results

Project was awarded in FY19 and achieved the following results:

- Replace educational signs including a fishing regulation sign and a seafood health advisory sign
- A Naval Facilities Engineering Command (NAVFAC) canopy for use at outreach events
- Reprint the fishing regulation brochure, which contains mooring buoy locations.
- A trifold display for outreach events was developed (Figure 41). The display has interchangeable pictures and content, and can be tailored to match the outreach event.

EPR: Listed Species
Outreach Material;
61755NR306

2019 JRM INRMP Reference: TEDU-1; 5-91, MEDU-1; 5-104



Figure 41. An image of the trifold standing display to be used at outreach events. Content can be changed to match the event.

JRM Natural Resources Stewardship Outreach & Public Engagement Program

Location: JRM AOR **Period of Performance:** AUG2020 - AUG2021

Project Objective

To develop materials and training enabling JRM Natural Resource (NR) managers to effectively and efficiently implement a NR stewardship engagement program. This program aims to better educate uniformed and civilian staff, their dependents, JRM contractors, and the general public in order to improve NR stewardship and awareness within the Area of Responsibility (AOR). The AOR includes DoD lands within Guam and the CNMI.

Conservation Benefit

The 2019 INRMP outlines JRM NR responsibility to reach as many uniformed and civilian staff, their dependents, and JRM contractors with focused, consumable environmental education and outreach. The development and production of NR education materials and training is a beneficial support to increasing awareness of T&E species, proper stewardship behavior, and threats to local ecosystems.

FY20 Results

- Project awarded AUG2020
- Kickoff completed 03SEPT2020

EPR:

2019 JRM INRMP Reference: TEDU-1; 5-91, MEDU-1; 5-104

Migratory Bird Management

Migratory Bird Surveys – NBG

Location: NBG; NMS; NBG TS **Period of Performance:** recurring annually

Project Objective

To: (1) identify migratory bird species on NBG; (2) examine trends in abundance; (3) identify and quantify suitable habitat for migratory birds; and (3) examine habitat relationships of migratory birds.

Conservation Benefit

Monitor long-term trends of spatial and temporal distribution of migratory birds on NBG lands.

FY20 Status

- Migratory bird abundance was monitored at 20 sites on NBG between August 2019 and August 2020.
- 11 species were recorded with Pacific golden plovers accounting for 53% of migratory birds observed, ruddy turnstones 21%, whimbrels 13%, and all other species collectively accounted for 13% of observations. These findings are consistent with data from past years.
- Abundance was higher during September – April compared to May –August.
- Migrants used grass fields more often than shoreline or wetland habitats; however, habitat use varied among species.
- Navy plans to continue conducting migratory bird surveys on NBG and examine the relationship between habitat use and maintenance plans at grass fields.

EPR: 1 RP MAR CNMI ESA and MBTA Species Management (Key species Moorhen and Sea Turtles); 61128NR211

2019 JRM INRMP Reference: MIG-1; 5-90

Monitoring of MBTA-Listed Bird Species – FDM

Location: FDM **Period of Performance:** OCT2019 – SEP2020

Project Objective

To identify migratory bird species on FDM; examine trends in abundance; identify and quantify suitable habitat relationships of migratory birds. Monitor long-term trends of three booby species (Brown, Masked, Red-footed) on FDM via helicopter surveys.



Conservation Benefit Provides information of bird species present and habitat usage to guide implementation of appropriate conservation practices.

FY20 Status

- Accompanied the sea turtle and marine mammal aerial surveys on January 2020 to determine the viability of conducting booby surveys from a fixed-wing aircraft.
- 475 Red-footed boobies were counted after several passes around the island. The speed of the aircraft (85-98 mph) only allowed for the counting of Red-footed boobies that contrast with trees and shrubs that they roost on.
- Masked and Brown boobies roost on the ground and not discernable from the ground.
- JRM continuing to explore options to continue monitoring long-term seabird trends for the three booby species.

EPR: 1 S MAR NBG Endangered Species Surveys; 61128NR211

2019 JRM INRMP Reference: MIG-1; 12-35

Terrestrial Habitat Management

Listed Plant and Invertebrate Surveys

Location: JRM **Period of Performance:** JUL2019– JAN2021

Project Objective

This purpose of this project is to conduct plant and invertebrate surveys and to implement management techniques to provide a conservation benefit to federally-listed threatened and endangered species under the Endangered Species Act (ESA).

Conservation Benefit

Identifying locations of ESA-listed plant and invertebrate species will allow for management actions to reduce habitat fragmentation, enhance and restore habitat, buffer protected areas, and implement new conservation strategies.

FY20 Status

- The final report for surveys conducted on DOD lands from October 2014 through July 2019 was provided in July 2020.
- A new cooperative agreement was awarded through the Cooperative Ecosystem Studies Units (CESU) Network to University of Guam (UOG) in July of 2019 to conduct surveys for plant and invertebrate surveys on all JRM lands and other lands on Guam and the Commonwealth of the Northern Mariana Islands (CNMI).

***Tuberolabium guamense* surveys on Non-DOD lands:**

- Surveys have been conducted for *Tuberolabium guamense* in support of the *Tuberolabium guamense* Species Action Plan (SAP), which was developed to increase our understanding of the range-wide status of the species, threats, and conservation actions that could lead to a potential change in the listing status. Surveys for *Tuberolabium guamense* have been conducted from November 2019 through July 2020 on non-DOD lands (primarily Government of Guam lands) at Bolanos Conservation Area, Mati Point, and the forested area near the Yigo Raceway (Figures 42 and 43).
- A total of 27,272 *Tuberolabium guamense* have been observed to date (Table 5).

Table 5. ESA-listed species recorded during non-DOD lands at the Bolanos Conservation Area, Mati Point, and the forested area near the Yigo Raceway from November 2019 through July 2020.

All Non-DoD													
Species	**October**	**November**	**December**	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**Total**
Bulbophyllum guamense	N/A	1	31	16	60	13	17	2	7	3	0	0	150
Cycas micronesica	N/A	54	87	33	43	4	49	1	629	244	0	0	1144
Dendrobium guamense	N/A	25	228	182	295	14	68	2	10	6	0	0	830
Eugenia bryanii	N/A	2	46	0	6	0	0	0	0	0	0	0	54
Hedyotis megalantha	N/A	0	0	0	0	0	0	0	0	0	0	0	0
Heritiera longipetiolata	N/A	0	0	0	0	0	0	0	16	12	0	0	28
Nervilia jacksoniae	N/A	0	0	0	0	0	0	0	0	0	0	0	0
Phyllanthus saffordii	N/A	0	3	0	0	0	0	0	0	0	0	0	3
Serianthes nelsonii	N/A	0	0	0	0	0	0	0	0	0	0	0	0
Solanum guamense	N/A	0	0	0	0	0	0	0	0	0	0	0	0
Tabernaemontana rotensis	N/A	0	1	0	0	0	0	0	35	12	0	0	48
Tinospora homosepala	N/A	0	0	0	0	0	0	0	0	0	0	0	0
Tuberolabium guamense	N/A	54	5	1066	5520	3,952	3,898	0	9556	3221	0	0	27272
Hypolimnas octocula mariannensis	N/A	0	0	0	0	0	0	0	4	3	0	0	7
Vagrans indica	N/A	0	0	0	0	0	0	0	0	0	0	0	0
Partula gibba	N/A	0	0	0	0	0	0	0	0	0	0	0	0
Samoana fragilis	N/A	0	0	0	0	0	0	0	108	14	0	0	122
Partula radiolata	N/A	0	0	0	0	0	0	0	111	87	0	0	198

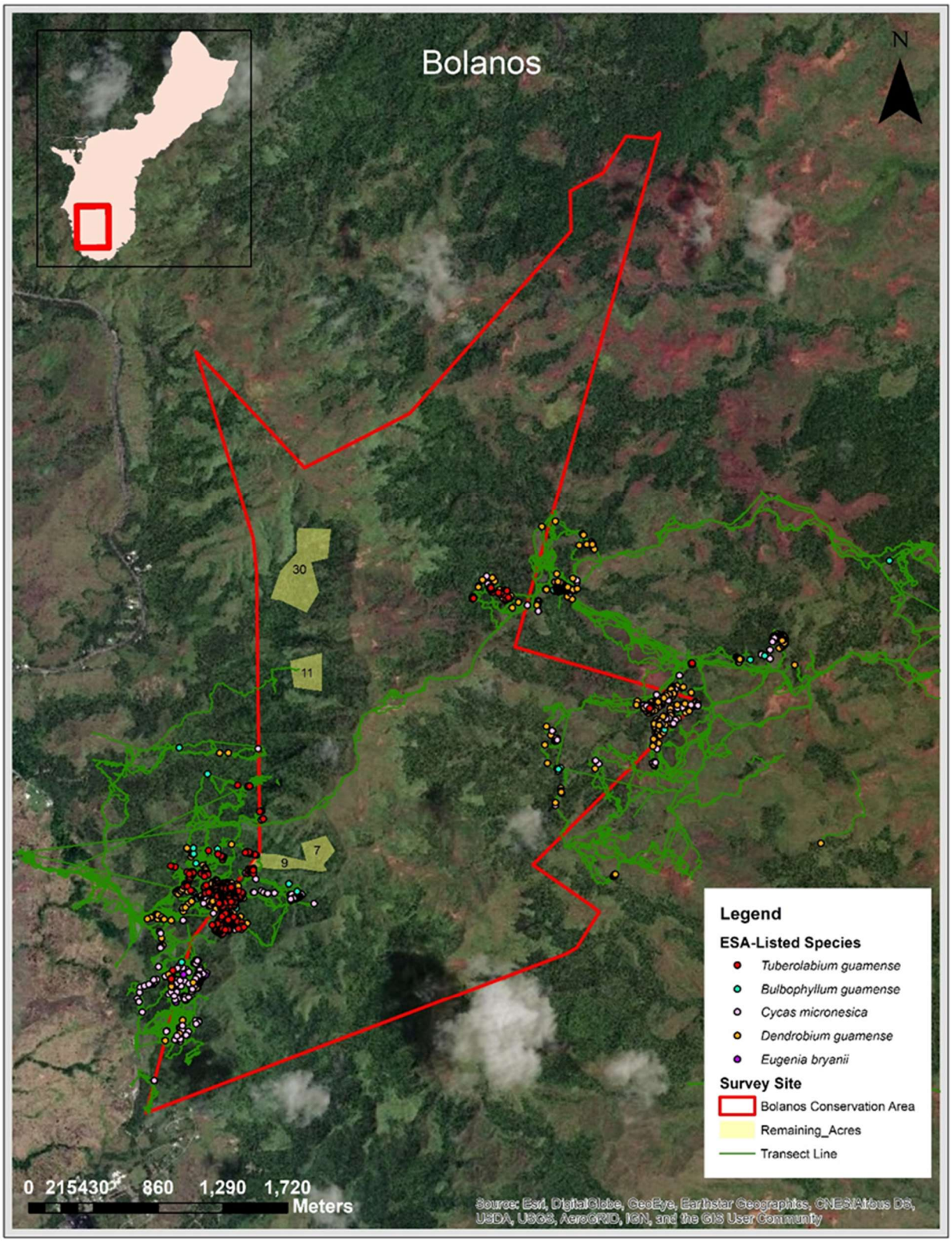


Figure 42. ESA-listed species recorded at Bolanos Conservation Area.

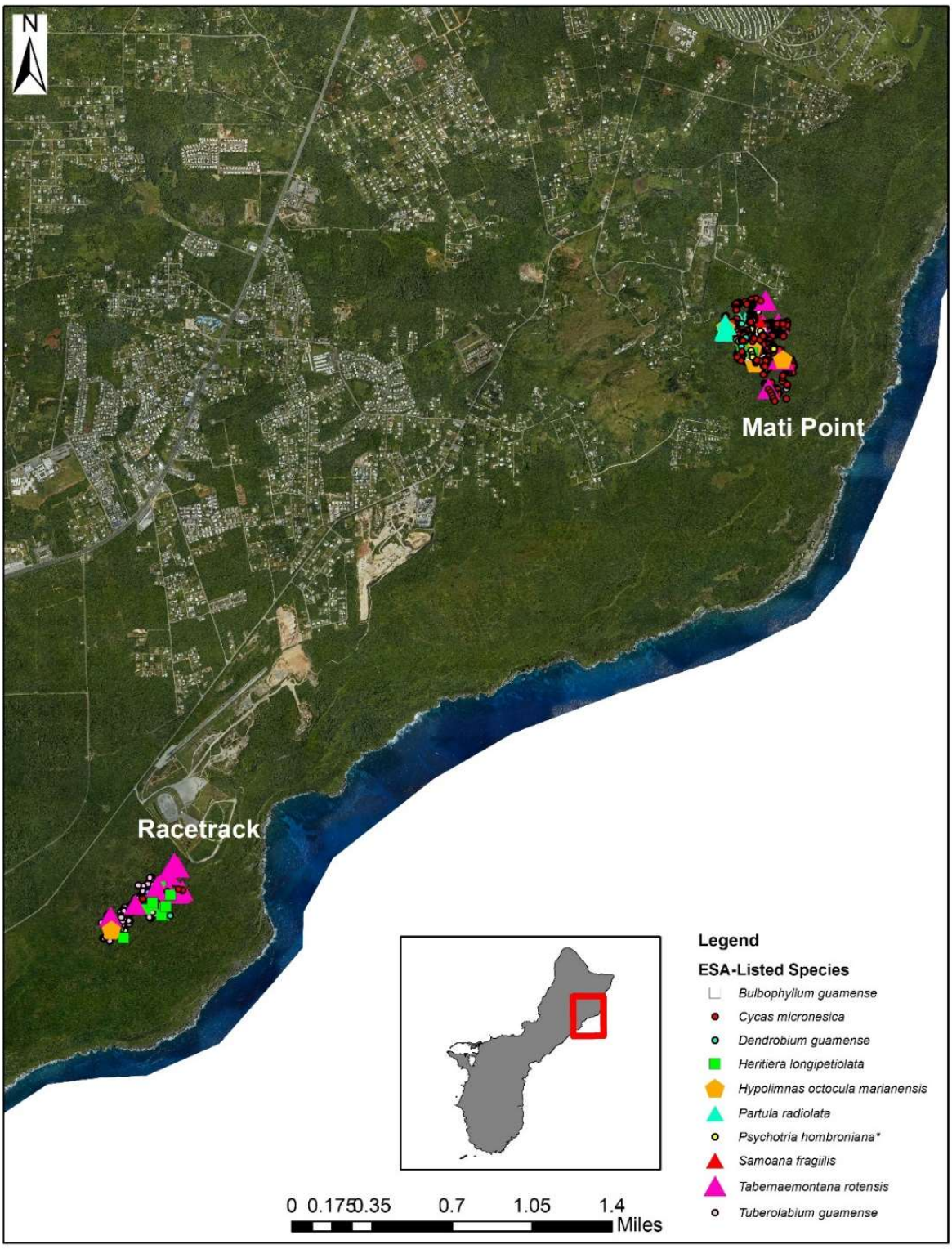


Figure 43. ESA-listed species recorded at Mati Point and the forested area near the Yigo Raceway.

ESA-listed species surveys on Andersen Air Force Base:

- The MSA1 perimeter was surveyed in May 2020. The area consisted of vitex forest and degraded limestone forest. ESA-listed species found during surveys included *Cycas micronesica* (75), *Tabernaemontana rotensis* (183), and *Tuberolabium guamense* (4).

ESA-listed species surveys on Andersen Air Force Base (J-200-11):

- Transect surveys (5-10 m) for listed plants were conducted over 91 acres in AAFB, and 10 acres in NBG.
- In May 2020, ESA-listed species surveys were conducted on AAFB. ESA-listed plants are in Table 6 and depicted in Figure 44.
- In August 2020, ESA-listed species surveys were conducted on NBG. No ESA-listed were observed.

Table 6. ESA-listed species recorded at J-200-II, AAFB

Species	Quantity
Bulbophyllum guamense	11
Cycas micronesica	14
Dendrobium guamense	10
Tabernaemontana rotensis	1
Tuberolabium guamense	598



Figure 44. ESA-listed species recorded at J-200-II, AAFB.

<u>ESA-listed species surveys on Andersen Air Force Base (Northwest Field):</u>

- Transect surveys (5-10 m) for listed plants were conducted over an approximately 142 acre area adjacent to the HMU in AAFB from January through May 2020. A total of 123 mature *Cycas micronesica*, *Tuberolabium guamense* (7,575), and *Bulbophyllum guamense* (76). Host trees were *Vitex parviflora*, *Meiogyne cylndrocarpa, Ficus prolixa, Aglaia mariannensis, Morinda citrifolia, Ficus tinctorial,* and *Ochrosia oppositifolia* (Figure 45). Three (3) *Elatostema calcareum* plants were found, but no ESA-listed larvae were observed.
- Surveys are being conducted on approximately 80 acre area at Northwest Field. ESA-listed species found were *Tuberolabium guamense* (1,510), *Tabernaemontana rotensis* (10), and

Dendrobium guamense (4). No invertebrates were found during this survey. Surveys are still underway.

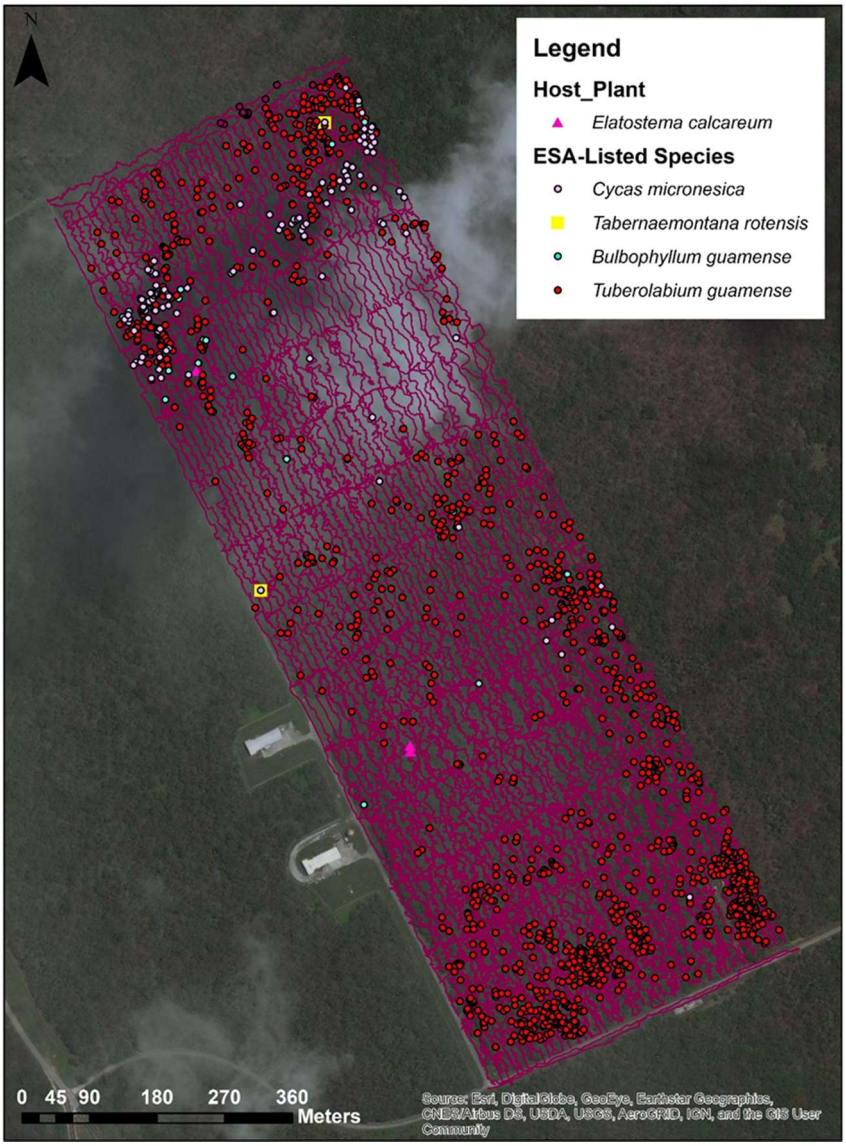


Figure 45. ESA-listed species recorded at the area adjacent to the HMU in AAFB.

<u>ESA-listed species surveys on Naval Munitions Site</u>:

- Transect surveys are ongoing in the Naval Base Guam Naval Munitions Site. Forest types include Vitex and Ravine forests. During July and August 2020 the following ESA-listed species were found: *Bulbophyllum guamense* (1,855)*, Cycas micronesica* (9)*, Dendrobium guamense* (990)*,* and *Tuberolabium guamense* (1,639) (Figure 46).

EPR: Listed plant surveys, Propagation, planting, and Establishment in the Wild; 61128NR209 and 1 S JRM AAFB - Monitoring and Surveys for Listed Tree Snails, Butterfly, Plants; M5240CN048
2019 JRM INRMP Reference: THM-2; 6-39, TPS-5; 9-77

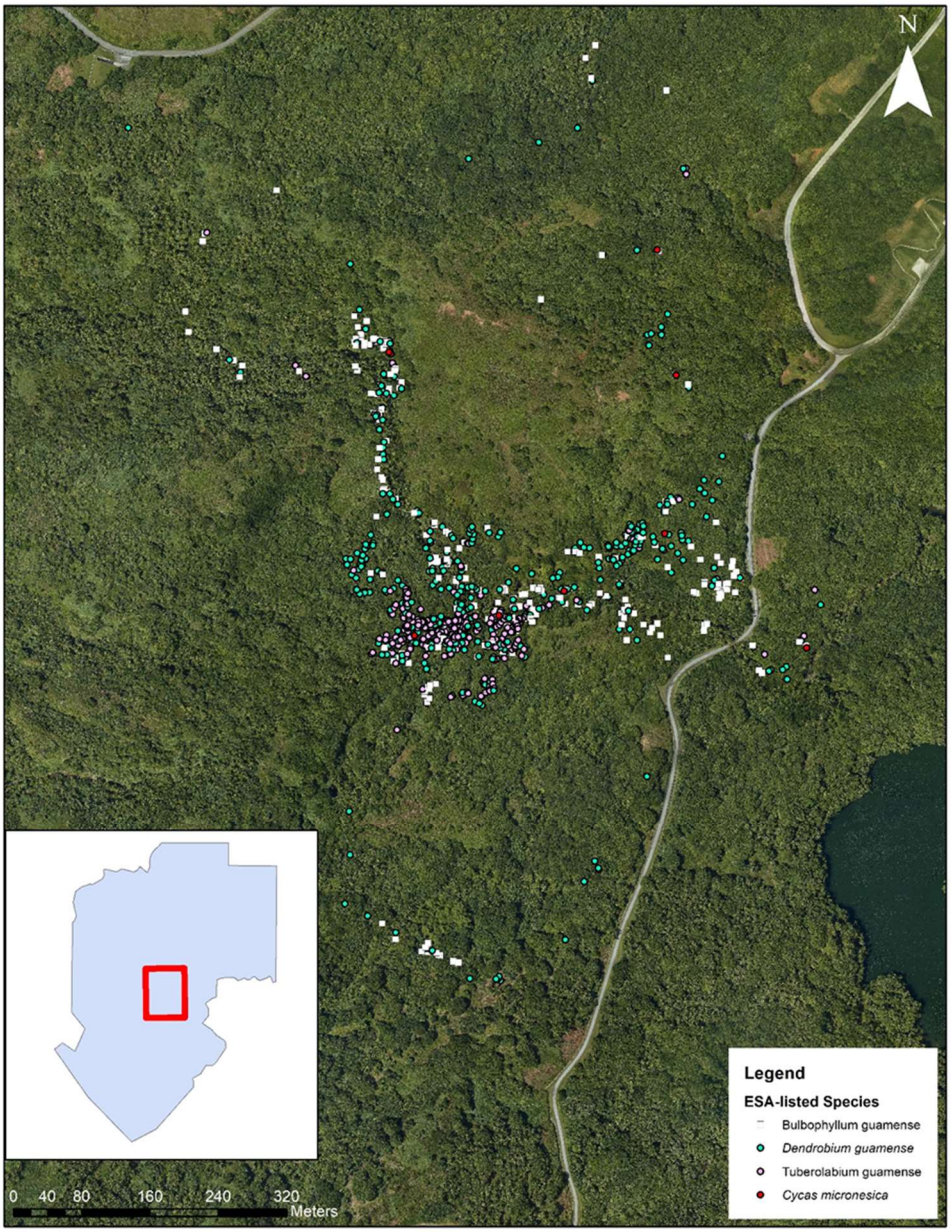


Figure 46. ESA-listed species recorded at the Naval Munitions Site.

Threatened and Endangered Species Preconstruction Surveys

Location: JRM **Period of Performance:** various, multiple awards

Project Objective

Conduct preconstruction surveys prior to vegetation clearing and grubbing for construction and design related activities.

Conservation Benefit

To minimize impacts to specific listed species due to construction and design related activities.

FY20 Status

- Preconstruction fruit bat surveys ongoing for the following construction projects: J-001B, J-200-II, J-755, P-102, P-103, P250/P260, P295, and P-715.
- Preconstruction fruit bat surveys conducted for design-related project J-755 and P-735.
- Preconstruction ESA listed species surveys completed for J-001B, J-006, J-007, J-200-II, J-609, J- 755, P-102, P-103, P-290, P-295, P-296, P-715, P-735, P-103, and Haputo fence line.
- Preconstruction ESA listed species surveys on-going for Andersen South, P-608, and Forest Enhancement Site ungulate removal.
- Preconstruction ESA listed species survey completed for J-001B Forest Enhancement Fence Phase I and Phase II.

EPR: DPRIbio: Marine Corps Relocation 2017/2018 amendment to 2015 BO, Conservation Measures to Contribute to the Recovery of Listed Species.

2019 JRM INRMP Reference: THM-2; 6-39, TPS-5; 9-77



Figure 47. Preconstruction survey at P-608

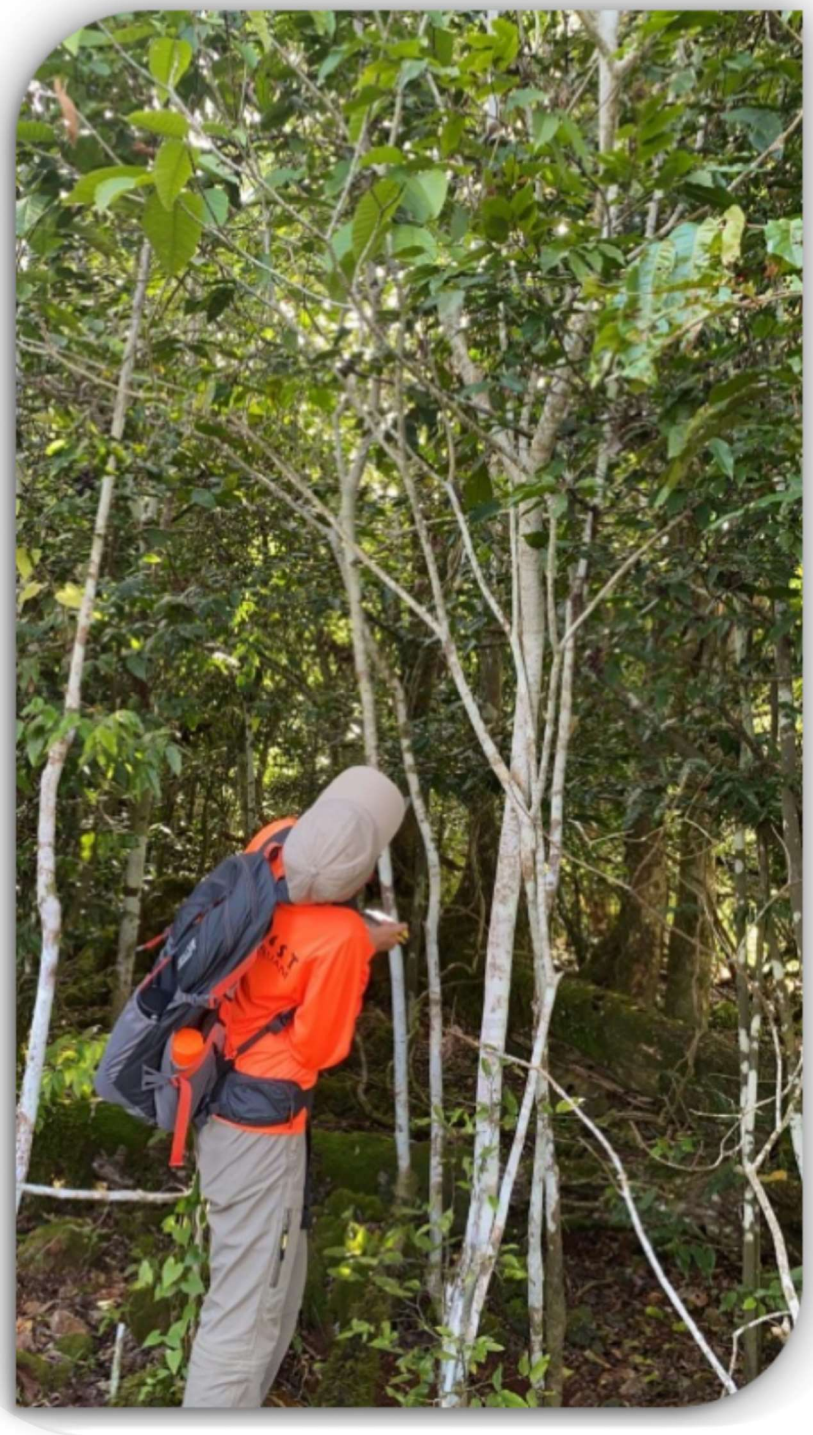


Figure 48. Preconstruction survey at J-200.

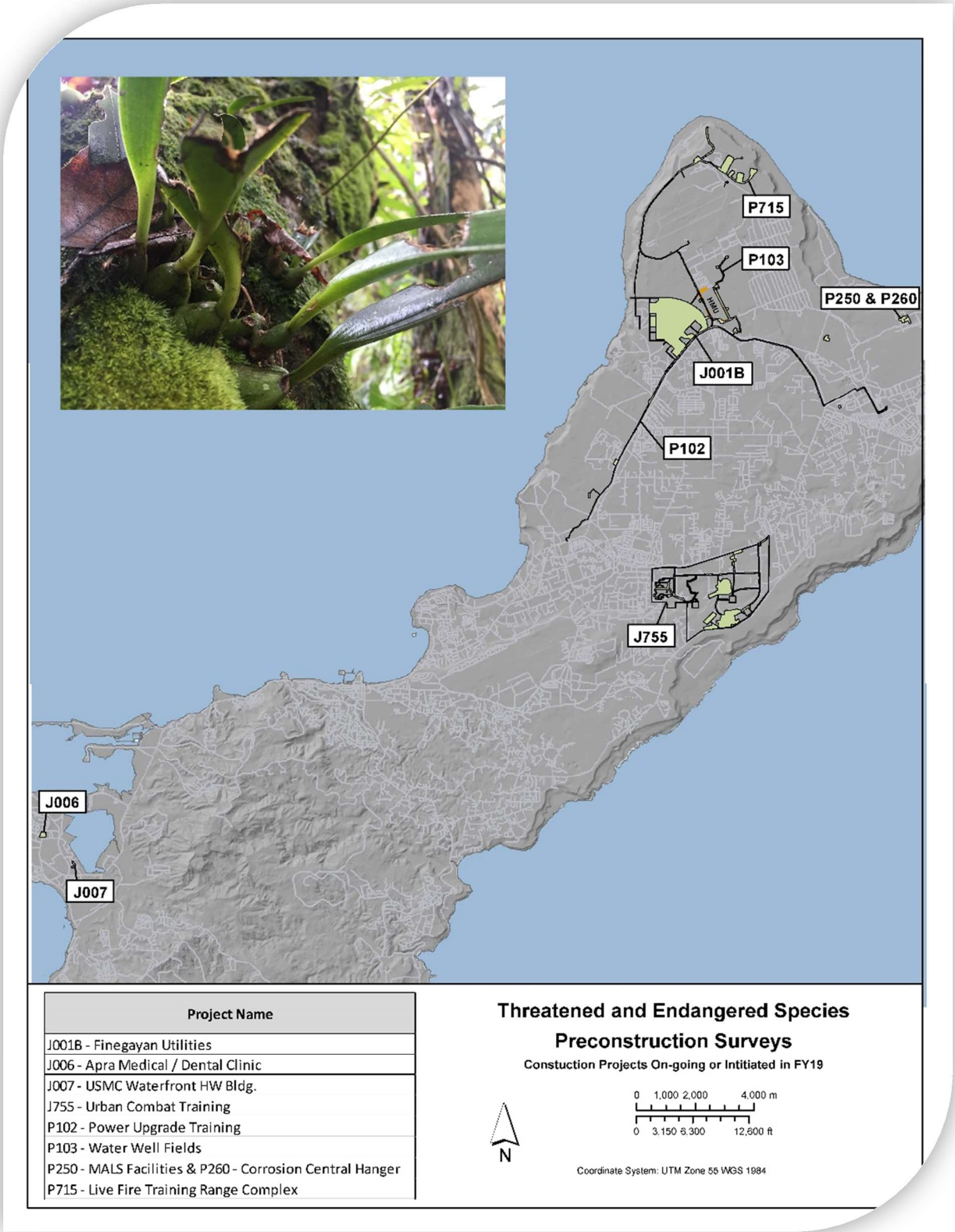


Figure 49. Map of threatened and endangered species preconstruction surveys and consolidated project locations.

Forest Restoration Plan Implementation – NBG

Location: NMS **Period of Performance:** SEP2017 – DEC2019

Project Objective

- Restore native forest ecosystems within fenced areas where feral pigs, deer and carabao have been removed on the NMS.
- Propagate and plant and/or use direct seed techniques for reforestation following the recommendations of the Naval Base Guam (NBG) Forest Restoration Plan and the Conceptual Limestone Forest Restoration and Enhancement Plan (NAVFAC PAC 2018).
- Manage new plantings for a minimum of three years to ensure establishment.

Conservation Benefit

Increasing native forest habitats would improve native species survival, particularly threatened and endangered species enhance native habitat for listed animals, increase the biodiversity of native species, and contributes to the connectivity with surrounding communities in ways that support improved ecosystem functionality. It also contributes to the goals of the Guam NWR as an overlay unit the NMS.

FY20 Status

Work within Fence Unit #1

- Twenty research plots have been established in the NMS. Ten of the plots are within an ungulate exclosure area (Labeled 1 in Figure 50). Ten of the plots are in a control area where ungulates have access to them for comparison.
- Ground vegetation and tree surveys have taken place in all plots to set the baseline. Surveys have been periodically updated.
- Vitex trees (*Vitex parviflora*), which are the most common aggressive invasive tree in the research area were removed in the dry season of 2020. Trees were removed using the hack and squirt method. Trees were left to die in place, to minimize the immediate impact to the area.
- All vitex trees with orchids on them were left in place.

Work within Fence Unit #2

- New work was awarded for forest restoration within Fence Unit #2 in 2019.
- Restoration activities will include:
    - Phased removal of vitex trees throughout the fenced unit.
    - Experimental plots to record the effects of fencing on forest restoration

compared to unfenced areas
    - Measurements of the rate of natural tree regeneration
    - Measurements of planted seedling success
- Vitex will be removed in phases throughout Fence Unit #2, once an Section 7 consultation for orchids has been completed

EPR: 1 CP MAR NBG Native Forest Habitat Restoration; 61755NR856

2019 JRM INRMP Reference: THM-2; 6-39

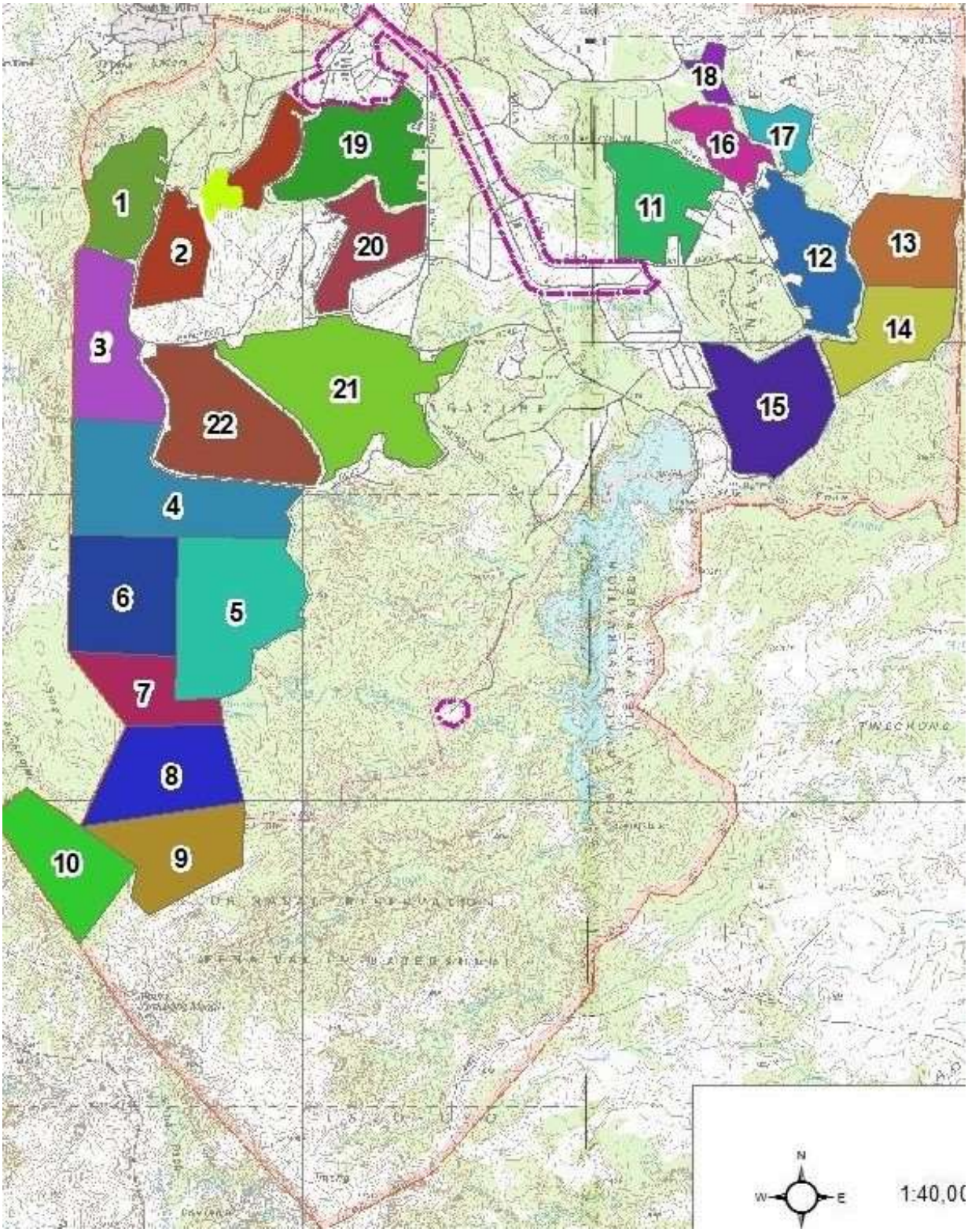


Figure 50. Map depicting location of the fenced and proposed fenced units within NMS. The Plots within the fenced area are located in Site 1 and Site 2.

Cetti Bay Watershed Terrestrial Monitoring

Location: Cetti Bay Watershed **Period of Performance:** SEP2017 - MAR2021

Project Objective

To gage the efficacy of the acacia plantings in reducing the effects of fires in Cetti Bay and reducing the amount of soil that settles into Cetti Bay. The measures involved in addressing the project objective include survival and growth rates of the acacia trees, tree survival rates after a fire, and the amount of sediment reaching the bay from the two rivers that drain the Cetti watershed into the Bay.

Conservation Benefit

The project will establish how effective the acacia tree plantings are in improving Cetti Bay aquatic resources, given the environment and site history of annual fires.

FY 2020 Status

- Awarded CESU network to UOG
- 522 acres planted originally, with some areas planted multiple times after initial plantings did not survive. Total net acres planted was 280 acres.
- Yearly survival rate was difficult to ascertain because adequate records and locations of the initial plantings do not exist. More information will follow.
- Cetti Bay has been subject to fires every year since the start of this project.
- The fires of 2019 were more intense and wider spread. Trees with a diameter less than one inch had a 5% survival rate. Trees with a diameter greater than one inch had a 71% survival rate.
- Turbidity measurements show overall differences between 2018 and 2019, possibly attributed to precipitation. 2018 average turbidity data for dry and wet season are 8.5 and 22 NTU. The data show a decrease in turbidity for 2019 dry and wet season 7.6 and 8.2 NTU.
- To remove precipitation as a cause for the difference in turbidity levels, turbidity as a function of precipitation was graphed for both 2018 and 2019 (Figure 52). The result shows that as precipitation increases turbidity increases. However, in 2019 the turbidity as a function of precipitation decreases slightly.
- Future measurements will determine if the decrease in sedimentation is random or an actual trend.

EPR: USACE Permit, NBG Reforestation Site, Cetti Bay; 61755NR896

2019 JRM INRMP Reference: THM-2; 7-50

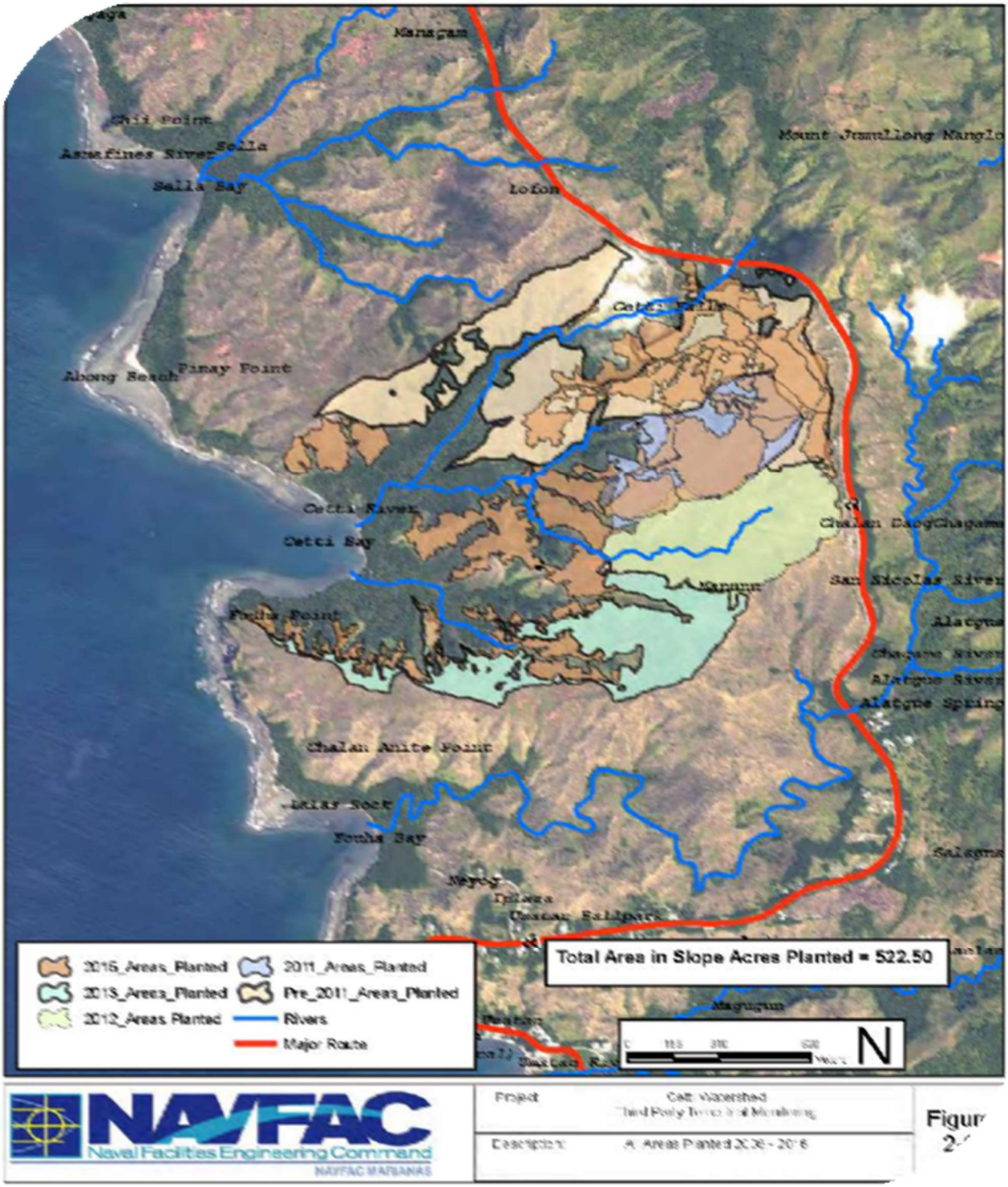


Figure 51. Map depicting the location of Cetti Bay Watershed and acacia plantings by year.

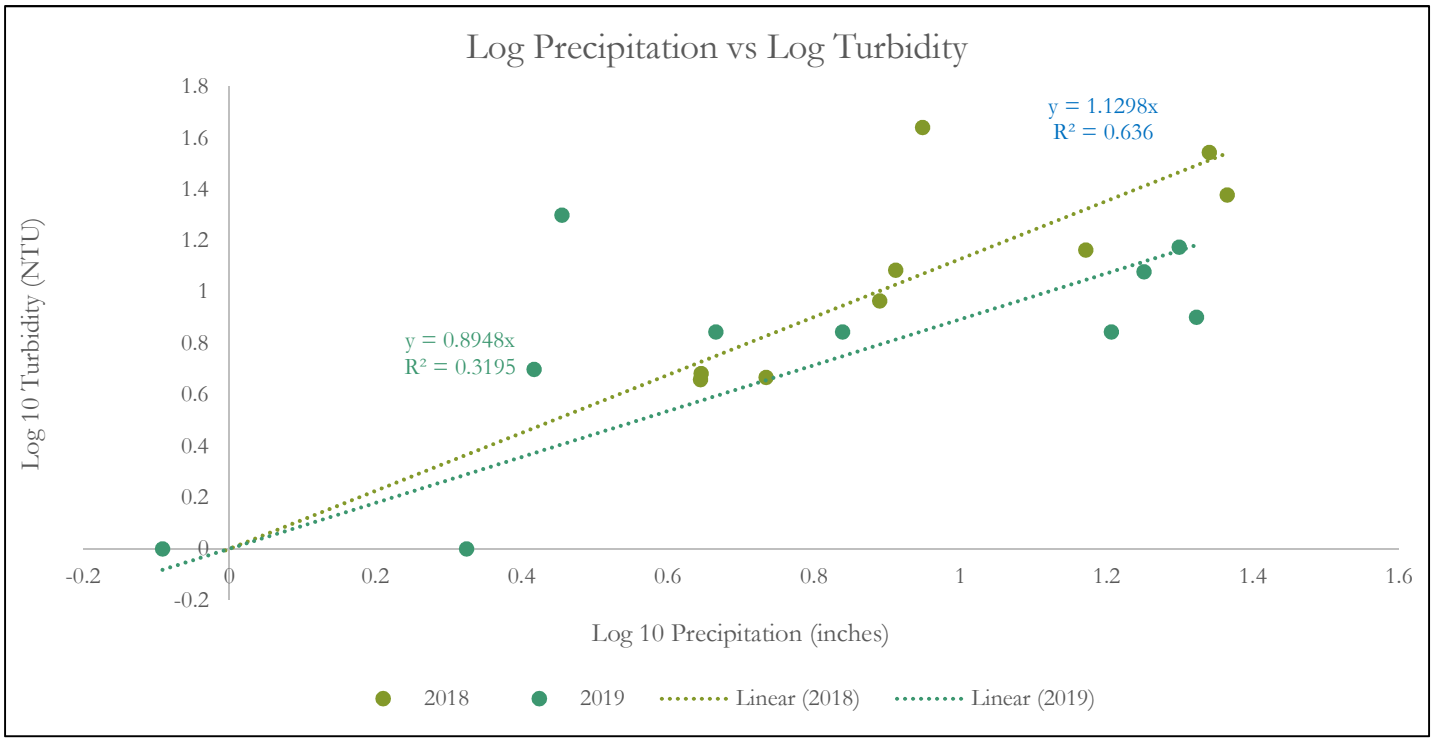


Figure 52. Comparison of turbidity levels as a function of precipitation between years 2018 and 2019. The data show a slight downward trend in turbidity levels.

Ungulate Fencing – NMS

Location: NMS **Period of Performance:** AUG2020 – AUG2021

Project Objective

Construction and maintenance of ungulate fencing on the Naval Munitions Site (NMS) to facilitate eradication of feral pigs, Philippine deer, and carabao and to prevent immigration into the fenced areas. The objective is to fence off native limestone and ravine forest on NMS and eradicate ungulates inside the fenced areas (Figure 53).

Conservation Benefit

Will allow native forest regeneration and recovery.

FY 20 Status

- An 80-acre fence (#1 in Figure 53) was constructed Jun 2017-February 2018.
- Construction of a second fence (#3 in Figure 53) began in August 2019 and was completed in December 2020.
- Contract awarded to Sustainable Resources Group (SRG) in FY2019 to construct third fence (#2 in Figure 53). Work will begin soon.

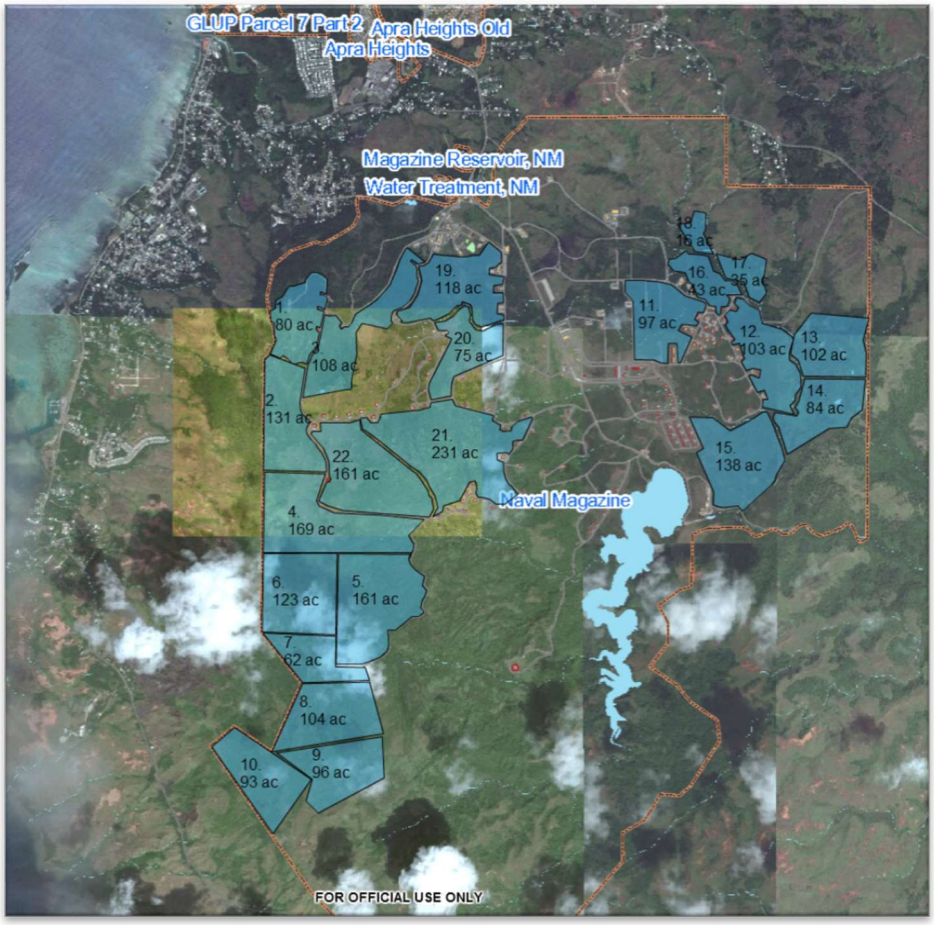


Figure 53. Map depicting areas that may be fenced on NMS. The section labeled "1. 80 ac." was fenced in FY18.

EPR: 1 RP MAR NBG Ungulate Fencing; 61755NR894

2020 JRM INRMP Reference: THM-2; 6-39

Firebreak Management Plan Implementation – NBG

Location: NMS **Period of Performance** AUG2018 – AUG2020

Project Objective

To implement the NBG Wildland Fire Management Plan. Specifically, to treat problem fuels (e.g. swordgrass (*Miscanthus floridulus*)) in strategic locations to disrupt the spread of wildland fires in savannah/ grasslands on NBG land.

The long-term goal is to have less flammable vegetation to allow uninterrupted land use that meets the military mission requirements. This project will implement specific management actions for Fire Management by planting and/or direct seeding of trees to create shaded fuel breaks and annual management of forested fuel breaks by mowing and chemical treatments of high-fuel load grasses.

This project took place in two areas.

- Areas in Sasa Valley have previously been planted with acacia trees were under-planted with native species. Eventually those trees will grow and replace the acacia with a native tree landscape.
- Naval Magazine Site along Firebreak No. 3. This area frequently experiences fires and is dominated by swordgrass. Planting in this area is designed to help disrupt fires in the area and help protect other projects adjacent to the area owned by Guam Department of Agriculture.

Conservation Benefit: Protect native ecosystems that might otherwise be susceptible to wildfire damage. Protect against soil erosion which causes further damage. Over time the project will protect natural resources and listed species by reducing soil erosion which causes siltation of Guam's coral reefs.

FY20 Status

- This project was awarded as a contract in October 2018.
- Tree planting has been completed in both the NMS and in Sasa Valley during both 2019 and 2020 rainy seasons.
- Phase 1 in the 2019 rainy season focused on fast growing shrubby species *Scaevola sericea* closest to the road. The medium height tree *Hibiscus tiliaceus* is planted the next layer further away.
- Low growing species were planted along the edge closest to the road to avoid a "fuel

ladder" effect that facilitates the ability of fires to jump over roads.

- Phase 2 in 2020 focused on planting native forest trees shown on Table 7. These trees were placed furthest from the road and firebreak.
- Tree plantings in Sasa Valley took place in areas that were previously planted with acacia. Eventually the acacia will be removed so that they can be replaced by Guam native species.
- In all, a total of 23,307 native trees seedlings were planted for this project.
- Some areas were planted by direct seeding. Areas were direct seeded to experimentally determine if this can be used as an alternative to avoid costly MEC (Munitions and Explosives of Concern) avoidance measures. MEC avoidance measures are costly and absorb the Navy's yearly capacity for restoration projects. The number of seeds planted in 2020 total 3,879.
- An additional firebreak project will be awarded in 2021.

EPR: 1 RP MAR NBG Wildland Fire Management Plan (2015) Implementation through Habitat Management; 61755NR857

2019 JRM INRMP Reference: THM-3; 6-41

Table 7. Total number of native trees planted 2019 to 2020.

Phase	*Hibiscus tiliaceus*	*Scaevola sericea*	*Pandanus tectorius*	*Pandanus dubius*	*Areca catechu*	*Artocarpus mariannensis*	*Calophyllum inophyllum*	*Cerbera dilatata*	*Morinda citrifolia*	*Ficus prolixa*	*Cordia subcordata*	Total
Phase 1 Outplanting: 2019	1,340	2,765	0	0	0	0	0	0	0	0	0	4,105
Phase 2 Outplanting: 2020	1,449	6,095	2,731	135	133	41	5,731	18	600	487	1,781	19,202
Total	2,789	8,860	2,731	135	133	41	5,731	18	600	487	1,781	23,307

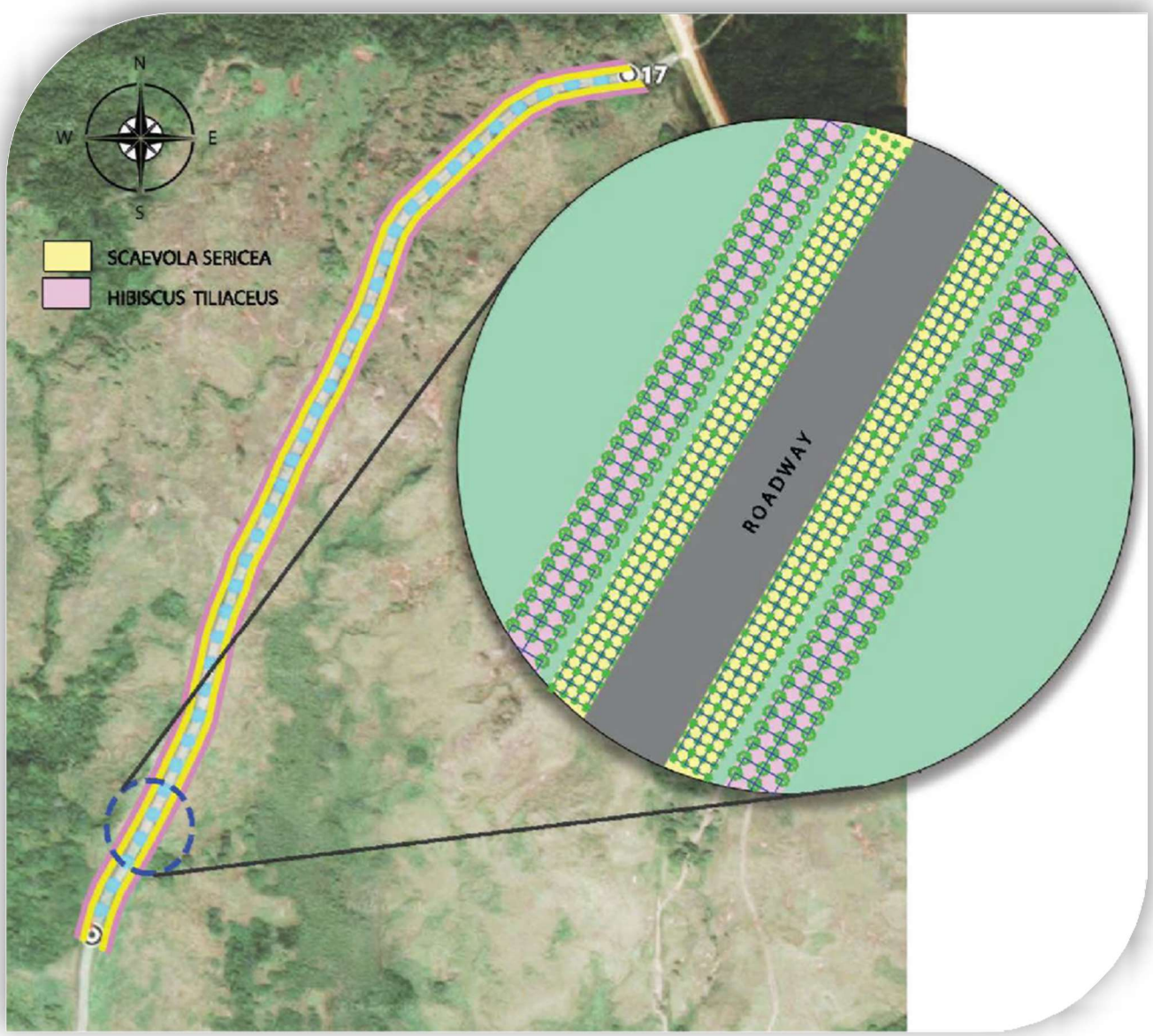


Figure 54. The work plan depiction of the native tree planting along Firebreak #3 in the Naval Magazine.

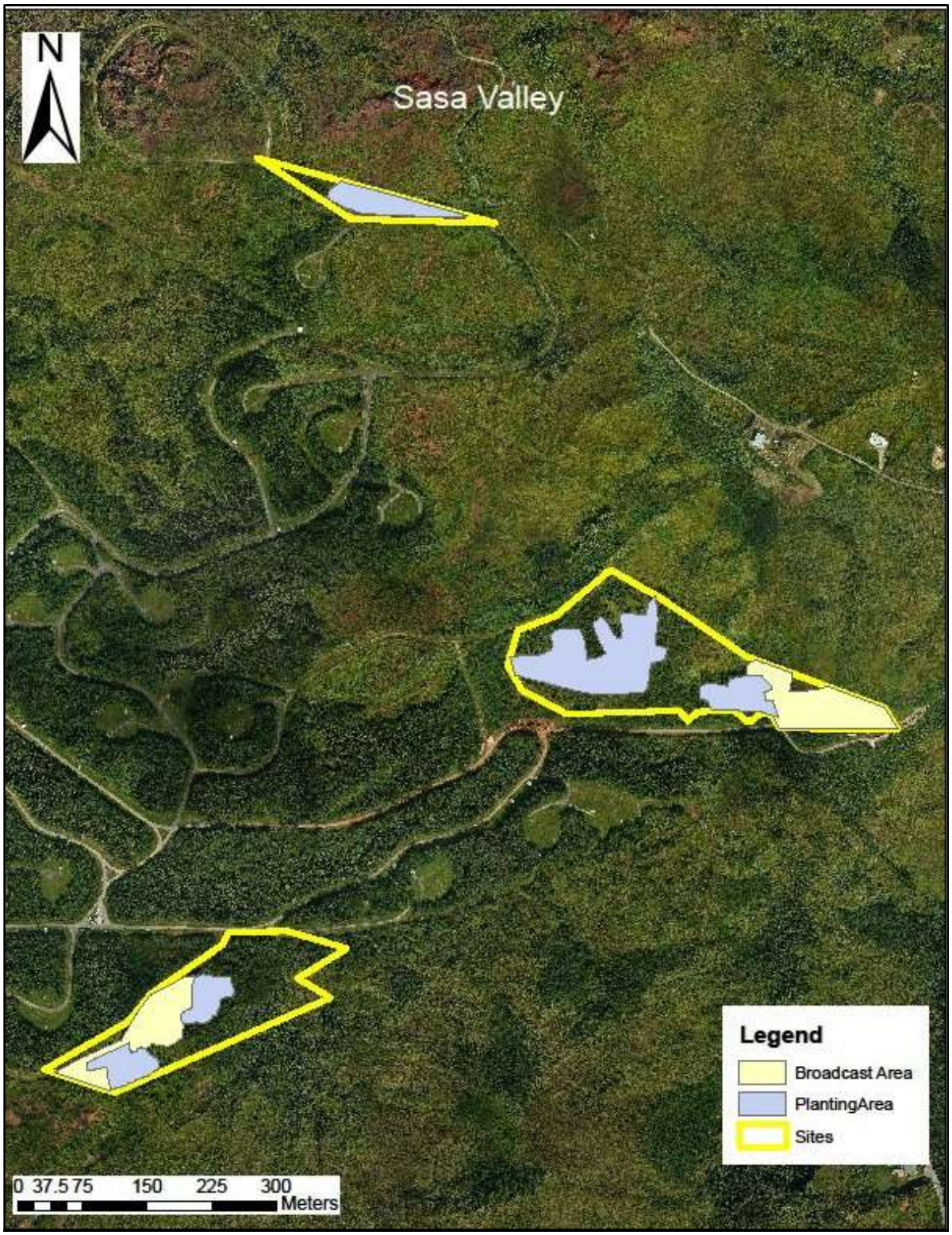


Figure 55. Areas planted in Sasa Valley, both with nursery grown seedlings and by direct seeding.

Range Fire Management Plan for Marine Corps Ranges on Guam

Location: AAFB and Andy South **Period of Performance:** SEP2017 – SEP2021

Project Objective

Create a range fire management plan to reduce range/wildfire potential, protect and enhance natural and cultural resources, integrate applicable permit and reporting requirements and implement ecosystem management goals, sustainable training, and objectives already supported on existing Marine Corps installations.

Conservation Benefit

Management plan goal is to reduce the effects of fires by limiting their frequency, size, and severity while still allowing the USMC to maintain a high level of combat readiness. The fire management plan is being developed in accordance with a conservation measure in the Biological Opinion for the Marine Corps relocation program.

FY20 Status

- CESU awarded to Colorado State in Sept 2017.
- Final Plan expected in September of 2021.

EPR: DPRI: Marine Corps Relocation 2017/2018 amendment to 2015 BO, Conservation Measures to Minimize the Effects of Fire

2019 JRM INRMP Reference: THM-1; 9-68

Seed Collection from *Heritiera longipetiolata* and *Tabernaemontana rotensis*

Location: AAFB **Period of Performance:** OCT2018 - 2021

Project Objective

To collect seeds from federally endangered *Heritiera longipetiolata* and threatened *Tabernaemontana rotensis* identified within project footprints associated with the Guam Relocation.

Conservation Benefit

To minimize impacts of military construction activities to native ecosystems by collecting the seeds from as many mature individuals as possible and preserving the genetic diversity of the species.

FY20 Status

- 39 seeds have been collected from 2 of 5 mature *Heritiera longipetiolata* located within AAFB project footprints.
- 15 Heritiera longipetiolata seeds have germinated.
- 735 seeds have been collected from 19 of 136 mature *Tabernaemontana rotensis* located within AAFB project footprints.
- 560 *Tabernaemontana rotensis* seeds have germinated.

EPR: DPRI: Marine Corps Relocation 2017/2018 amendment to 2015 BO, Conservation Measures to Contribute to the Recovery of Listed Species.

2019 JRM INRMP Reference: THM-3; 8-49



Figure 56. ESA-listed species *Tabernaemontana rotensis* seeds

Forest Restoration at Achae Point

Location: AAFB **Period of Performance:** OCT2019 – JUL2020

Project Objective

Restore native vegetation component to limestone forest rehabilitation site.

Background

The Achae Point Reforestation Project at Ritidian Point was started as a collaborative effort between AAFB and US Fish and Wildlife Service, Guam National Wildlife Refuge (GNWR). This reforestation project was a multi-year project that included 1) constructing an ungulate exclusion fence 2) collecting and propagating native plant seeds, and 3) planting native trees important for endangered species recovery, specifically the Mariana fruit bat. In 2011, a chain link fence was constructed around a 1.5 acre Installation Restoration Program (IRP) site to exclude deer and feral pigs (Figure 57). Native tree seedlings were outplanted in November 2013, with a final count of 1,086 native trees outplanted in April of 2014.

In June of 2016 a brush fire occurred in and around the reforestation site and destroyed numerous trees within approximately one acre of the fenced area. An additional 860 native plants were planted in September 2016 (Figure 58) within the fenced area in open burned areas.

Conservation Benefit

Enhance and restore habitats, reduce habitat fragmentation, increase populations of native species, and buffer protected areas.

FY20 Status

- The contract to maintain the site ended in Sept 2019 and in Oct 2019 the maintenance work was added to the *Serianthes* Management Cooperative Agreement held by UOG/GPEPP.
- As of June 2020, there are 829 native plants within the site.
- Plans under the current cooperative agreement include planting and maintaining listed plant species such as *Serianthes nelsonii* and *Heritiera longipetiolata*.

Original EPR: 1 CR MAR AFB Native Forest Habitat Restoration; M5240NR067

EPR (under Serianthes Management): 2 LC MAR AAFB *Serianthes nelsonii* Monitoring and Management; M5240CN039

2019 JRM INRMP Reference: THM-1; 9-68



Figure 57. Location of the Achae Restoration Site on Route 3A.



Figure 58. Progress of outplantings at Achae Restoration Site on Route 3A.

Vegetation Restoration for the HMU

Location: AAFB **Period of Performance:** AUG2016 – DEC2020

Project Objective

Implement vegetation restoration within the Habitat Management Unit (HMU) utilizing the 2017 HMU Vegetation Restoration Plan.

Conservation Benefit

Enhance and restore habitat and maintain or increase populations of threatened and endangered species, including those extirpated from Guam and potentially reintroduced within the HMU.

FY20 Status

- Ten plots were established, including five (5) experimental and five (5) control plots, per the HMU Management Plan (Figure 59). Evaluation of plot size indicated 30 x 30 m plots needed (vs 50 x50 m plots). Mapping of vegetation within plots completed. Mapping of edge vegetation initiated.
- Mapping of vegetation within plots completed. Mapping of edge vegetation completed.
- A greenhouse was established and native plants for restoration are growing in the greenhouse.
- Treatment of *Vitex parviflora* was delayed due to listed orchid species being present on *Vitex*. A stopgap measure was instituted by treating those *Vitex* without listed orchids. A formal section 7 consultation will be initiated in the near future.
- Herbicide treatments began on *Vitex* and *Averrhoa bilimbi* in May and June of 2020.
- Outplantings within the plots were completed in April (Figure 60) using the following species: *Pandanus tectorius, Ixora triantha, Premna obtusifolia, Procris pedunculata,* and *Ochrosia mariannensis.*

EPR: 1 CR MAR AFB Native Forest Habitat Restoration; M5240NR067

2019 JRM INRMP Reference: THM-1; 9-68



Figure 59. Proposed locations of experimental plots in the HMU.



Figure 60. UOG Center for Island Sustainability Biologist outplanting in the HMU.

Maintenance of Ungulate Exclosures

Location: AAFB **Period of Performance:** Oct 2019-Dec 2021

Project Objective

Annual fence line maintenance and repairs to maintain the efficacy of AAFB ungulate- free exclosures. This project includes 1) weekly inspections, which involves walking or driving the fence-line encompassing multiple ungulate exclosures and conducting any repairs and 2) cutting and trimming the vegetation within 3 feet of each side of the fence monthly to reduce any damage to the fence.

Conservation Benefit

The routine maintenance and repair of ungulate exclosures will enhance the longevity of the ungulate barrier. Regular fence monitoring and repair also has the benefit of early detection to any possible immigration of ungulates into fenced eradicated areas.

Monitoring, maintenance and repair all support the purpose of facilitating ungulate-free areas to enhance native forest ecosystem regeneration.

FY20 Status

- "Taragüe Triangle" ungulate exclosure completed August 2020.
- Cooperative agreement for weekly HMU fence inspections awarded Sept 2020.

EPR: 2 BO MAR AAFB Maintenance of Ungulate Exclosure; M5240NR045
EPR: 1 CR MAR AAFB BTS Barrier Maintenance in HMU; M52401000

2019 JRM INRMP Reference: THM-1; 9-68

Ungulate Fencing

Location: AAFB **Period of Performance:** Sept 2019 – Aug 2020

Project Objective

Construct ungulate fencing on AAFB to facilitate eradication of feral pigs and Philippine deer as well as prevent immigration of ungulates within fenced areas.

Conservation Benefit

Supports ungulate eradication goals within fenced areas of AAFB (Figure 61). Ungulate eradication facilitates the revitalization of native habitat that supports viable populations of native species, increases the biodiversity of native species, and contributes to the connectivity with surrounding communities in ways that support improved ecosystem functionality. Contributes to the goals of the Guam NWR as an overlay unit on AAFB.

FY20 Status

- Tarague Triangle fence contract awarded in September 2019 and completed in August 2020. Post ungulate eradication this area will provide for approximately 80 acres of conservation area for INRMP project implementation.
- Ungulate fencing 10 year plan, funding has been programmed.

EPR: 1 RP MAR AAFB Ungulate Fencing; M5240NR043

2019 JRM INRMP Reference: THM-1; 9-68

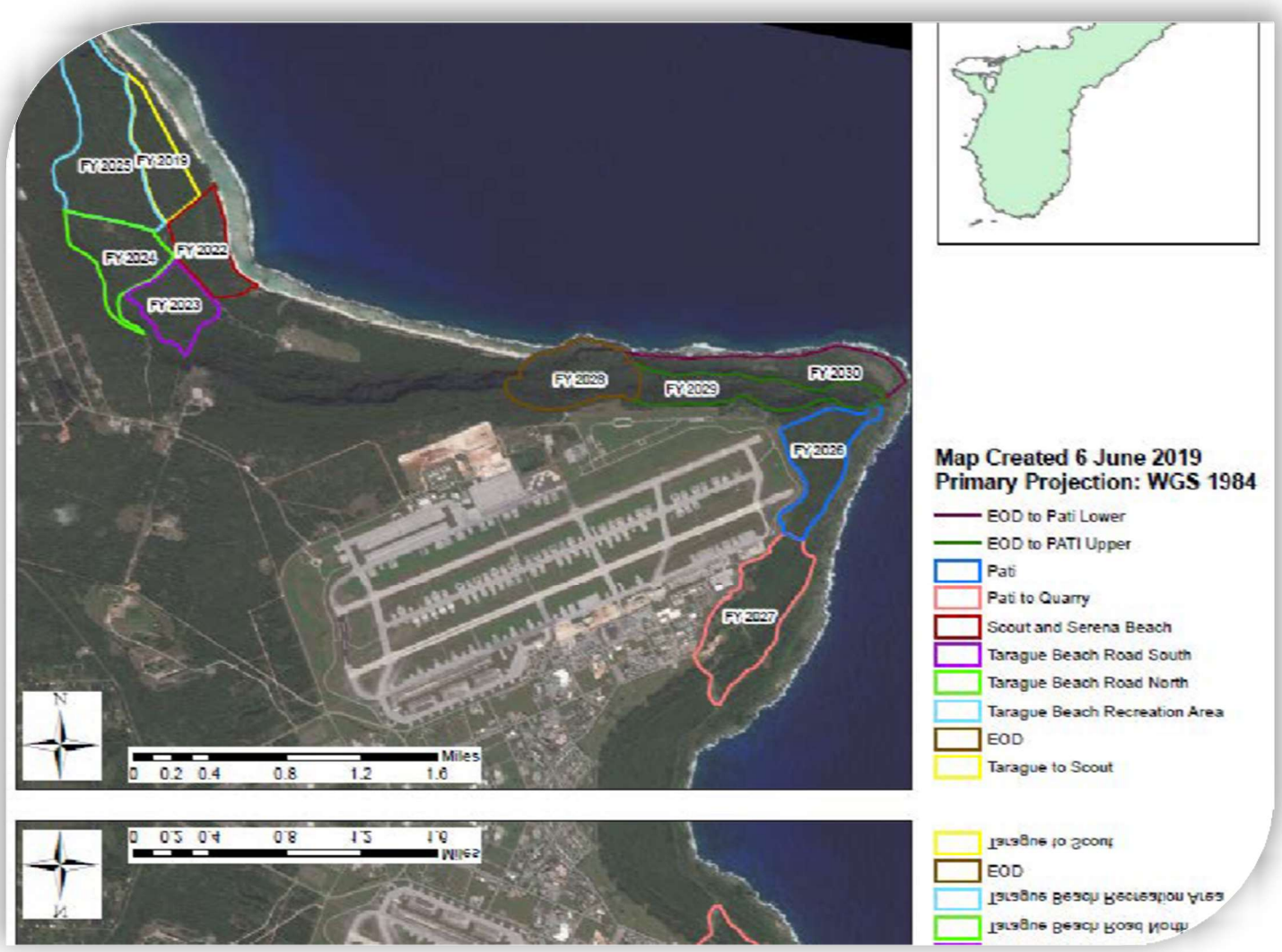


Figure 61. Map depicting areas of programmed ungulate fencing at AAFB.

Ungulate Eradication and Control

Location: AAFB **Period of Performance:** AUG 2019 – Dec 2021

Project Objective

Removal of feral pigs and Philippine deer from AAFB to protect and enhance native species and associated habitat.

Conservation Benefit

Enhance and restore habitats to increase populations of native species, particularly threatened and endangered species, as well as promote biodiversity of native plants. Reduce ground disturbance from ungulates to improve soil stabilization, and reduce suitability of invasive plant species.

FY20 Status

- Although driven by human health and safety, the AAFB Volunteer Conservation Officer Program (VCOs) conducted 77 depredation events to increase roadway safety and remove animals from recreation areas. Ecosystems will benefit from the removal of 404 deer and 77 pigs from AAFB as of July 2020 (Figure 62).
- A Cooperative Agreement was awarded to White Buffalo Inc. in September 2019 for the collaring and tracking of 18 ungulates (9 deer, 9 pigs) on AAFB. Data collected is being used to conduct spatial analysis for home range, pathways and habitat selection and use to increase effectiveness and efficiency of future ungulate control activities. 7 Collars are still active and will be used for judas deer/pigs
- Inter-Agency Agreement awarded July 2020 with USDA-WS for eradication within the Tarague Triangle fence area.
- Informal consultation underway for ungulate control outside of fenced areas on AAFB.

EPR: 1 CP MAR AAFB Ungulate Eradication and Control; M5240NR069

2019 JRM INRMP Reference: THM-1; 9-68

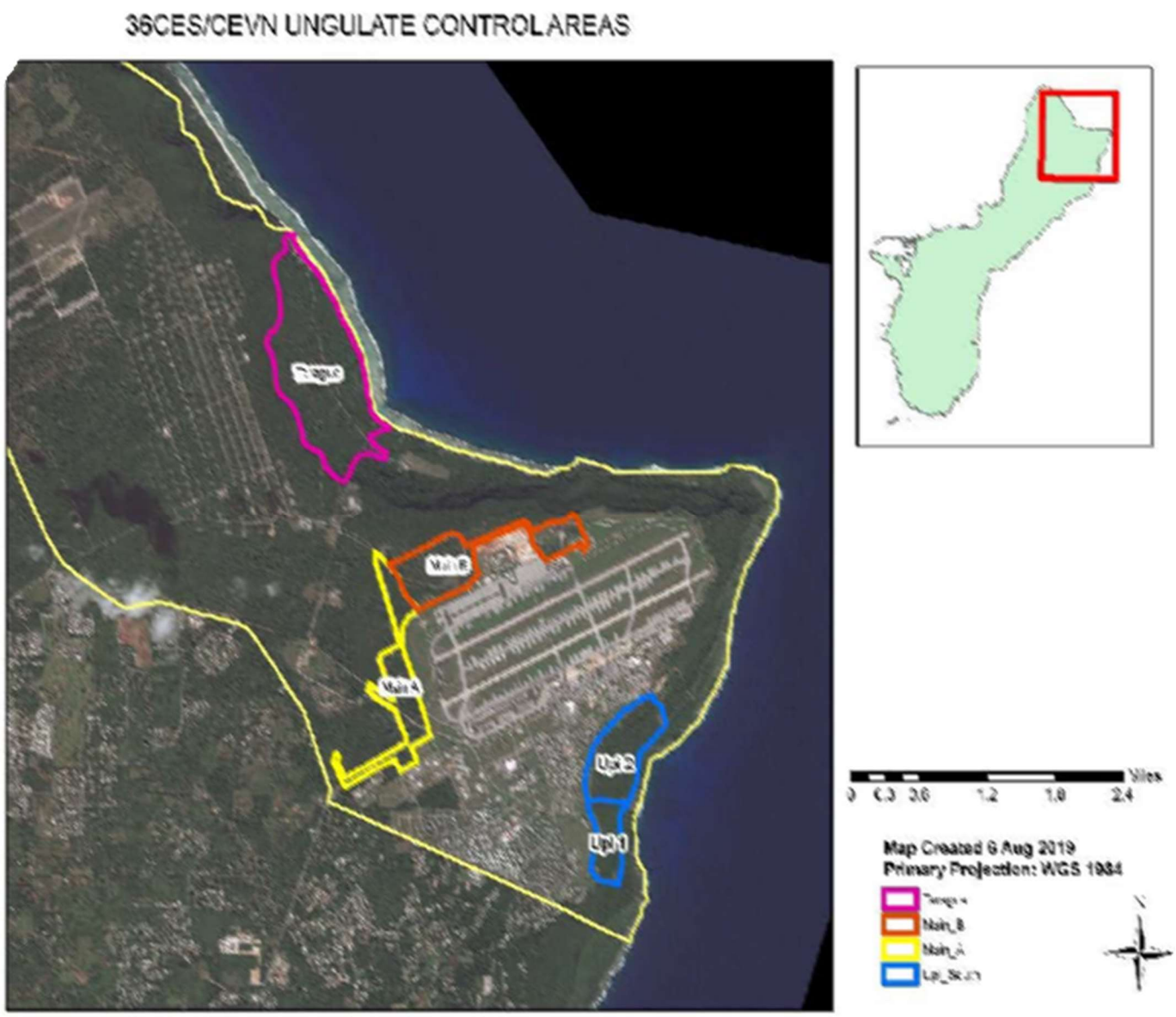


Figure 62. AAFB Depredation Areas Current as of 30 September 2020.

Northwest Field Ungulate Control Area Fencing and Eradication - AAFB

Location: AAFB **Period of Performance:** JUL2020-FEB2022

Project Objective

The project will install ungulate-proof fencing around the limestone plateau in the vicinity of the Live Fire Training Range Complex and subsequently eradicate pigs and deer from the exclosure.

Conservation Benefit

Feral pigs and deer are among the most significant threats to sensitive limestone forests; ungulate removal will promote growth of native species and increased survival of threatened and endangered species.

FY20 Status

- Fencing contract awarded and target completion is March 2021.
- USDA will begin population estimates concurrent with fence installation (Figure 63) and begin eradication immediately after fence closure.

EPR: DPRI: Marine Corps Relocation 2017/2018 amendment to 2015 BO, Conservation Measures to Minimize the Effects of Invasive Species.

INRMP FY2019 Reference:
THM-1; 9-68

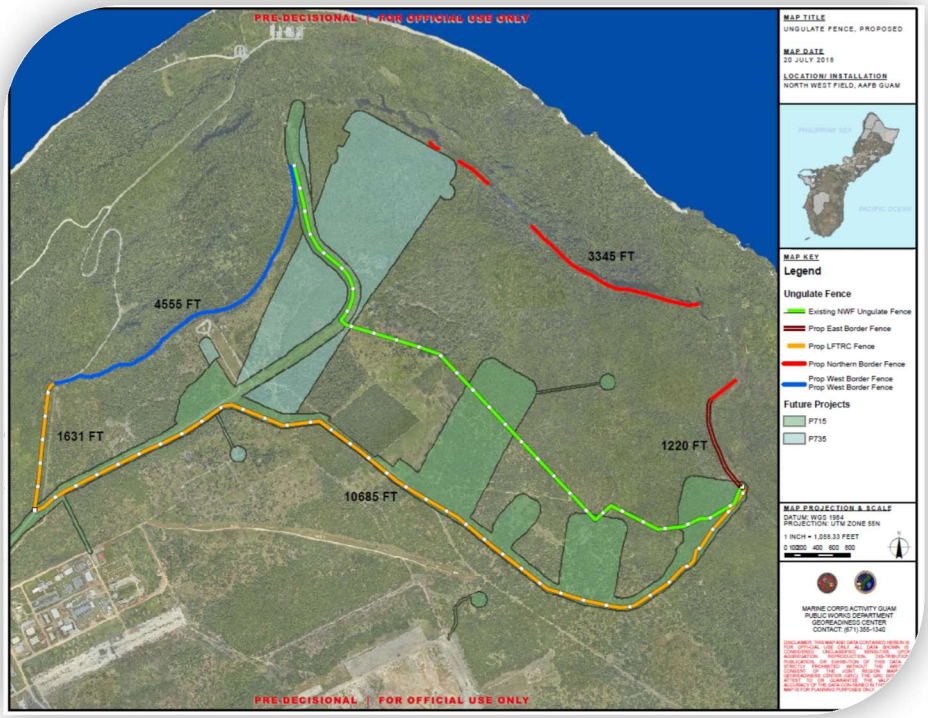


Figure 63. Location of Ungulate Exclusion Fence (Yellow/Blue/Red) Targeted for ungulate eradication at future USMC LFTRC at NWF, AAFB (Gaps are Sheer Cliff Areas)

Salvage and Transplantation of ESA-listed Orchids – NBG TS and AAFB

Location: NBG TS; AAFB **Period of Performance:** 2017 - 2021

Project Objective

To salvage and transplant federally threatened *Bulbophyllum guamense*, *Dendrobium guamense*, and *Tuberolabium guamense* identified within construction footprints associated with the Guam Relocation.

Conservation Benefit

To minimize impacts of military construction activities to native ecosystems by salvaging as many healthy individuals as possible and preserving the genetic diversity of each species.

FY20 Status

Bulbophyllum guamense

- 71 individuals have been identified, salvaged, and transplanted to the Forest Enhancement Area from project footprints on Finegayan.
- 71 individuals survived at least 1 year after transplantation.
- One individual was identified in AAFB in July 2019. It was salvaged and translocated to the Government nursery in September 2019.

Dendrobium guamense

- 21 individuals have been identified, salvaged, and transplanted to the Forest Enhancement Area from project footprints on Finegayan and Andersen South since 2017.
- 18 individuals survived at least 1 year after transplantation.

Tuberolabium guamense

- 15,385 individuals have been identified in NBG Telecommunications Site and throughout AAFB since 2017.
- 6,357 individuals have been salvaged and transplanted to the Forest Enhancement Area (Figure 64).
- 4,826 individuals survived at least 1 year after transplantation.
    - Survival criteria:
        - 2017 through 2019: New root growth
        - 2019 and all future projects: New root growth and root attachment to the new host tree

EPR: DPRI: Marine Corps Relocation 2017/2018 amendment to 2015 BO, Conservation Measures to Contribute to the Recovery of Listed Species.

2019 JRM INRMP Reference: THM-3; 8-49



Figure 64. Surviving adult *Tuberolabium guamense* fruiting after salvage and transplantation to the Forest Enhancement Area.

Salvage and Transplantation of *Cycas micronesica* – NBG TS and AAFB

Location: NBG TS; AAFB **Period of Performance:** JUL2017 - JUL2021

Project Objective

To salvage and transplant federally threatened *Cycas micronesica* identified within construction footprints associated with the Guam Relocation.

Conservation Benefit

To minimize impacts of military construction activities to native ecosystems by salvaging as many healthy individuals as possible and preserving the genetic diversity of the species.

FY20 Status

- NBG Telecommunications Site
  - Six adult cycads were salvaged and transplanted to an area of the Forest Enhancement Area. Salvage and transplantation was completed on 03 October 2018. The cycads received maintenance and monitoring for 1 year until 03 October 2019 (Figure 65).
  - Four (4) of the six are alive, two of the six are confirmed dead.
- Northwest Field, AAFB
  - Pup salvage was completed on December 2019. 1,503 pups were salvaged. Currently, there are 28 alive pups being maintained and monitored in a Government-approved nursery, 22 of which have had new leaf emergence.
  - Direct salvage and outplanting of 27 cycad trees was conducted between October and November 2019. All 27 directly outplanted cycad trees continue to receive weekly maintenance and monitoring.
  - 17 cycad trees showed signs of long horn beetle damage. Screen barriers are being installed to prevent additional beetle damage (Figure 66).
  - Cycad seed collection was completed on 09 June 2020. 1,233 cycad seeds were collected. To date, 742 seeds are being maintained and monitored in the Government-approved nursery. 238 cycad seeds have radicle root emergence, 171 of which had leaf formation (Figure 67).
- Munitions Storage Area (MSA), AAFB
  - All Five cycads were identified within the construction area, were suitable to survive transplantation and/or salvage.
  - Nine pups and/or stem cuttings were salvaged from five cycads and transplanted to pots within a Government-approved nursery in December 2019. Pup and/or stem

cuttings continue to receive maintenance and monitoring until they are suitable for outplanting in the FES.

- Andersen South, AAFB
    - 27 cycads were identified within the construction area, but only eight were considered healthy enough to potentially survive transplantation.
    - Eight pups and stem cuttings were salvaged from six cycads and transplanted to pots within a Government-approved nursery in September 2019. Pups and/or stem cuttings continue to receive maintenance and monitoring until they are suitable for outplanting in the FES.

EPR: DPRI: Marine Corps Relocation 2017/2018 amendment to 2015 BO, Conservation Measures to Contribute to the Recovery of Listed Species.

2019 JRM INRMP Reference: THM-3; 8-49



Figure 65. Adult *Cycas micronesica* salvaged from NBG Telecommunications Site and directly transplanted into the Forest Enhancement Site.

Figure 66. Adult *Cycas micronesica* salvaged from Northwest Field and directly transplanted into the Forest Enhancement Site



Figure 67. *Cycas micronesica* seeds collected from Northwest Field and germinated in a nursery.

Invasive Plant Control – NBG TS and AAFB

Location: NBG TS; AAFB **Period of Performance:** SEPT2020 – MAR2022

Project Objective

This project intends to eradicate limited infestations of *Antigonon leptopus* and *Mimosa diplotricha* in the North Finegayan and Finegayan Forest Enhancement Sites.

Conservation Benefit

Invasive plants can outcompete native vegetation and interfere with restoration efforts for threatened and endangered species. Removal of invasive plants, particularly in new or smaller infestations where it may be possible to eradicate the invasive species from sensitive areas, will improve survivorship and growth of native plant species during future restoration efforts.

FY20 Status

- Prescribed burn for *M. diplotricha* conducted through a partnership with Guam Dept. of Agriculture as a training exercise.
- Follow on herbicide control to be awarded through a CESU in August 2020.

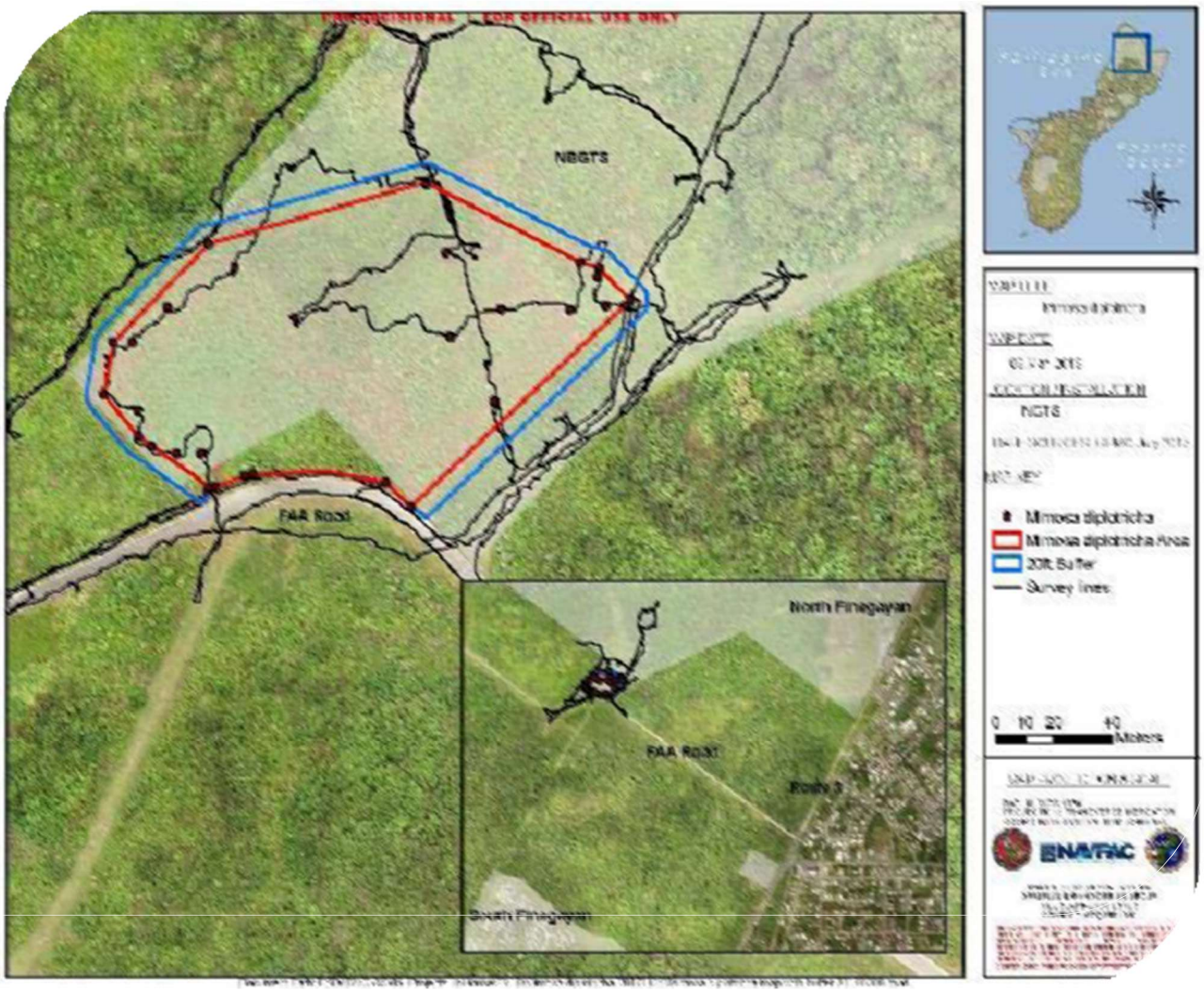


Figure 68. *Mimosa d.iplotricha* infestation site

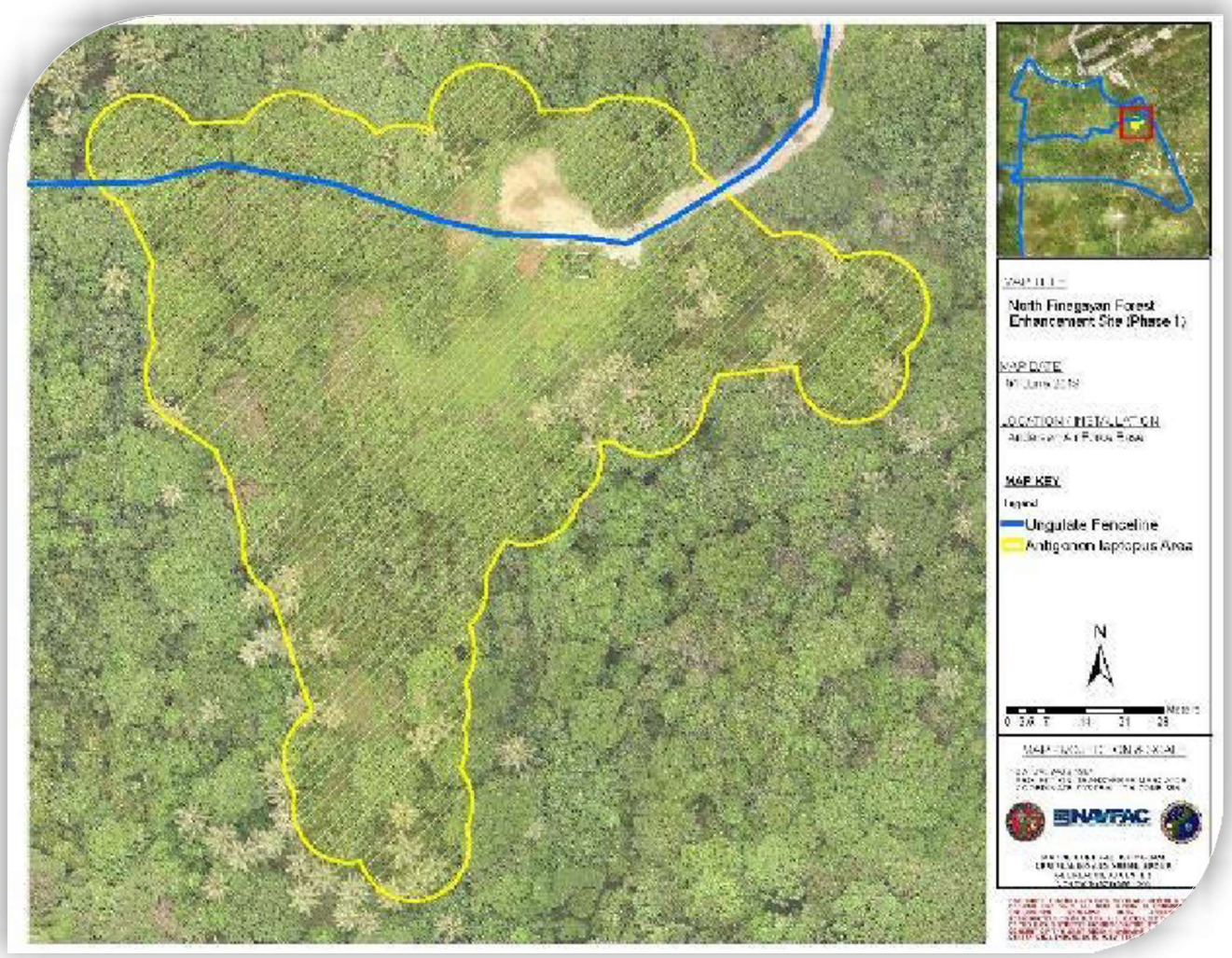


Figure 69. *Antigonon leptopus* infestation area within Phase I, North Finegayan Forest Enhancement Site.

EPR: DPRI: Marine Corps Relocation 2017/2018 amendment to 2015 BO, Conservation Measures to Minimize the Effects of Invasive Species.

2019 JRM INRMP Reference: THM-3; 8-49, TIS-1; 8-52, THM-1; 9-68

North Finegayan Forest Enhancement Site Ungulate Fencing and Eradication

Location: NBG TS; AAFB **Period of Performance:** SEP2020 – SEP2022

Project Objective

The project will eradicate feral pigs and Philippine deer in both phases of the North Finegayan Forest Enhancement Site.

Conservation Benefit

Feral pigs and deer are among the most significant threats to sensitive limestone forests; ungulate removal will promote growth of native species and increased survival of threatened and endangered species.

FY20 Status

- The North Finegayan FES Phase 1 exclosure (Figure 70 and 71) was completed in March 2020. The Phase 2 fencing project is projected to be complete in the first quarter of FY21.
- The contract for ungulate eradication in Phase 1 was awarded in the second quarter of FY20.
- Phase 1 eradication is projected to be complete by September 2020, but the effort has been complicated by Covid-19 restrictions.

EPR: DPRI: Marine Corps Relocation 2017/2018 amendment to 2015 BO, Conservation Measures to Minimize the Effects of Invasive Species.

2019 JRM INRMP Reference: THM-33; 8-49



Figure 70. Ungulate fence

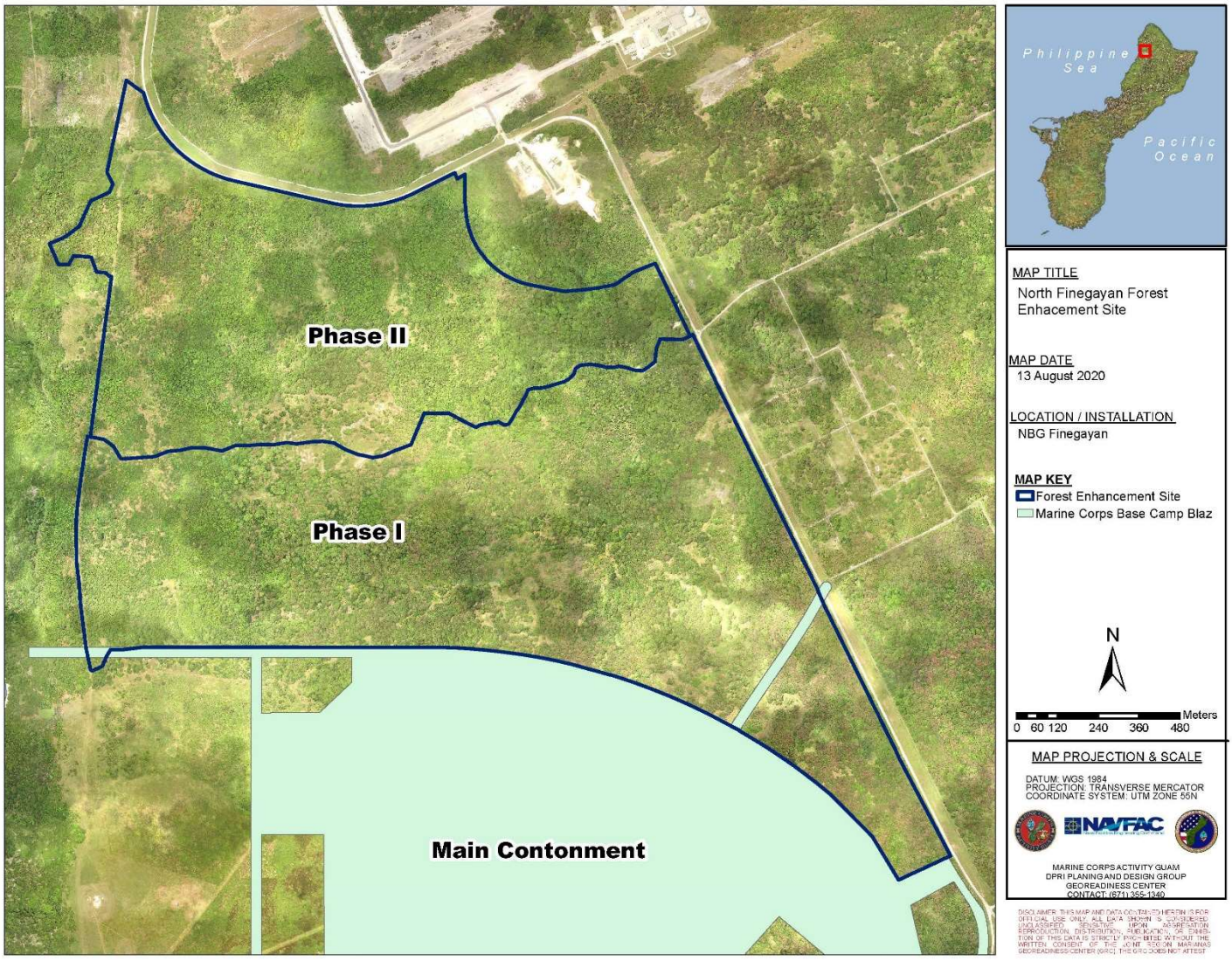


Figure 71. Location of Ungulate Eradication Areas of the North Finegayan Forest Enhancement Site.

Haputo Ecological Reserve Area Ungulate Fencing

Location: NBG TS **Period of Performance:** AUG2019 – FEB2021

Project Objective

Haputo Ecological Reserve Area will be fenced to exclude feral ungulates. The northern section will encompass 168 acres while the southern section encloses approximately 116 acres.

Conservation Benefit

The ungulate fence (Figure 72) will exclude deer and pigs that destroy native vegetation and contribute to erosion that harms nearshore reefs. Ungulate removal will promote growth of native species and increase survival of threatened and endangered species.

FY20 Status

- N. Haputo ERA fence contract was awarded in August 2019 to SRGI, Inc. Fence installation is pending.
- S. Haputo ERA fence contract was awarded in August 2020 to Sundance-EA.

EPR: DPRI: 2015 Navy-USFWS Guam Micronesia Kingfisher MOA.

2019 JRM INRMP Reference: THM-2; 8-48

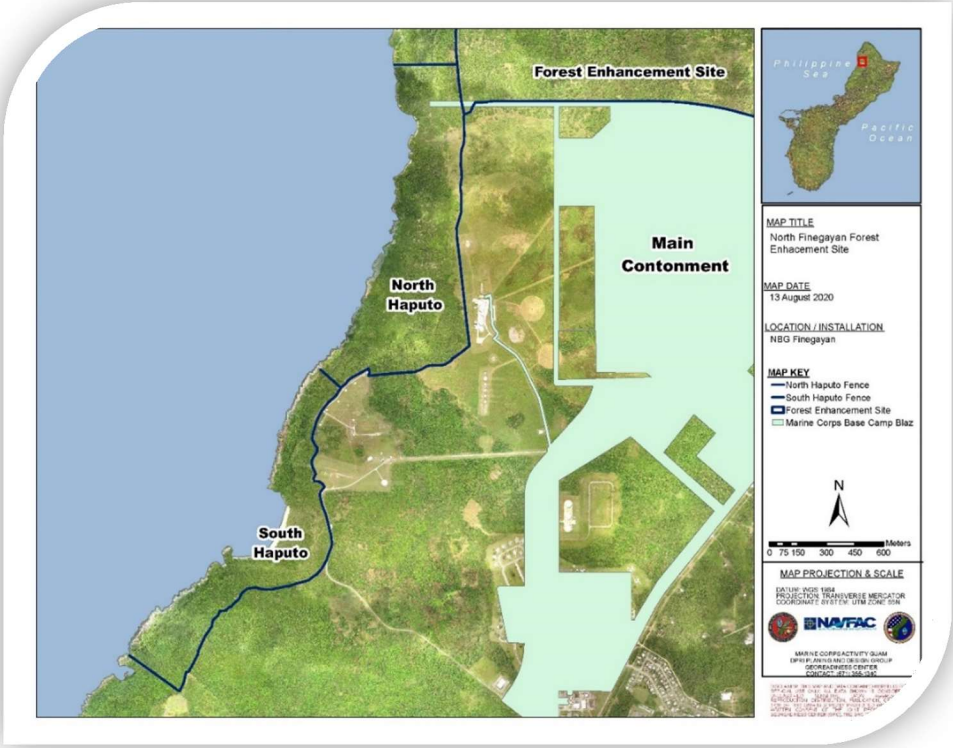


Figure 72. Haputo Ecological Reserve Area ungulate fence alignment.

Implementation Plan for Phase I of the North Finegayan Forest Enhancement Site

Location: NBG TS; AAFB **Period of Performance:** JUL2019 – JUL2020

Project Objective

The project will develop a site-specific plan for Phase 1 of the North Finegayan Forest Enhancement Site (Figure 73) to address regulatory compliance, infrastructure needs, invasive plant removal options, and sequencing for native species outplanting.

Conservation Benefit

Forest enhancement efforts will improve habitat for native species, including threatened and endangered plants and animals.

FY20 Status

- CESU awarded to UOG in July 2019.
- Plan delayed due to Comprehensive Baseline Report delay.
- Currently working on invasive tree control trials

EPR: DPRI: Marine Corps Relocation 2017/2018 amendment to 2015 BO, Conservation Measures to Contribute to the Recovery of Listed Species.

2019 JRM INRMP Reference: THM-1; 9-68

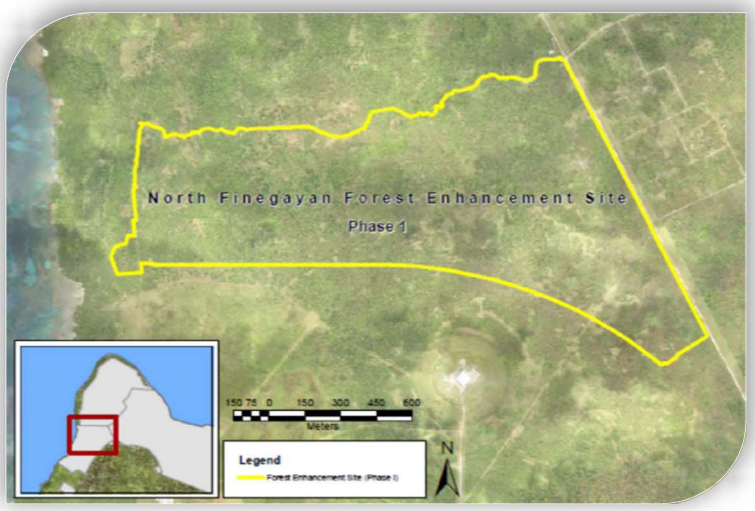


Figure 73. Map depicting North Finegayan Forest Enhancement Site Phase 1.

Terrestrial Protected Species Management

Conservation Management of Listed Invertebrates

Location: JRM **Period of Performance:** JUL2018-DEC2019

Project Objective

To prepare a survey method protocol for ESA-listed snails that is statistically sound and applicable, to provide field and classroom training for natural resource staff and partners, and to create a snail ID field booklet.

Conservation Benefit

Identifying locations of ESA-listed snail species will allow for management actions to avoid and conserve locations of protected species and host plant species. The survey protocol will be coordinated with natural resource partners.

FY20 Status

- A Cooperative Agreement was awarded through the CESU network to UOG in July 2018. Deliverables include the survey protocol, field training, and a snail ID booklet (in coordination with USFWS).
- Snail survey classroom and field training was conducted for JRM NR managers, USFWS, and DAWR biologists in June 2019.
- The Survey Protocol titled: “Biomonitor Support for Natural Resource Management Surveys at Joint Region Marianas Area of Responsibility (Partulid Snail Survey Methods)” was finalized in December 2019 and provided to resource partners.
- The snail ID field booklet is complete and printed copies are available.

EPR: 1 CP JRM Conservation Management of ESA-listed Invertebrates; 61128NR203

2019 JRM INRMP Reference: TPS-1; 5-88, TPS-1; 6-46, TPS-1; 7-55, TPS-1; 8-54, TPS-4; 9-76; TPS-5; 11-66

ESA-Listed Treesnail Monitoring - NBG

Location: NBG; NMS **Period of Performance:** JUL2019– JAN2021

Project Objective

To collect baseline population, demographic and habitat data on ESA-listed treesnails: *Samoana fragilis*, *Partula gibba* and *Partula radiolata* at twelve different locations and to collect presence absence data on roadside edge habitat on two installations and a fuel pipeline.

Conservation Benefit

Identifying locations of ESA-listed snail species will allow for management actions to avoid and conserve locations of protected species.

FY20 Status

- A new cooperative agreement was awarded through the CESU Network to UOG in July of 2019 to conduct surveys for plant and invertebrate surveys on all JRM lands and other lands on Guam and the Commonwealth of the Northern Mariana Islands (CNMI).
- Roadside surveys along the Sinajana portion of the fuel pipeline were conducted with 2-meter search areas on either side of the access road. A total of 596 *Partula radiolata* were found at sites along both sides of the pipleline road (Figure 74) from March through May 2020. Roadside surveys at the Sasa Valley Fuel Farm were conducted from May through July. *Samoana fragilis* and *Partula radiolata* have been observed (Figure 75).
- Photo mark recapture (PMR) surveys have been conducted from May through August 2020 at Naval Base Guam Naval Munitions Site (Figure 76), Haputo Beach and Pugua Point (Figure 77), and San Luis Beach (Figure 78).

EPR: 1 CP JRM Conservation Management of ESA-listed Invertebrates; 61128NR203

2019 JRM INRMP Reference: TPS-1; 5-88, TPS-1; 6-46, TPS-1; 7-55, TPS-1; 8-54

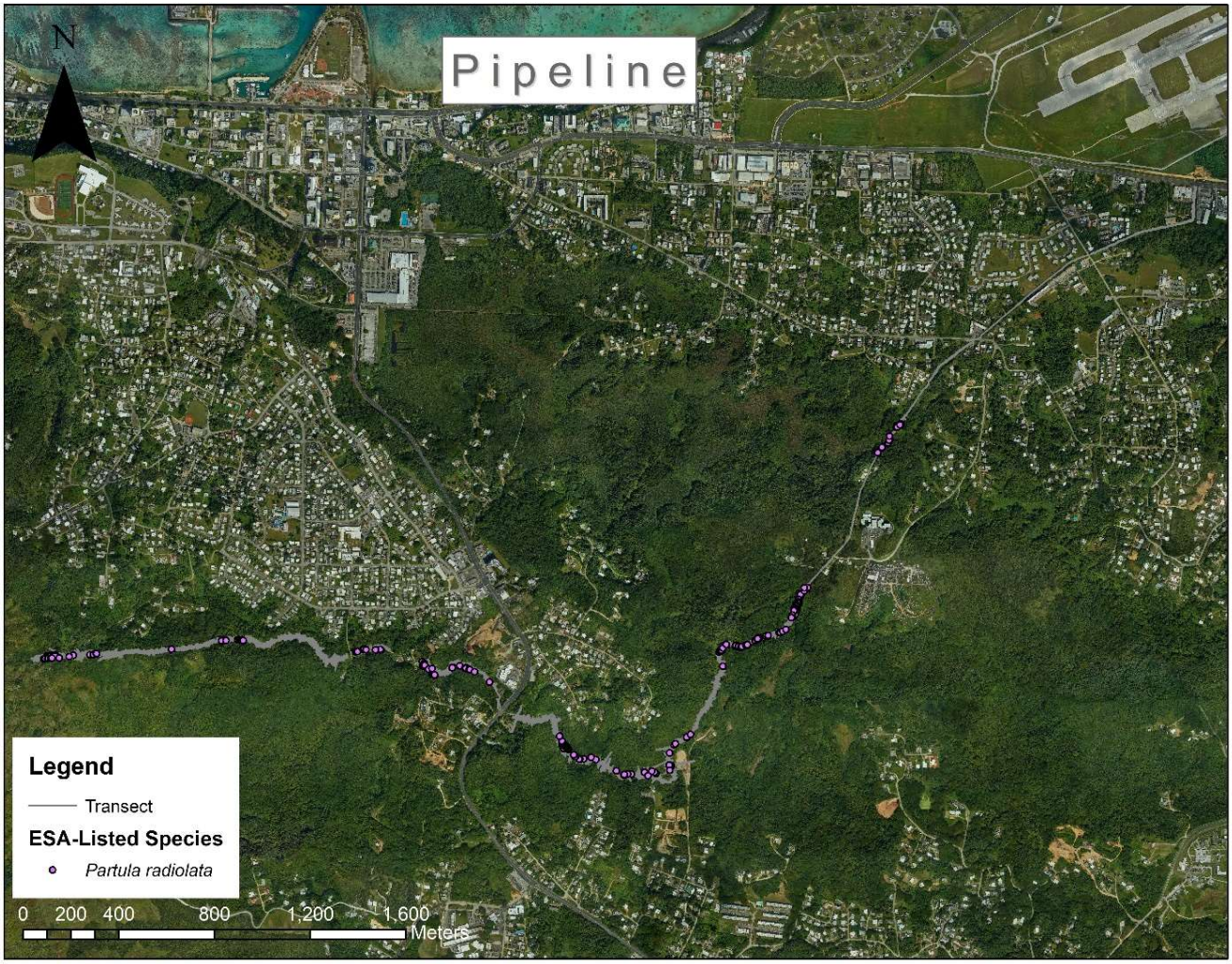


Figure 74. ESA-listed snails observations along the Sinijana fuel pipeline from March through May 2020.

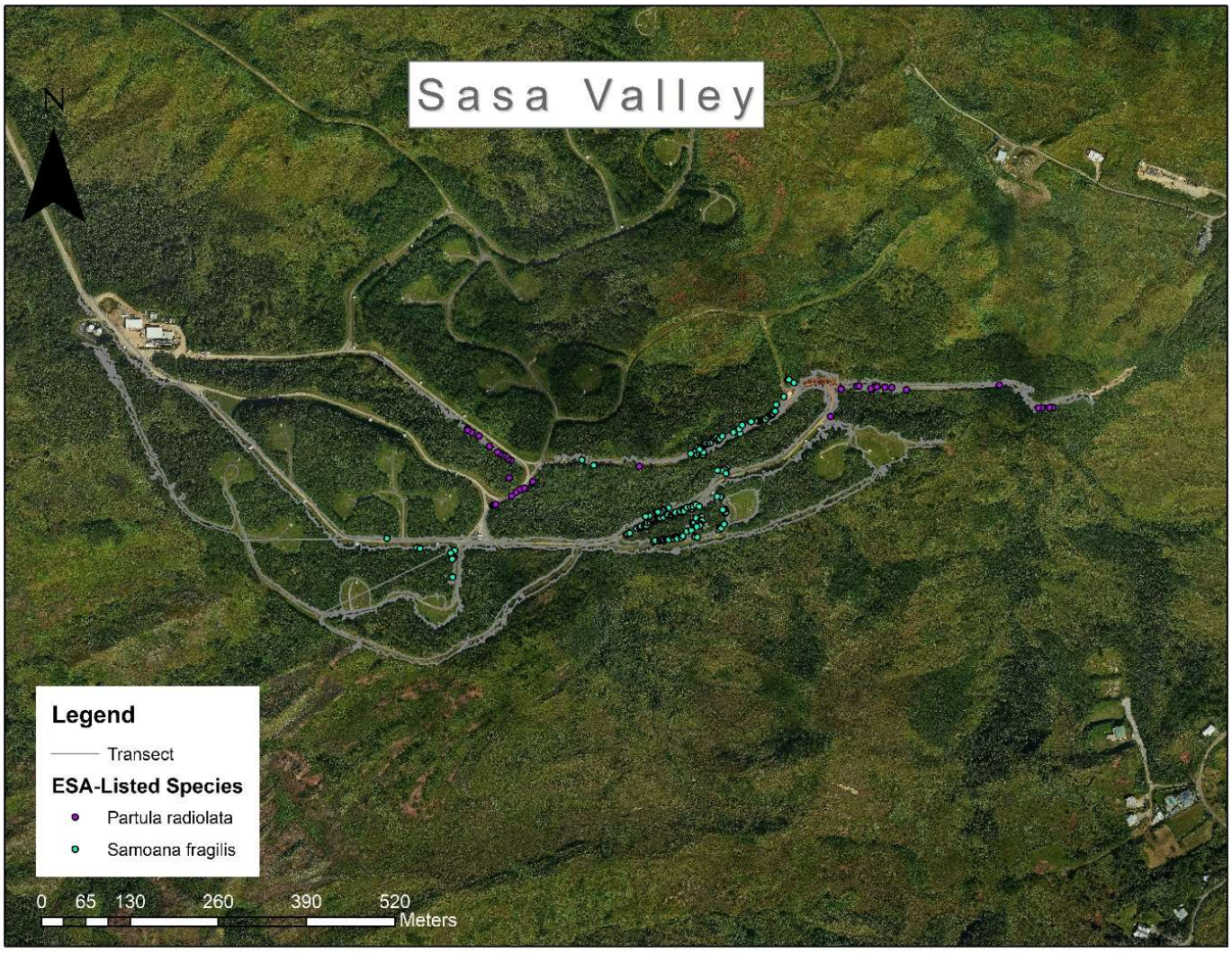


Figure 75. ESA-Listed snails found during snail surveys from May through July 2020.



Figure 76. Mark and recapture sites at Naval Base Guam Naval Munitions Site.



Figure 77. Mark and recapture sites at San Luis Beach.

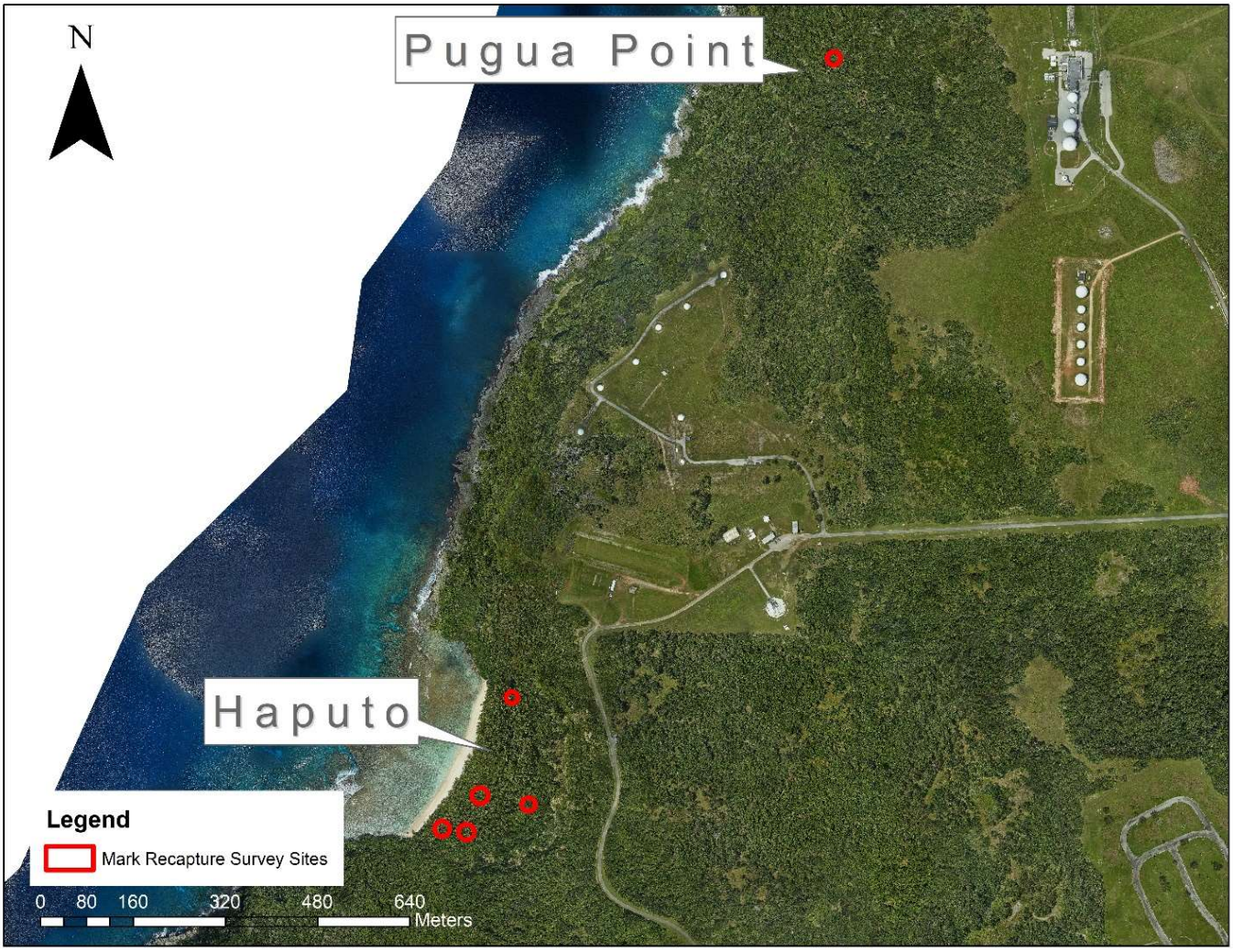


Figure 78. Mark and recapture sites at Haputo and Pugua Point.

Biomonitor Support for Natural Resource Management at Joint Region Marianas Area of Responsibility

Location: JRM AOR **Period of Performance:** JUL2019 – JAN2021

Project Objective

Provide biomonitor support to assist the Department of the Navy in natural resource management across lands under Joint Region Marianas AOR.

Conservation Benefit

Biomonitors will conduct surveys for threatened and endangered species, culturally valuable plant species, rare plants, and non-native/invasive species. Activities support the GMK MOA (2015) and the Biological Opinion for the Department of the Navy's Relocation of the U.S. Marine Corps from Okinawa to Guam and Associated Activities on Guam (USFWS, 2015, 2017, 2018).

FY20 Status

- Awarded as cooperative agreement through the CESU network to UOG-CIS on 29 July 2019.

EPR: DPRI: Marine Corps Relocation 2017/2018 amendment to 2015 BO, Conservation Measures to Contribute to the Recovery of Listed Species.

2019 JRM INRMP Reference: TPS-1; 7-55

Sea Turtle Monitoring, Protection, and Educational Outreach - AAFB

Location: AAFB **Period of Performance:** JUL2018 – DEC2020

Project Objective

To implement management techniques and methodologies to monitor nesting sea turtles on AAFB. These methodologies include but are not limited to: collection of consistent data to determine population demographics, reduce mortality and increase natural survivorship, increase sea turtle awareness of AAFB units and beach stakeholders, and create/maintain a robust database for long-term monitoring data that can support future research and detect trends. Ensure active nests are protected until hatchlings emerge. Conduct two beach clean-ups and other educational outreach activities for public awareness regarding sea turtles.

Conservation Benefit

Implement recovery actions by conducting long-term monitoring to determine population estimates and abundance; provide protection of sea turtles and their nesting habitats; and conducting outreach and education to the public on sea turtles and their habitats.

FY20 Status

- Nesting activity monitoring awarded as a cooperative agreement through the CESU network to UOG and SeaGrant.
- During 2019, all nests were observed on Explosive Ordnance Disposal (EOD) and Pati Beaches only. During the 2020 nesting season nests have been recorded on all AAFB Beaches including Tarague, Scout, Sirena, Pati, and EOD. There have been a total of 106 emergences from August 2019 to present, with 84 nests and 22 false crawls (Figure 79) with an 88.7% emergence success.
- Since August 2019, four nesting turtles were Passive Transponder (PIT) tagged and one was satellite tagged. Figure 80 provides a map of the satellite tagged turtle and her movements.
- Clutch data was collected on previously marked nests located successfully either after the emergence of hatchlings or after 70 days incubation. Data from these nest inventories estimated hatching and emergence success.
- In July 2020, a nest inventory revealed a record of 135 live hatchlings within a nest which appeared to be in the process of hatching. All hatchlings were observed safely entering the ocean (Figure 81).

- Outreach events included the 2019 International Coastal Cleanup at the Tarague, Scout, and Serena Beaches, presentations to Notre Dame High School, Inarajan Middle School, Oceanview Middle School, WAVE Club, and in-brief with EOD personnel.
- Other outreach activities included public service announcements (PSA) posts and video. The video was filmed by Sea Grant for the purpose beach etiquette, sea turtle facts, and conservation of the species via the official Andersen Air Force Base Facebook page in conjunction with the Public Affairs Office. These PSA's specifically targeted military servicemen and their dependents.
- Project Final Report due December 2020.

EPR: 1 LC MAR AAFB Sea Turtle Monitoring; M5240CN037
2019 JRM INRMP Reference: TPS-1; 9-75

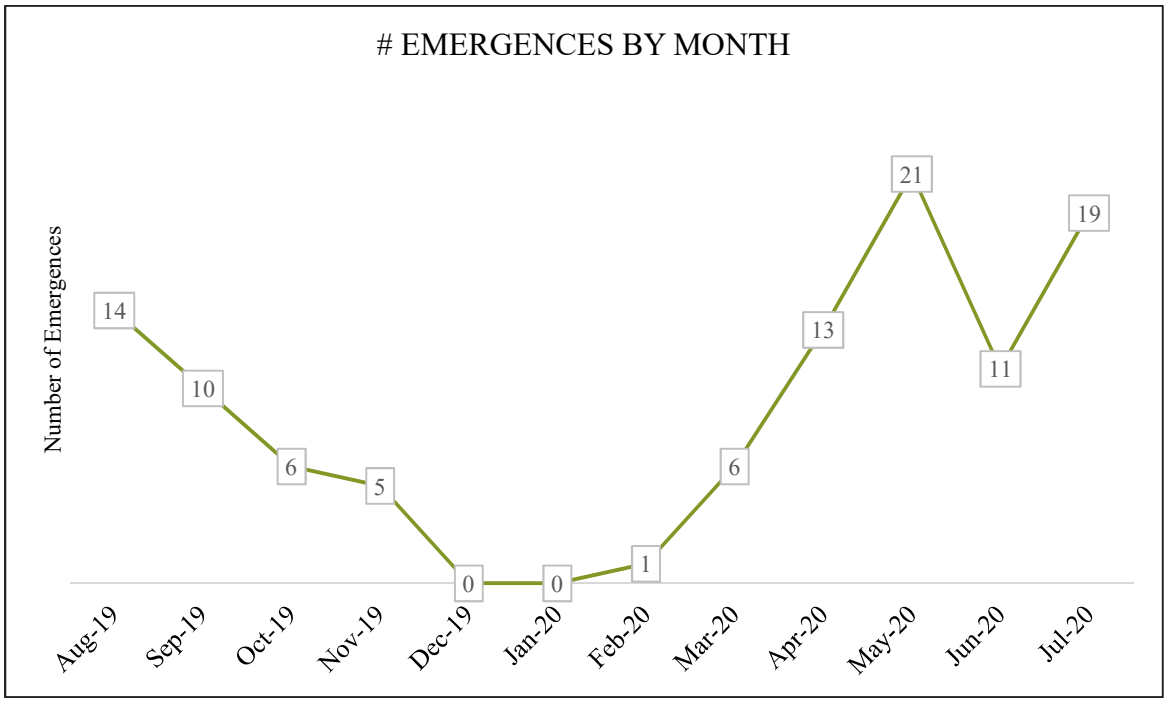


Figure 79. Total number of emergences by month from August 2019—July 2020, with peak activity from May to July.

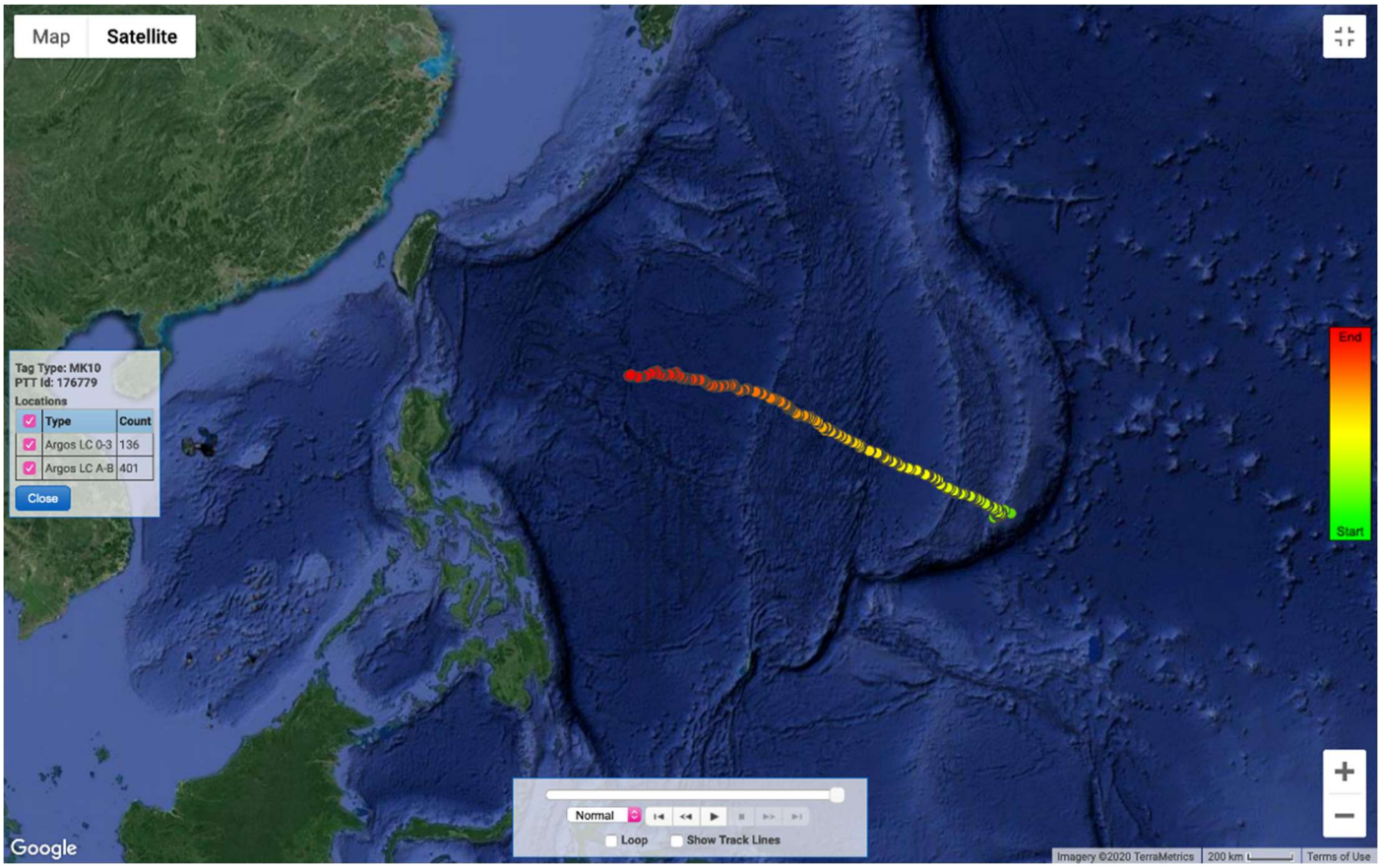


Figure 80. Movement of satellite tagged sea turtle starting in July 2020.



Figure 81. Live hatchlings from July 2020 making their way to the ocean.

Sea Turtle Nesting Beach Habitat Enhancement – NBG

Location: NBG **Period of Performance:** Ongoing

Project Objective

To increase the likelihood of hatchling turtles successfully traversing strand vegetation at Spanish Steps to access the ocean and enhance natural regeneration of native strand vegetation by removal of invasive vegetation. To reduce predation of sea turtle nests by trapping and removal of monitor lizards (*Varanus indicus*).

Conservation Benefit

Enhance and restore habitat and in an effort to recover sea turtle populations.

FY 20 Status:

- No beach cleanups were performed in 2020 due to both reduced staff and Covid-19 restrictions.
- Non-native vegetation and debris was removed from Spanish Steps beach in small increments during beach inspections for turtle activities.
- Monitor lizards were not culled in 2020, future plans are to place screens over the turtle eggs to stop predation. The change is due to new studies that provide compelling evidence that local monitor lizards are endemic to Guam.
- Screens were not used in 2020. Going forward with an expert has been hired who will accurately place screens over turtle eggs.
- Navy Base Guam is actively searching to fill the Marine Biologist position.
- Past monitor lizard activity included 208 trapping days in 2019 with zero lizards captured. Monitor lizard culling was conducted from August 2015-August 2018 at Spanish Steps beach. From 2015-2017 noose traps, pipe traps, gopher traps, A24 rat traps and active hunting captured has captured eight lizards. In 2017, Conibear Jaw traps were utilized (138 trap days) and captured five lizards. A total of 13 monitor lizards have been captured from 2015-2018. The size of the lizards has increased over time; mostly males were captured in 2017 and 2018. This implies a demographic shift as a result of trapping. Since males have larger home ranges than females, it's probable that the localized population was extirpated and males are now migrating into the area from elsewhere.
- In 2020 there were a total of 36 activities (32 nests and 2 non-nesting emergences) observed at Spanish Steps (SS); SS was the only NBG beach which experienced activity this season (Figure 82).

- The turtle activity will be updated in October, once a sea turtle expert has been brought on board who can verify whether the 36 turtle emergences are actual nesting activities.
- Predation activity will be determined when the certified turtle expert is brought on board
- Regular monitoring for sea turtle activity of all NBG-managed beaches includes following locations: GabGab, San Luis, Dadi, Haputo, Tipalao, and Spanish Steps
- Intermittent monitoring for sea turtle activity occurred at Reserve Craft Beach prior to and during military training events

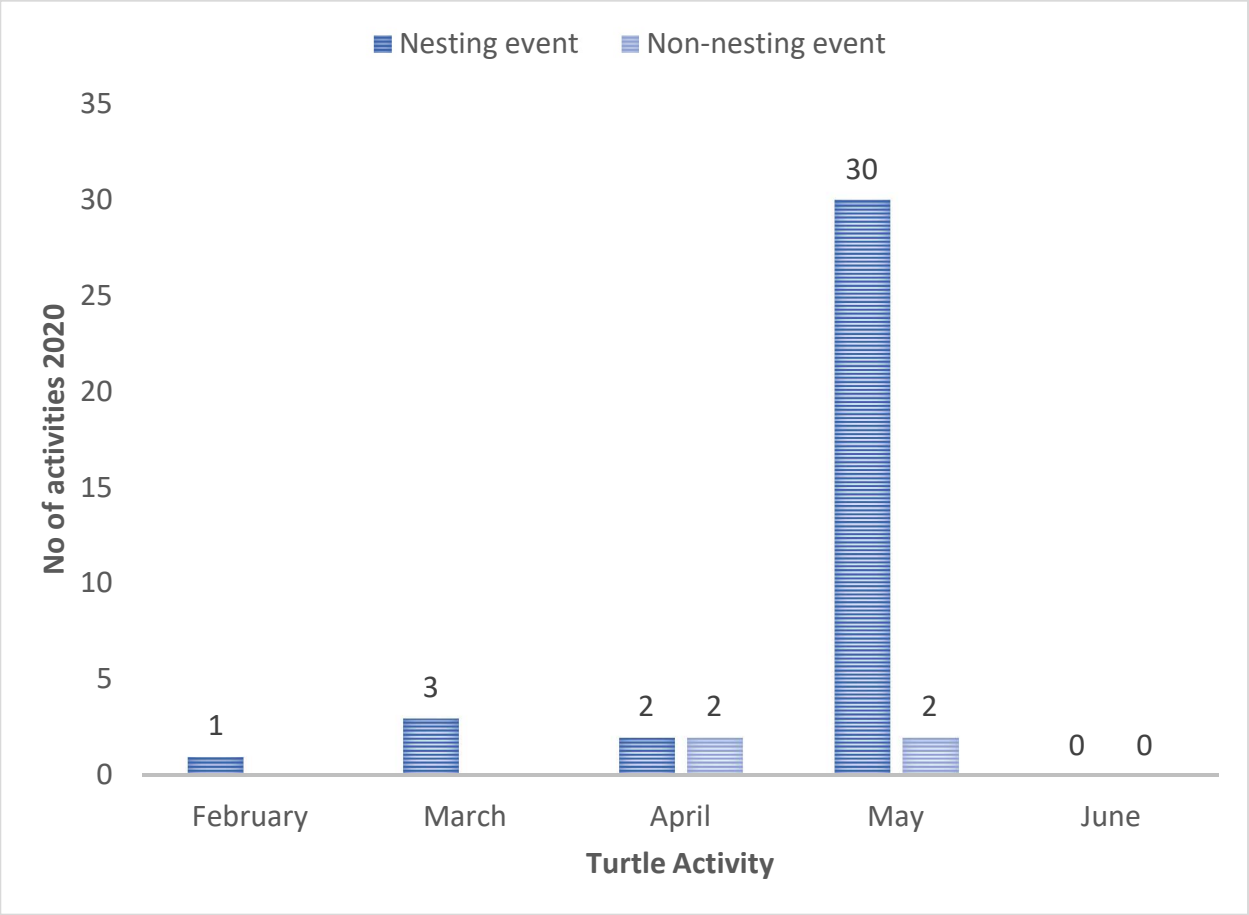


Figure 82. Summary of observations of sea turtle activities at Spanish Steps Beach, NBG (Feb 2020 – July 2020)

EPR: 1 S MAR NBG Endangered Species Monitoring; 61755NR142
2019 JRM INRMP Reference: TPS-2; 5-89

Sea Turtle Surveys – NBG

Location: NBG; NBG TS **Period of Performance:** AUG2020 - AUG2021

Project Objective

- Conduct sea turtle surveys on NBG beaches.
- Conduct monitor lizard control in sea turtle nesting areas.

Conservation Benefit

- Monitor the sea turtle nesting population at NBG and protect sea turtle nesting beaches for the recovery of sea turtles.

FY20 Status

- Contract awarded in August 2020.

EPR: 1 RP MAR NBG Green and Hawksbill Sea Turtle Nesting Habitat – Invasive Plant and Predator Control; 61755NR808
2019 JRM INRMP Reference: TPS-2; 5-89

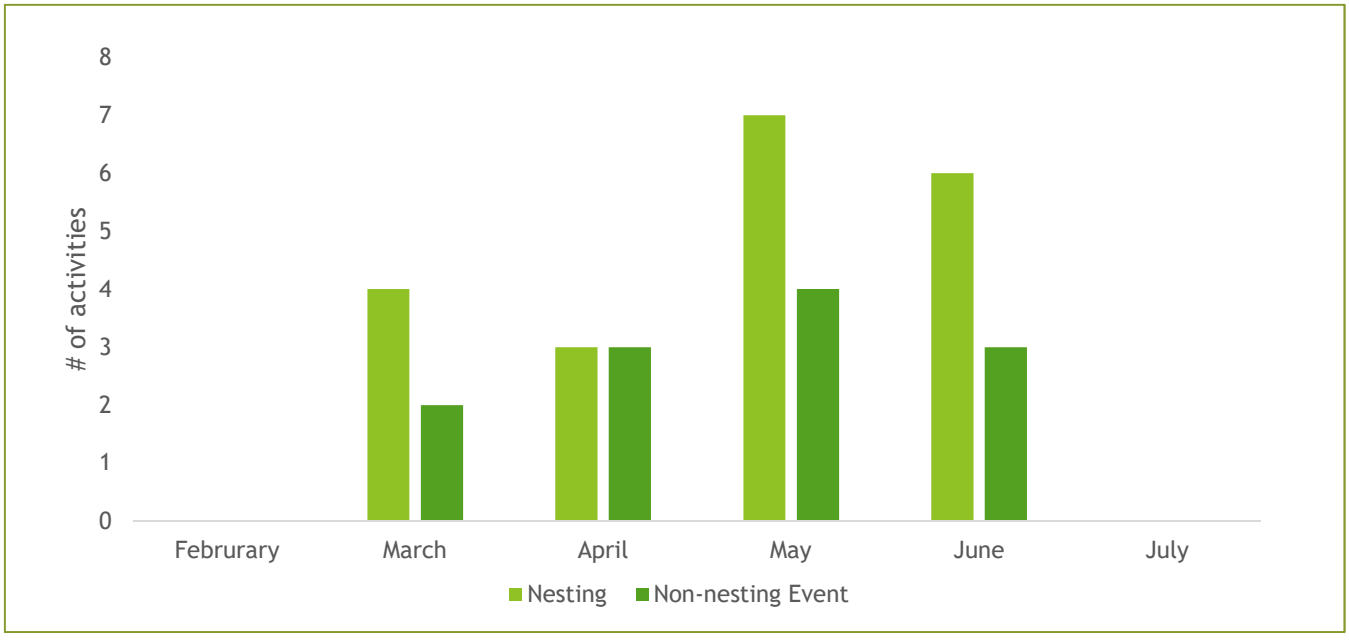


Figure 83. Summary of observations of sea turtle activities at Spanish Steps Beach, NBG (Oct 2018 – Sept 2019).

Restoration/Enhancement of Mariana Moorhen Habitat

Location: NBG; NMS **Period of Performance:** SEP2018 – SEP2020

Project Objective

To provide nesting platforms in ponds/wetlands where Mariana Common Moorhen (*Gallinula chloropus guami*) are known to occur. Platforms will be installed at two ponds on NMS, two ponds on the main Navy base and one pond at the old Barrigada golf course. To determine the viability for monitoring for moorhen presence via trail cameras.

Conservation Benefit

Improve nesting habitat for a listed species and increase population numbers on Guam. If successful the technique could be used in other areas with moorhen.

FY 20 Status

- Monitoring has shown the presence of moorhen on all ponds except for the Front Wetland near the NBG main gate.
- Activity has been recorded through both camera and direct observation.

Table 8: Results for June and July 2020 include the following:

Pond	Month	Observation
San Luis	June	Two moorhen are caught on camera, including one juvenile
San Luis	July	Moorhen are heard, but not seen nor caught on camera
Camp Covington	June	Up to two moorhen are seen at any one time
Camp Covington	July	Up to two moorhen seen in the upper T section at any one time Up to two moorhen and one juvenile seen at any one time in the lower T section. Nest platform appears to be used for sleeping only due to massive activity to and from another area of the pond
NBG Gate	June	No moorhen seen
NBG Gate	July	No moorhen seen
NMS Parsons RD	June	Up to two moorhen are seen at any one time
NMS Parsons RD	July	Up to two moorhen are seen at any one time

Along Fence Opposite NMS Fire Station	June	Up to three moorhen are seen at any one time. Two are adults and one juvenile
Along Fence Opposite NMS Fire Station	July	Up to three moorhen seen at any one time. Distance from cameras makes distinguishing adults versus juveniles difficult.
Radio Barrigada	June	Up to five moorhen seen at any one time, a mixture of adults and juvenile
Radio Barrigada	July	Up to three adult moorhen seen at any given time as well as two chicks- Platforms were already present on a sixth pond in Camp Covington.

EPR: 1 RP MAR Restoration of Mariana Moorhen at Fena Reservoir; 61744NR895

2019 JRM INRMP Reference: TPS-3; 5-89





Figure 84. Camera Capture of Moorhen on Platform.

Figure 85. Map depicting the location Ponds 1 and 2 on NBG.

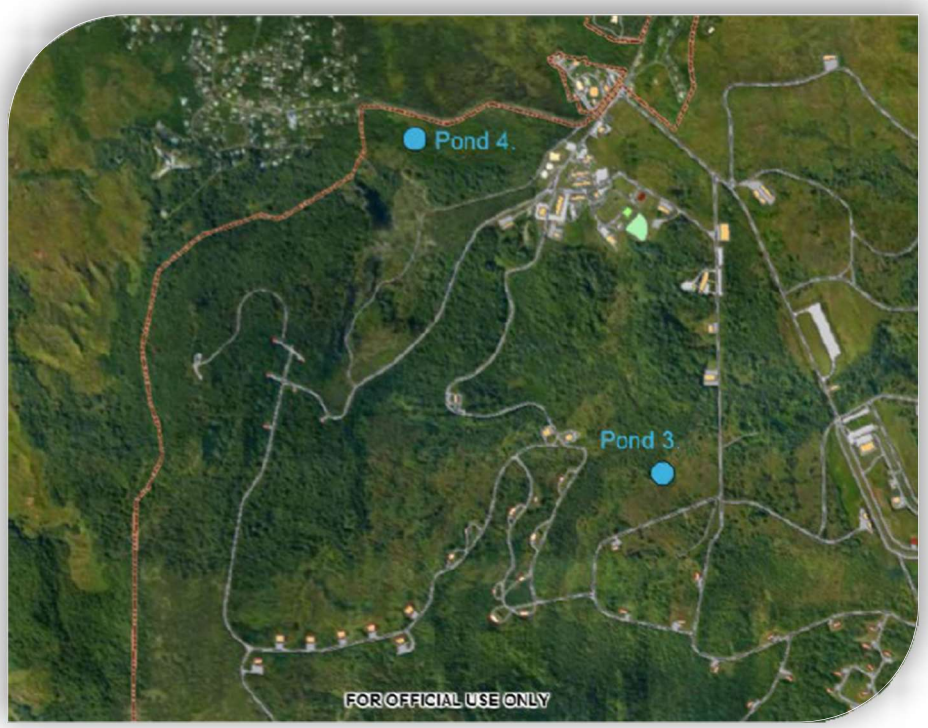


Figure 86. Map depicting the location Ponds 3 and 4 on NMS.



Figure 87. Map depicting the location Pond 5 on old Barrigada golf course.

Monitoring of Mariana Swiftlets

Location: NMS **Period of Performance:** Recurring annually

Project Objective
Monitor population trends of Mariana swiftlets (*Aerodramus bartschi*) at three caves on NMS.

Conservation Benefit
Monitoring to allow for management actions to enhance and restore habitat, reduce habitat fragmentation, buffer protected areas, and implement new conservation strategies.

FY 20 Status:

- Conducted quarterly surveys Maemong, at Mahlac, and Fachi. March 2020 count did not occur due to Covid-19 restrictions. A total of three (3) surveys occurred at each cave.
- Estimated population size of swiftlets on NMS in 2020 was 1,130 (Figures 88 - 92).

EPR: 1 S MAR NBG Endangered Species Monitoring; 61755NR142

2020 JRM INRMP Reference: TPS-4; 6-47

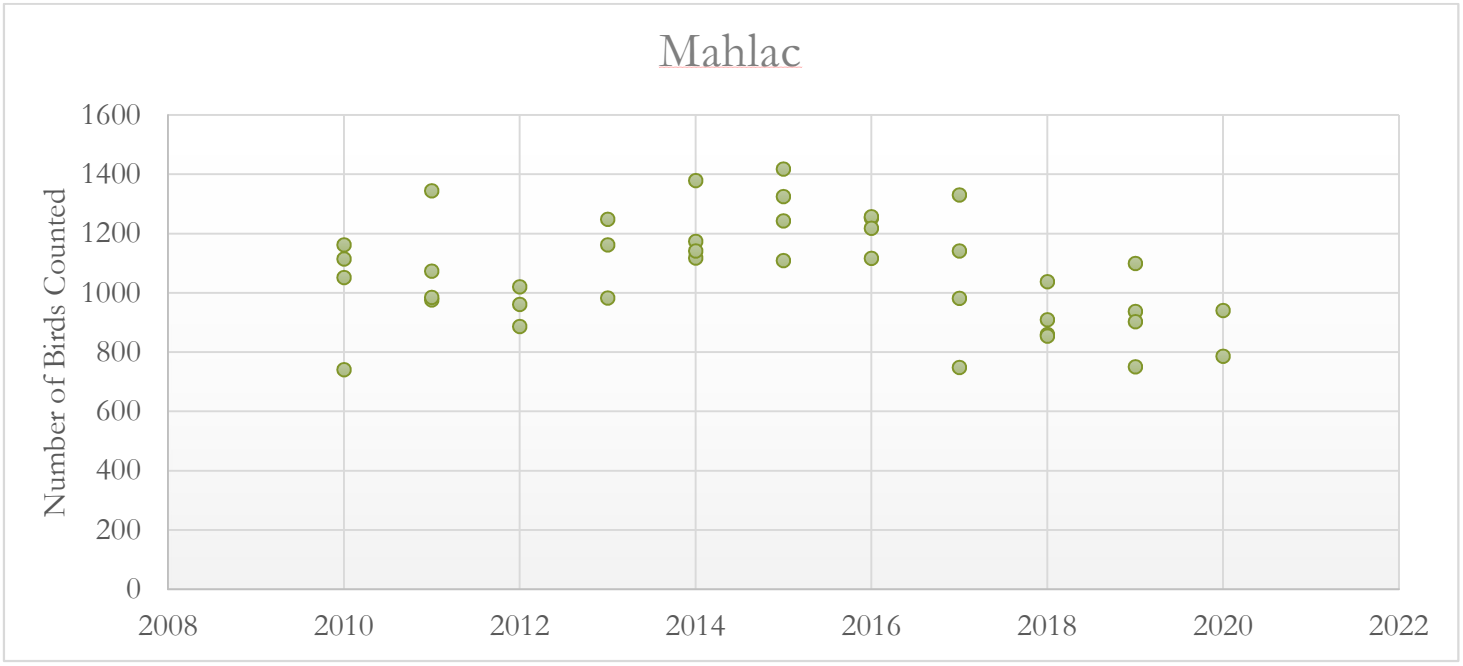


Figure 88. Summary of Observations of Mariana Swiftlets at Mahlac Cave, NMS (2010- 2020).

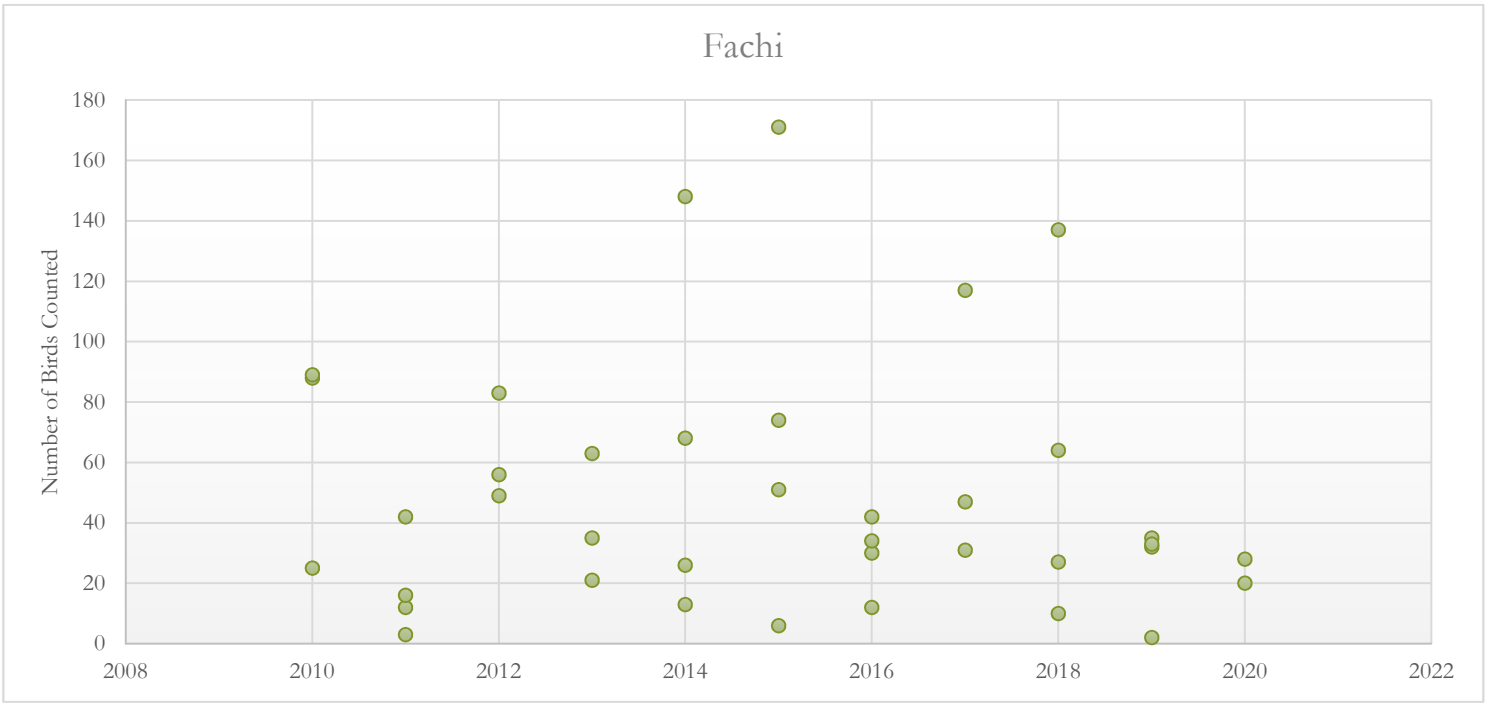


Figure 89. Summary of Observations of Mariana Swiftlets at Fachi Cave, NMS (2010- 2020).

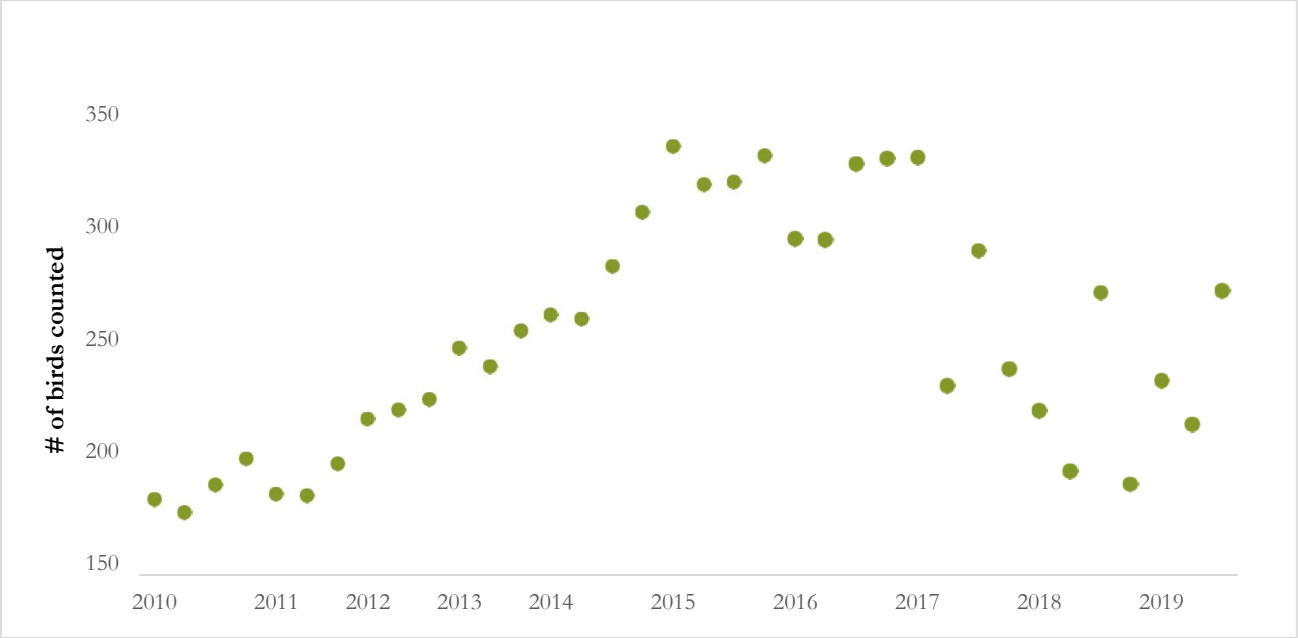


Figure 90. Summary of Observations of Mariana Swiftlets at Maemong Cave, NMS (2010-2020).

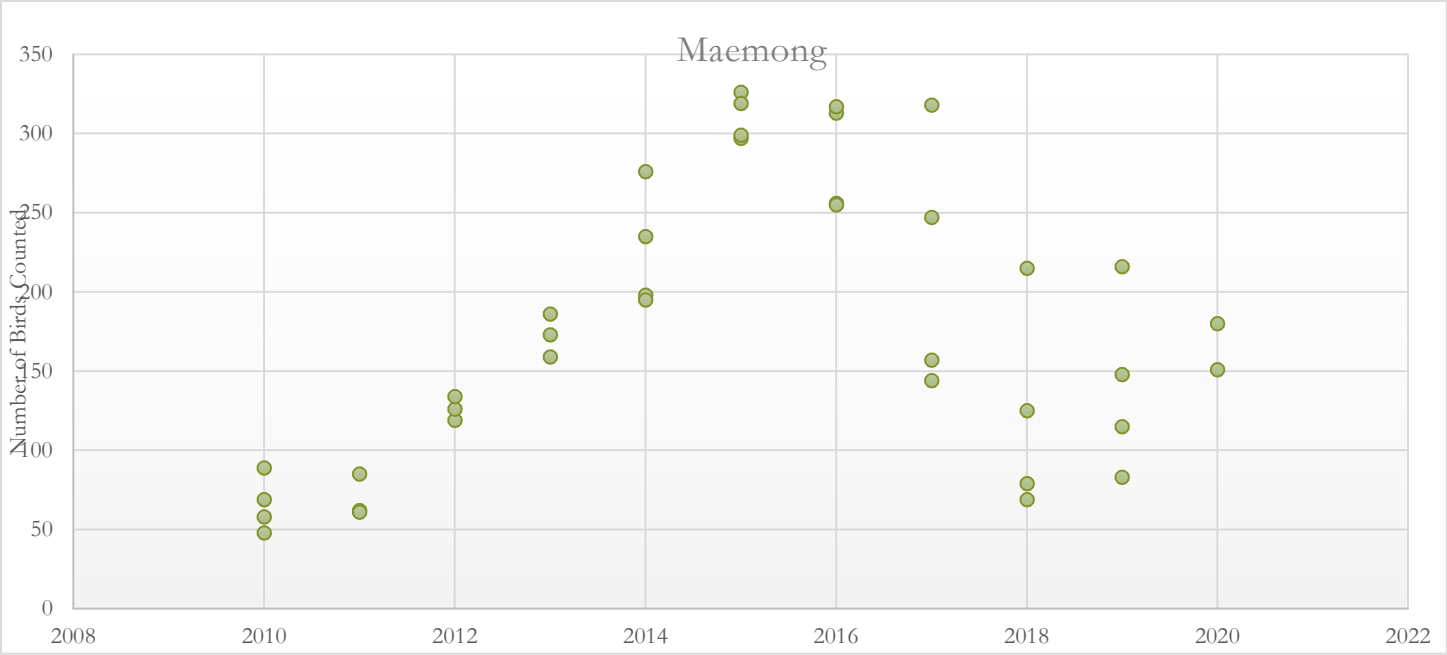


Figure 91. Summary of Observations of Mariana Swiftlets at Mahlac, Fachi, and Maemong Caves, NMS (2010-2020).

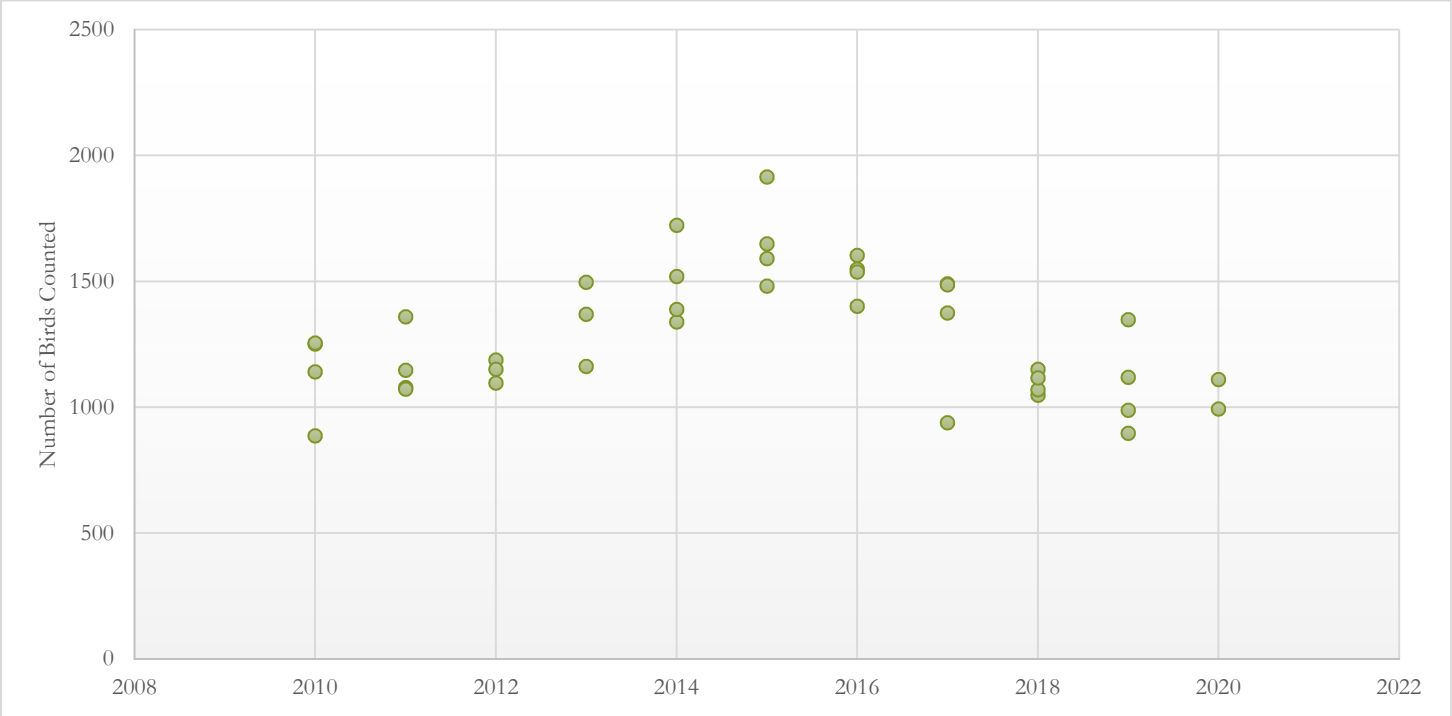


Figure 92. Summary of Observations of Mariana Swiftlets at Mahlac, Fachi, and Maemong Caves, NMS (2010-2020)

Mariana Swiftlet Recovery and Habitat Use

Location: NMS **Period of Performance:** SEP2018 – SEP2022

Project Objective

To provide an understanding of Mariana swiftlet (*Aerodramus bartschi*) habitat use, movement, reproductive success, and breeding site selection to inform management actions and meet specific objectives identified in the USFWS Recovery Plan for the Mariana Swiftlet.

Conservation Benefit

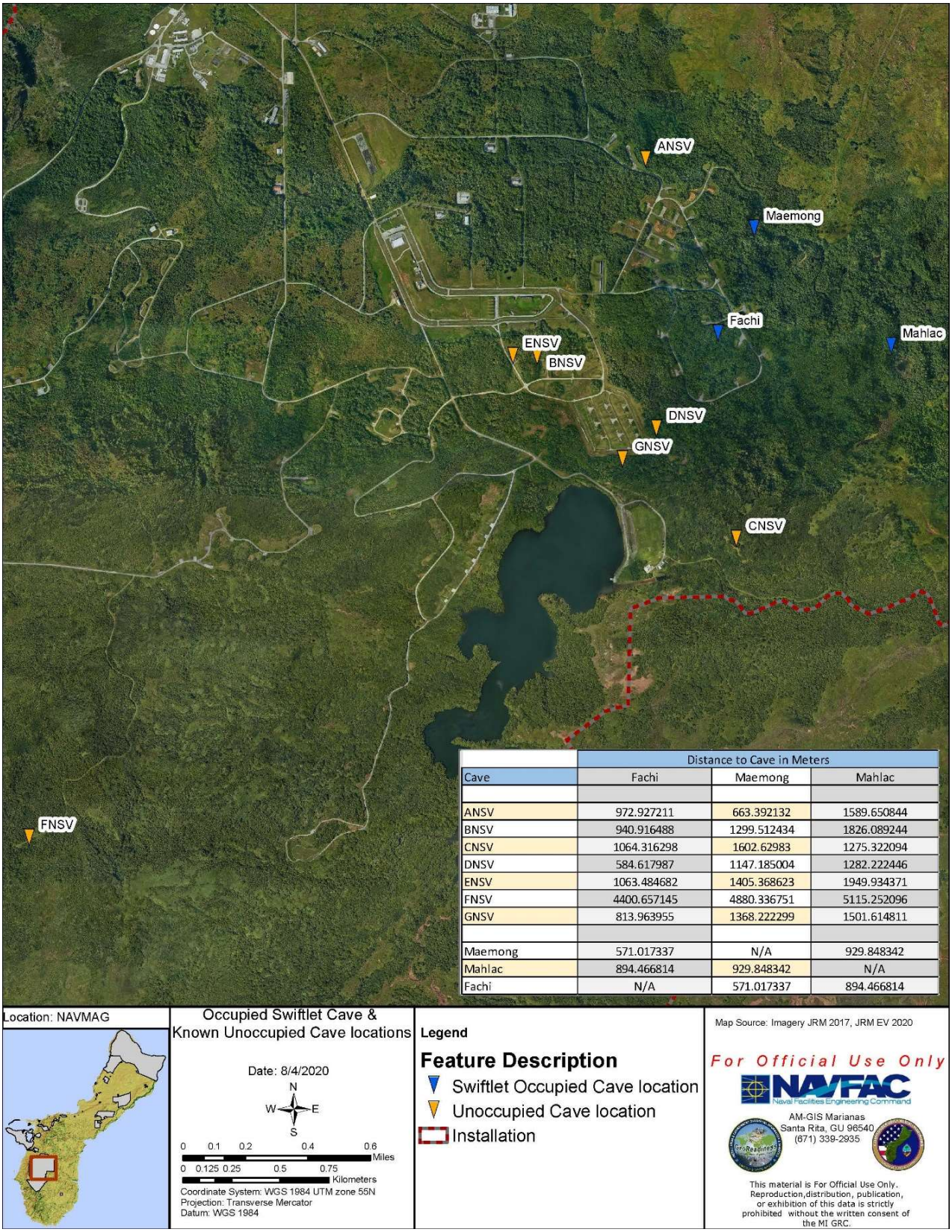
Implement actions for the recovery and potential down-listing of the Mariana Swiftlet.

FY19 Status

- IAA complete and in process for start of work by end of September 2020
    - Establish thermal camera system to visualize, map, and monitor roosting and nesting locations in occupied caves.
    - Monitor nesting activity and success
    - Estimate roosting population size.
    - Banding and radio tracking movement of adult swiftlets at caves and surrounding landscape
    - Develop low cost audio detectors to detect swiftlets prospecting of unoccupied caves.

EPR: 1 RP MAR NBG Mariana Swiftlet Habitat Use; 61755NR303

2019 JRM INRMP Reference: TPS-4; 6-47



Cave	Distance to Cave in Meters		
	Fachi	Maemong	Mahlac
ANSV	972.927211	663.392132	1589.650844
BNSV	940.916488	1299.512434	1826.089244
CNSV	1064.316298	1602.62983	1275.322094
DNSV	584.617987	1147.185004	1282.222446
ENSV	1063.484682	1405.368623	1949.934371
FNSV	4400.657145	4880.336751	5115.252096
GNSV	813.963955	1368.222299	1501.614811
Maemong	571.017337	N/A	929.848342
Mahlac	894.466814	929.848342	N/A
Fachi	N/A	571.017337	894.466814

Figure 93. Map depicting occupied and unoccupied swiftlet caves on NMS.

Mariana Fruit Bat Monitoring - AAFB

Location: AAFB **Period of Performance:** FEB2018 – AUG2020

Project Objective

Conduct surveys for Mariana fruit bats (*Pteropus mariannus mariannus*) at AAFB as part of long-term population monitoring and to provide analysis on the effects of aircraft overflights and behavior of Mariana fruit bats at Pati Point.

Conservation Benefit

Monitoring will allow for management actions to enhance and restore habitat and increase efforts to recover Mariana fruit bat populations on Guam.

FY20 Status

- Addresses three of the recovery criteria in the 2009 U.S. Fish and Wildlife Service (USFWS) Draft Revised Recovery Plan for the Mariana Fruit Bat or Fanihi by implementing seven of the Recovery Actions outlined in the Draft Plan.
- The 7th Annual Base-wide Count occurred on August 7, 2020. This year 64 individuals participated. There were less people this year due to COVID-19 base access restrictions. Preliminary data suggest that a total of 34 sightings of AAFB, this year. Data collected from off-installation survey points is still pending analysis (Table 9, Figure 94).
- Pati Point surveys continue to occur on a quarterly basis. There has been no sign of fruit bats present at the historic roost site.
- An aggregate site was identified on 11 May 2020, above the cliff line south of CATM range. The number was initially estimated at 30-40 bats but was not counted so as not to disturb the roost. The location is visited ever 2-3 weeks to document occupancy and the site continues to be occupied.

EPR: 2 BO MAR AAFB Fruit Bat Monitoring; M5240CN041

2019 JRM INRMP Reference: TPS-2; 9-75

Table 9. Results of AAFB annual base-wide Mariana fruit bat counts from 2014-2019.

Year	# Bats Counted	AAFB Fanihi Estimate: (flight – area)	Area Sampled acres (% of AAFB habitat)
2019	46	79 - 98	7307 (47%)
2018	32	57 - 76	6233 (41%)
2017	32	57 - 68	6125 (34%)
2016	25	45 - 64	5068 (28%)
2015	13	24 - 32	5245 (29.3%)
2014	8	14 - 20	5200 (29.3%)

***2020 Base-wide survey data analysis pending final results.**

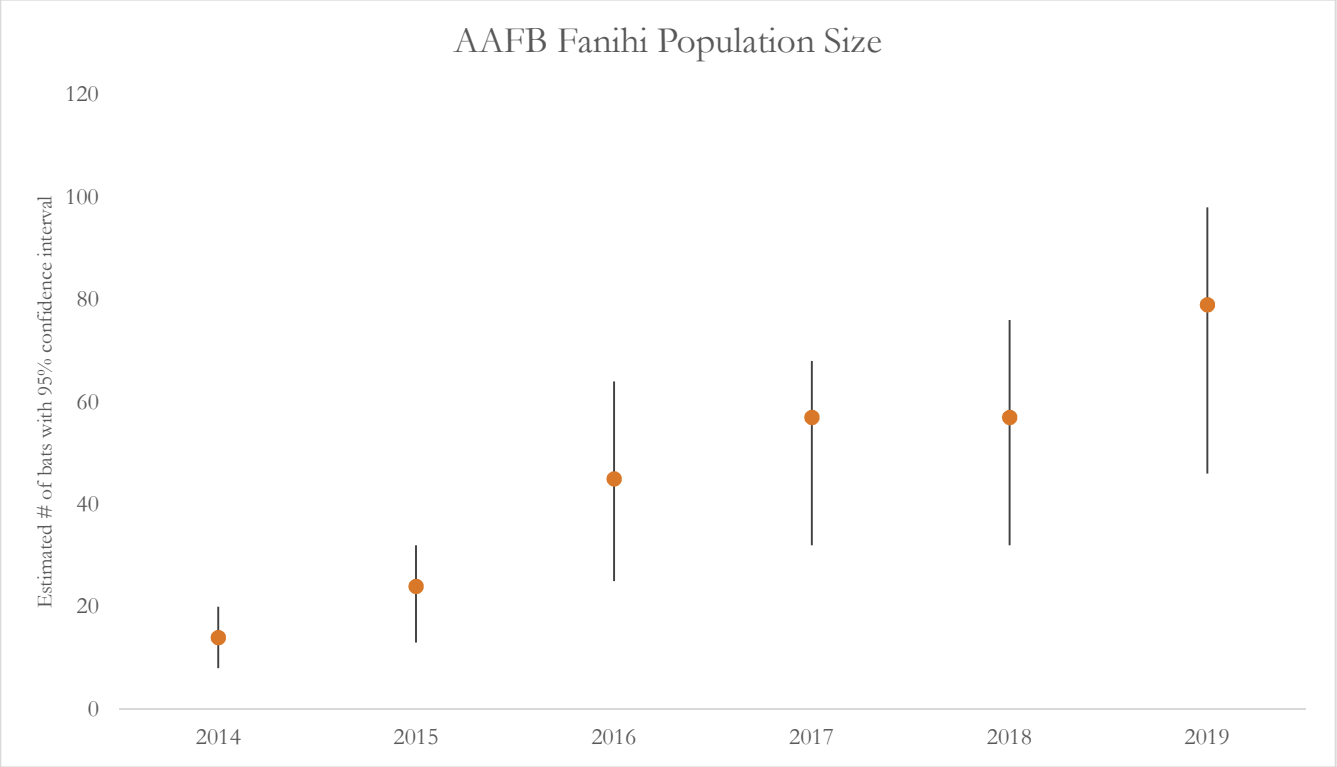


Figure 94. Estimations of AAFB Fruit Bat population size by year.

Cycad Conservation - AAFB

Location: AAFB **Period of Performance:** SEPT2017 – APR2021

Project Objective

Maintenance and monitoring of four, 1-acre, permanent fenced cycad (*Cycas micronesica*) plots (Achae Point, Ritidian, Tarague Basin, and Golf Course) (Figure 95).

Conservation Benefit

Research and monitoring on management actions that directly benefit *Cycas micronesica*. The intent is to identify which management actions most benefit the plant and if possible implement on a more broad scale.

FY20 Status

- A Cooperative Agreement through the CESU network was awarded to UOG on September 2017.
- UOG continues to monitor the Tarague, Achae, and Palms Golf Course plots. As of July 2020, the monitoring of the NWF plot was withdrawn due to impacts from the construction of the new Live Fire Training range that supports the USMC build-up. In addition, the cycad plot at the HMU is no longer monitored due to access issues and poor health of trees. Two new plots in Tarague Triangle will be used as substitutes for NWF and the HMU.
- UoG continues to monitor unfenced plots adjacent to existing cycad plots as controls in order to gauge the effectiveness of conservation methods being implemented.
- Yearly data collection of cycads includes: base circumferences; trunk circumference at 1.45 m; total height; number of leaves. Additional notes describe the overall assessment of each tree.
- Sticky traps are being deployed within the plots as part of a study to determine the seasonality of scale breeding. Crawler stage scales are captured by the sticky traps to be counted.
- A systemic pesticide (Merit®) is applied on a quarterly basis (every 3 months) to increase the trees' resilience to invasive insect pests, while seedlings are treated with direct application of Distance® to target scale infestations.
- Cycads with reproductive structures were more numerous in fenced plots than control plots (Figure 98).

EPR: 3 SAR JRM, AAFB – *Cycas micronesica* Management for Conservation; M5240NR061

2019 JRM INRMP Reference: TPS-5; 9-77



Figure 95. Map of Cycad Monitoring Plots.



Figure 96. A male cycad tree in the Tarague plot with a new cone emerging.

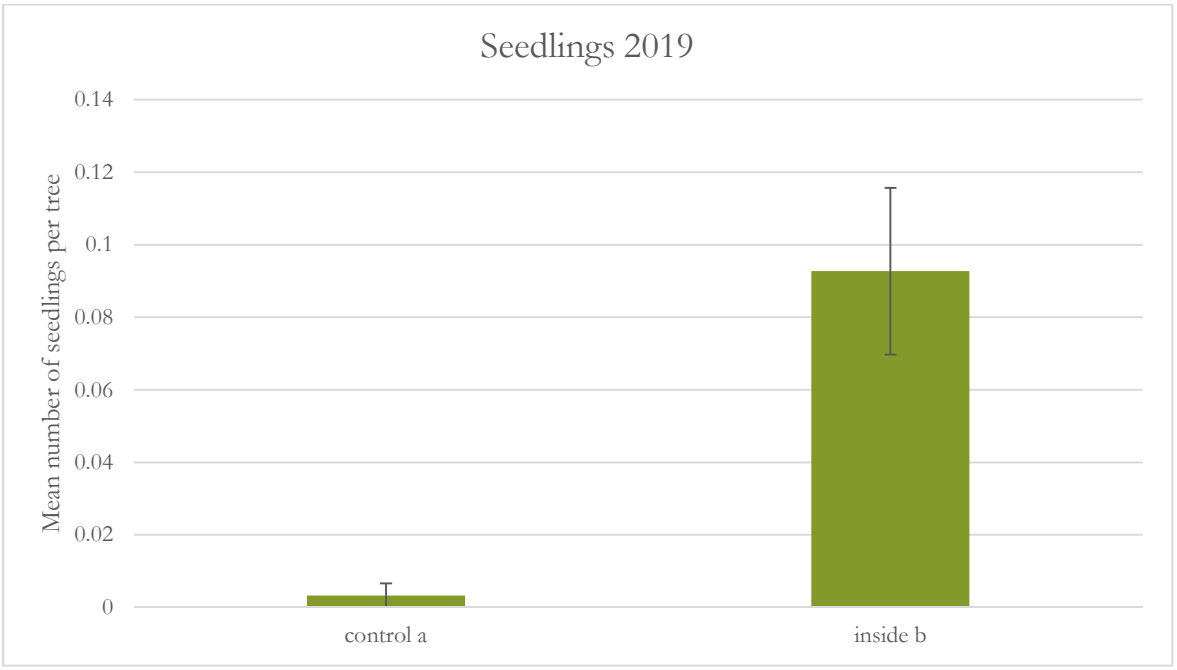


Figure 97. Mean number seedlings between fenced and control plots

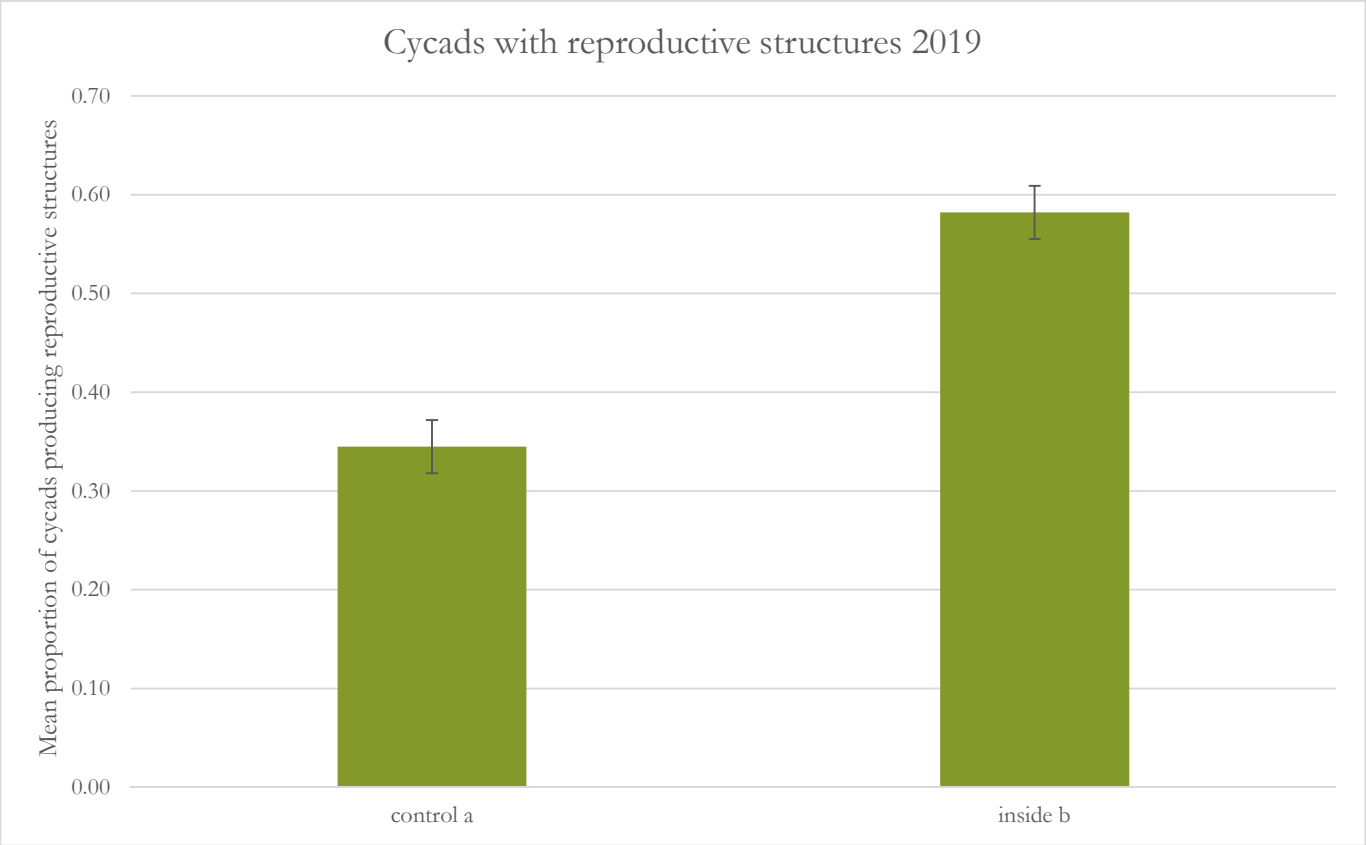


Figure 98. Cycads with reproductive structures

Serianthes nelsonii Monitoring, Outplanting and Management - AAFB

Location: AAFB **Period of Performance:** MAY2016 – JULY2020

Project Objective

Maintenance and monitoring of mature *Serianthes nelsonii* tree in Northwest Field at Ritidian point, including in situ seedlings and fence maintenance, monitoring and maintenance of outplanted seedlings, and nursery propagation and maintenance of seedlings.

Conservation Benefit

Implementation of recovery actions such as increasing populations, insuring against catastrophic events, and testing and implementing new conservation strategies.

FY20 Status

- The mature tree at Ritidian remains stable though the heartwood is 80% infected with the fungus *Ganoderma sp*., which is weakening the internal structure of the tree. As of July 2020 there were 37 seedlings within the enclosure and a total of 1,113 seeds collected between August 2019 – July 2020 (Table 10).
- *Serianthes* have been outplanted in two fenced cycad plots on AAFB at Tarague basin (6 saplings) and the Palm's Golf Course (10 saplings). Four out of the 16 saplings are considered to be in poor health. Only five saplings are considered in good health, while the remaining seven were moderately healthy. Up to 20 saplings are planned for outplanting in 2020.
- As of July 2020 there were 145 seedlings in the GPEPP Rare Plant nursery (Figure 99). Seven (7) graft saplings remain from a previous contract, 2 non-graft saplings, 58 seedlings older than 1 year, and 78 seedlings less than 1 years old.
- As of July 2020, there were eleven (11) embryos extracted from immature seeds and germinated successfully in #2 media. Most of these have shed their leaflets and have some chlorosis since being transferred to a nutrient-rich solution. Another eight (8) mature seeds with underdeveloped embryos (flattened seeds that generally don't germinate in soil) were sown *in vitro* during July. So far, two of these are developing.
- A new Cooperative Agreement awarded through the CESU Network to UOG/GPEPP. The initial period of performance is from August 2020 through July 2021. Future plans include air layering, further outplanting within existing Cycad plots as well as the 3A Achae Point restoration site and providing support to the GNWR for their Serianthes outplantings.

EPR: 2 LC MAR AAFB *Serianthes nelsonii* Monitoring and Management; M5240CN039
2019 JRM INRMP Reference: TPS-5; 9-76

Table 10. *Serianthes nelsonii* seed collection and status from August 2019 to July 2020.

	Seeds Collected	Seeds Planted	Seed Storage
August 2019	164		942
September 2019	235		1096
October 2019	161		1310
November 2019	41		1455
December 2019	279	3	1496
January 2020	191		1772
February 2020	23		1963
March 2020	4		1986
April 2020	4		1982
May 2020	4		1986
June 2020	5	140	1844
July 2020	2		1845



Figure 99. Serianthes saplings and seedlings in GPEPP nursery, July 2020.

Tracking Movement of Micronesian Starlings and BTS on Andersen Air Force Base with an Automated Telemetry Tracking Network

Location: AAFB **Period of Performance:** SEP2019 – MAR2021

Project Objective

The goals of this project are to track the movement of Micronesian starlings (*Aplonis opaca*) and BTS on AAFB to identify areas of high use and routes of transit through automated telemetry towers, and document areas of high predation by BTS. This project is one of four projects that will, collectively, further develop information on BTS behaviors related to predation and movement in the presence of abundant avian species.

Conservation Benefit

Tracking animals across the landscape over time can provide important information on habitat selection, resource needs, and factors influencing distribution and density. For a predator such as BTS, tracking movement can provide information on hunting patterns, dispersal potential, and identify areas that may be particularly susceptible to predation. Overlapping simultaneous movement from both predators and their prey can help identify areas of greatest contact, which may vary spatially and temporally. Additionally, population demographics that could be useful for supporting future avian restoration projects and controlling BTS in low density with competing food sources in the presence of control regimes.

FY20 Status

- Funded via an interagency agreement with USGS –PIERC
- Deployment delayed due to COVID-19
- Test network set up in progress

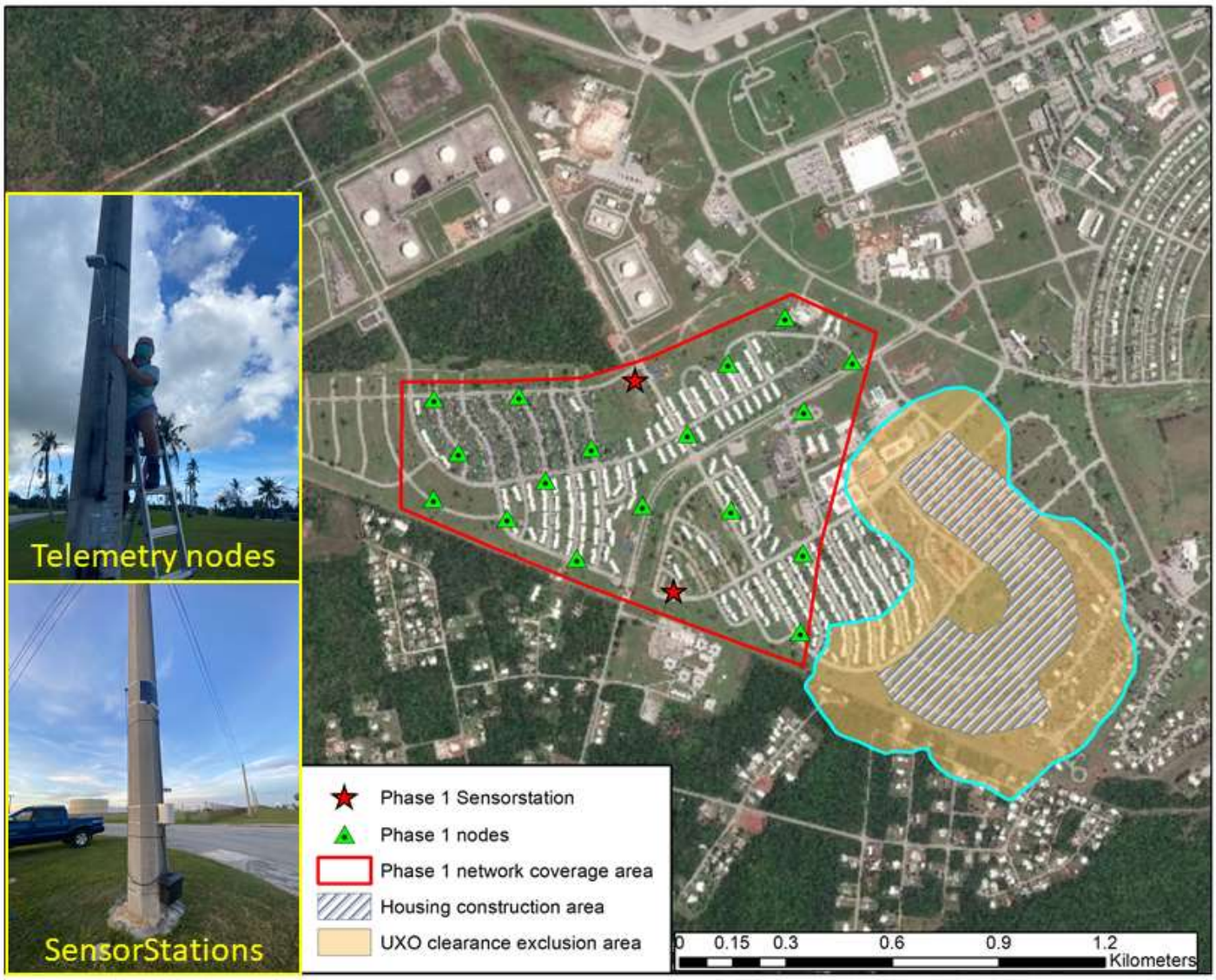


Figure 100. Telemetry network to monitor Sali and BTS, Andersen AFB. Image courtesy of USGS-PIERC.

EPR: 1 RP JRM Brown Tree Snake Eradication and Control to Support Recovery of ESA-Listed Birds; 61128NR202

2019 JRM INRMP Reference: TPS-6; 9-77

Evaluating and reducing BTS predation threat in urban Micronesian Starling Habitat – AAFB

Location: AAFB **Period of Performance:** SEP2019 – MAR2021

Project Objective

The project will evaluate control tools for urban BTS suppression in experimental high and low snake density plots. Also, monitor the relative abundance of BTS as a predation or dispersal threat via contact rates with baited camera devices. Overall this project will evaluate BTS control tools for suitability and efficacy in urban habitat, and use camera monitoring to index the decrease in Micronesian starling (*Aplonis opaca*) predation threat following snake removal. This project is one of four projects that will, collectively, further develop information on BTS behaviors related to predation and movement in the presence of abundant avian species.

Conservation Benefit

Recent work on AAFB has demonstrated that snakes in the housing area are having a pervasive impact on Micronesian Starling survival at all age classes. Snakes in these urban areas also constitute a greater risk for accidental export of live snakes to other vulnerable regions because shipments of household goods are routine. Additionally, previous research has shown that very large snakes, which pose the greatest predation and reproduction risk, are more often found in urban areas. For these reasons, it is important to begin to consider BTS risk mitigation in urban habitats. Contact rates can be interpreted as an index of relative abundance and as a proxy for the residual level of predation threat posed by BTS in snake-suppressed areas. Traditional tools for estimating BTS density and relative abundance are costly and impractical for long-term and broad-scale monitoring (e.g., mark-recapture) or provide no information on the snake (e.g., DNM bait tubes).

FY20 Status

- Funded via an interagency agreement with USDA –NWRC; project in progress
- 12 BTS caught tracked to date; 300 baits deployed (4% take rate)
- Different baits deployed: 10-15 g mouse, 10-15 g quail chick, 25-30 g mouse, 25-30 g chicken (chick)
- Difficulty in recovering BTS during the day – refugia underground or under urban structures



Figure 101. Brown treensnake consuming bait with transmitter on AAFB. Phots courtesy of USDA-NWRC.

EPR: 1 RP JRM BTS Eradication and Control to Support Recovery of ESA- Listed Birds

2019 JRM INRMP Reference: TIS-2, TIS-3; 5-85, 6-43; 7-52, 8-50-51, 9-71

Monitoring Survival and Demography of Micronesian Starlings

Location: AAFB **Period of Performance:** JUL2019 – JAN2021

Project Objective

To monitor and analyze for Micronesian starling (*Aplonis opaca* [Sali]) nest success and fledgling survival using telemetry, nest monitoring, and survey methods in relation to BTS control efforts. Through monitoring fledging survival and population recruitment efficacy of BTS control techniques can be assessed. This project is one of four projects that will, collectively, further develop information on BTS behaviors related to predation and movement in the presence of abundant avian species

Conservation Benefit

The Micronesian Starling is a useful proxy for understanding Guam forest bird ecology in the presence in of BTS. Behavior, survivorship, and population demographics could be useful for supporting future avian restoration projects and controlling BTS in low density with competing food sources in the presence of control regimes.

FY20 Status

- Agreement via the CESU network with Iowa State University (ISU)
- Project Ongoing
- 35+ Sali banded to date in 2020
- Cats and BTS known causes of mortality
- Population still skewed to adults (Figure 102)

EPR: 1 RP JRM Brown Tree Snake Eradication and Control to Support Recovery of ESA-Listed Birds; 61128NR202

2019 JRM INRMP Reference: TIS-2, TIS-3; 5-85, 6-43; 7-52, 8-50-51, 9-71

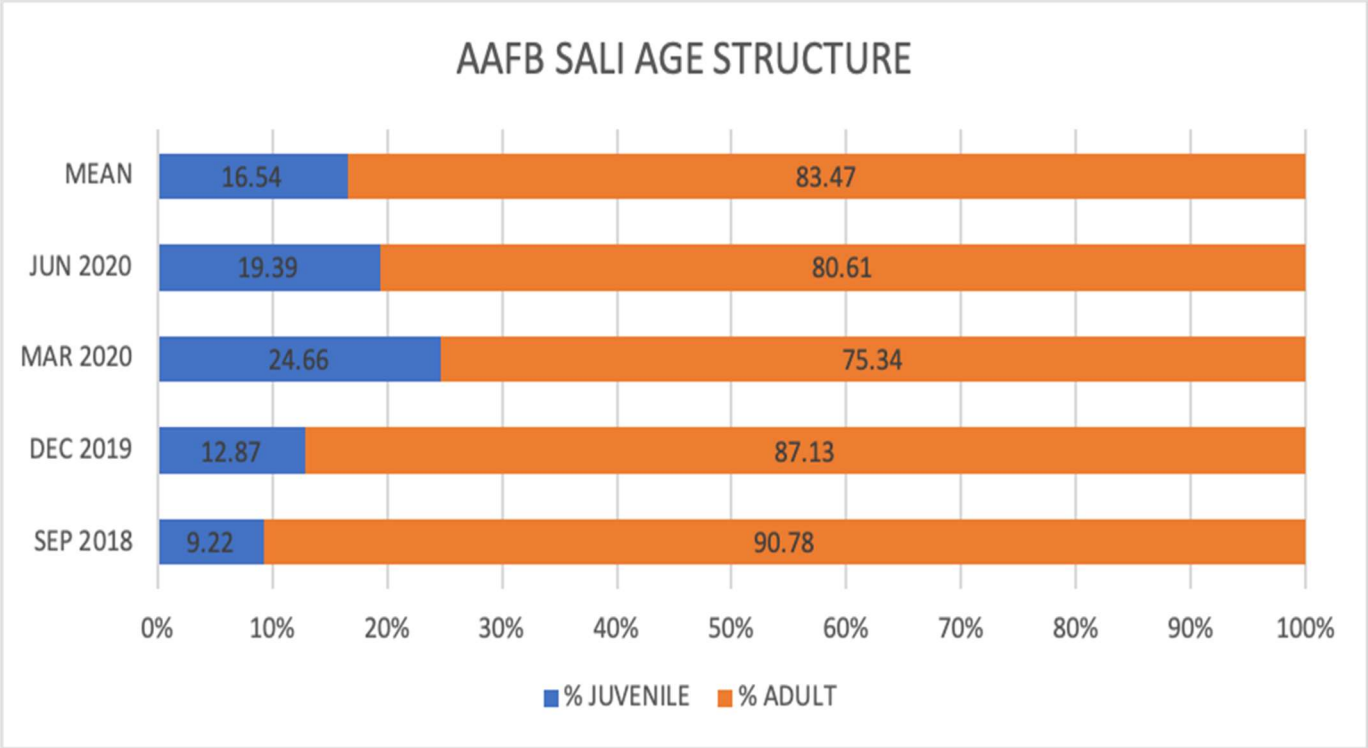


Figure 102. AAFB Sali Age Structure

Salvage and Transplantation of *Partula radiolata* – NBG TS and AAFB

Location: Andersen South, Haputo ERA **Period of Performance:** JAN2019 – FEB2021

Project Objective

To salvage and translocate federally endangered *Partula radiolata* identified within the construction footprint on Andersen South associated with the Guam Relocation.

Conservation Benefit

To minimize impacts of military construction activities to native ecosystems by salvaging as many healthy individuals as possible and preserving the genetic diversity of the species.

FY20 Status

- Snail surveys took place from January 2019 to March 2020.
- *P. radiolata* were located in two main areas of the project footprint.
- 3,850 P. radiolata were salvaged from the project footprint and translocated to the Haputo Ecological Reserve Area.
- Bi-weekly snail monitoring takes place at Haputo Ecological Reserve Area to count the number of marked (i.e., translocated) and unmarked snails.

EPR: DPRI: Marine Corps Relocation 2017/2018 amendment to 2015 BO, Conservation Measures to Contribute to the Recovery of Listed Species.

2019 JRM INRMP Reference: TPS-1; 7-55



Figure 103. One of Two Locations on Andersen South where *P. radiolata* were located. All snails located were salvaged and translocated to Haputo ERA.

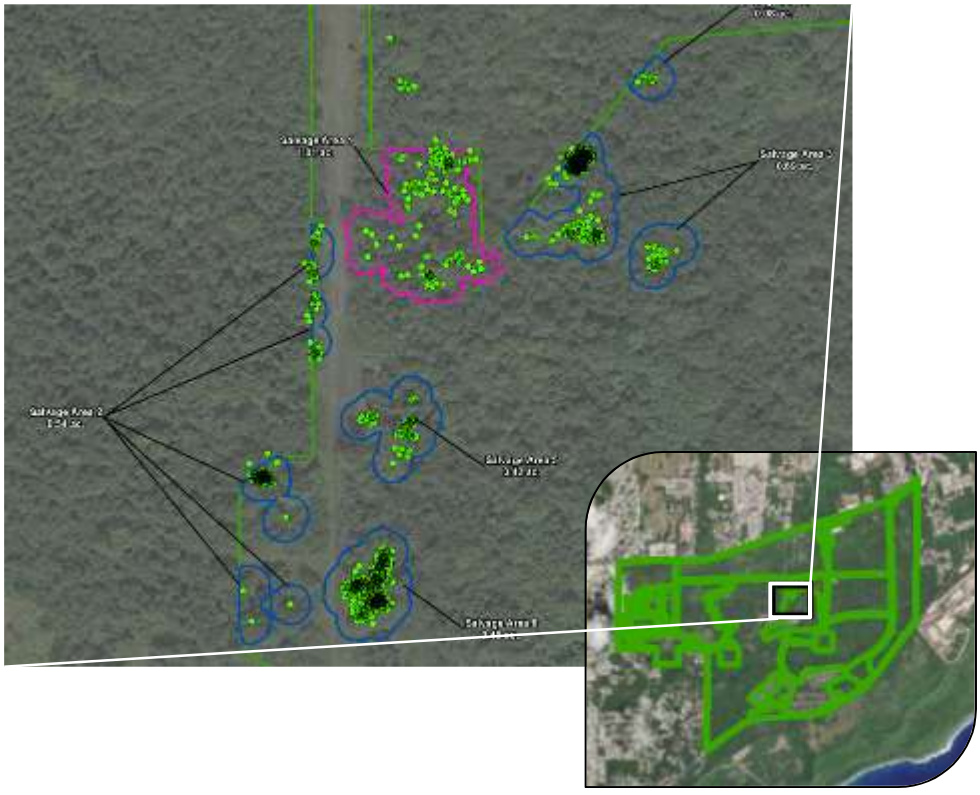


Figure 104. One of Two Locations on Andersen South where *P. radiolata* were located. All snails located were salvaged and translocated to Haputo ERA.

Native Plant Seed Collection, Salvage, Storage, and Nursery Propagation for Forest Enhancement

Location: NBG TS **Period of Performance:** OCT2017 – OCT2022

Project Objective

Collect salvaged native plant species and their seeds to propagate for use in limestone forest enhancement projects in Northern Guam. Design, install and operate a native plant nursery to maintain and provide healthy plant materials.

Conservation Benefit

To maintain a stock of healthy native plants ready to be used in forest enhancement planting. Native plant species from within DoD construction areas will be salvaged and propagated at the native plant nursery to maintain genetic diversity.



Figure 105. *Tabernaemontana rotensis* seedlings in the nursery.

FY20 Status

- Native plant nursery installed at Finegayan Dec 2018 – March 2019.
- Irrigation installed July 2019, water filtration system pending installation.
- 30 species of rare, high value, native, threatened and endangered plant species.
- Over 500 *T. rotensis* plants in propagation.
- Developed species-specific protocols for plant propagation and care
- Biosecurity program to manage pests, diseases and pathogens.
- FWS removed the requirement for Contractor to possess a 10(a)(1)(A) permit for collection of threatened and endangered species in June 2020.

2019 JRM INRMP Reference: TPS-1; 7-5



Figure 106. T. rotensis seed being prepared for water treatment before sowing.

Comprehensive Baseline Vegetation Survey and Long Term Monitoring Plan for the Forest Enhancement Areas at Finegayan

Location: NBG TS; AAFB **Period of Performance:** SEP2018 – APR2020

Project Objective

The project will complete an ecosystem vegetation baseline survey within the North Finegayan and Finegayan Forest Enhancement Sites. The survey and a suite of environmental data will be used to recommend treatment areas, identify sites appropriate for threatened and endangered plant species, develop long term monitoring protocols for the sites, and establish success criteria for enhancement efforts.

Conservation Benefit

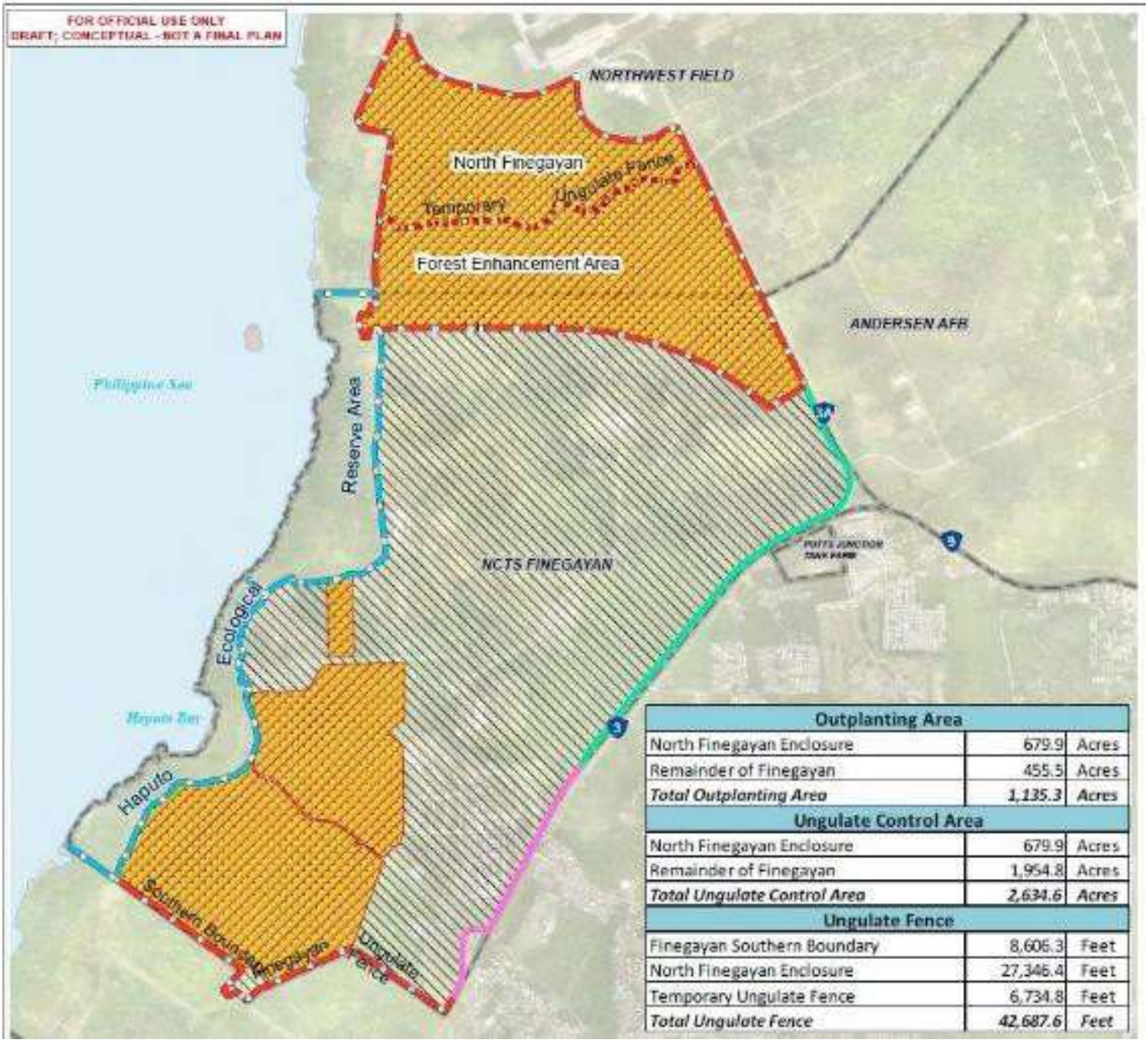
The plan will inform forest enhancement efforts intended to restore limestone forests and improve degraded landscapes to better support native species, including threatened and endangered plants and animals.

FY20 Status

- CESU awarded to ISU in September 2018.
- Draft report in August 2020.

EPR: DPRI: Marine Corps Relocation 2017/2018 amendment to 2015 BO, Conservation Measures to Contribute to the Recovery of Listed Species.

2019 JRM INRMP Reference: TPS-1; 7-55



Outplanting Area		
North Finegayan Enclosure	679.9	Acres
Remainder of Finegayan	455.5	Acres
Total Outplanting Area	***1,135.3***	***Acres***
Ungulate Control Area		
North Finegayan Enclosure	679.9	Acres
Remainder of Finegayan	1,954.8	Acres
Total Ungulate Control Area	***2,634.6***	***Acres***
Ungulate Fence		
Finegayan Southern Boundary	8,606.3	Feet
North Finegayan Enclosure	27,346.4	Feet
Temporary Ungulate Fence	6,734.8	Feet
Total Ungulate Fence	***42,687.6***	***Feet***

Figure 107. Map depicting North Finegayan and Finegayan Forest Enhancement Areas.

Cycad Conservation – Tinian

Location: Tinian, CNMI **Period of Performance:** APR2019 – APR2020

Project Objective

To conserve representative plants of *Cycas micronesica* populations from Guam; ongoing project from 2007.

Conservation Benefit

Increase populations, ensure resiliency to catastrophic events, and test and implement new conservation strategies.

FY20 Status

- The project continues to be implemented by UOG Plant Extinction Prevention Program. The current cooperative agreement was awarded in April 2020.
- As of November 2019, 990 live cycads were counted over the 24 plots for an estimated overall survival rate of 81%. Twelve plants were reproductive (had cones) during 2019. (Detailed health assessment results are in UOG 2019 annual report.)
- Plot clean-up from Super Typhoon Yutu and later storms required many visits and was finally completed in January 2020.
- Pesticide applications to control cycad scale and cycad blue butterfly started in January 2020 with subsequent applications in February and March. During the early March visit, UOG staff noted a reduction in the number of scale-infected plants from the previous month.
- Covid-19 travel restrictions have prevented any visits since March and the current status of plots/plants is unknown.
- Competing vegetation grows quite rapidly, “burying” many of the cycad seedlings. UOG is interested in hiring Tinian local help to maintain the plots.
- Established protocols prevent transfer of scale or other invasives between Guam and Tinian, and between Tinian plots.

EPR: 1 CP MAR Conservation Management of Tinian Cycads; 61128NR162

2019 JRM INRMP Reference: TPS-1; 11-63

Sea Turtle Nesting Surveys – Tinian

Location: Tinian, CNMI **Period of Performance:** JUN2020 - JUN2021

Project Objective

Ongoing monitoring of sea turtle nesting on Tinian MLA beaches.

Conservation Benefit

Long-term sea turtle nesting trends inform our understanding of the success and urgency of management efforts.

FY20 Status

- Contracting was delayed due to Covid-19 and other administrative issues. Contract award was made in June 2020.
- Twice monthly surveys began in July 2020 toward the end of the 2020 nesting season.
- Eighteen activities (16 nests; 2 non-nesting emergences) were recorded in July and August at Masålok, Dangkulo, and LamLam beaches. From 2009-2019, an average of 26 total nesting activities were recorded across Tinian MLA beaches annually.
- Six nests for which hatching evidence was observed were inventoried in July/August with a mean clutch size of 95, hatching success of 75%, and emergence success of 74%.

EPR: 1 S RP MAR CNMI ESA and MBTA Species Management; 61128NR211

2019 JRM INRMP Reference: TPS-2; 11-64

Beach Cleanups on the Tinian MLA

Location: Tinian, CNMI **Period of Performance:** JUN2020 – JUN2021

Project Objective

Removal of marine debris from all sea turtle nesting beaches in the Military Lease Area (MLA) with particular attention to the windward beaches of Dangkulo, Chiget and Masalok where debris accumulates after storms. Cleanup will be conducted annually at a minimum.

Conservation Benefit

The removal of marine debris benefits sea turtles by preventing entanglements and allowing successful nest excavation and egg deposition, and reduces the potential for ingestion of debris by seabirds.

FY20 Status

- Contracting was delayed due to Covid-19 and other administrative issues. Contract award was made in June 2020.
- The first FY20 cleanup targeted Masalok Beach on July 4th, removing 913 lbs of trash. Amount removed was similar to last year when 865 lbs were removed from Masalok, approximately half of the total removed from all MLA beaches in FY19 (1807 lbs).
- Masalok debris was sorted into a total of 40 bags of recyclables (plastic, aluminum, glass) and non-recyclables (foam, footwear, fishing gear, etc).
- All bags were transported from Tinian to the Lower Base Refuse Transfer Station located on Saipan, CNMI for final disposal.
- Beaches that collect little debris will be maintained on an ongoing basis. The next large-scale cleanup is scheduled for mid-October.

EPR: 1 RP MAR CNMI ESA and MBTA Species Management; 61128NR211

2019 JRM INRMP Reference: TPS-2; 11-64

Concrete barrier - Sea Turtle Conservation – CNMI

Location: Tinian, CNMI **Period of Performance:** ONGOING

Project Objective

The intent of this contract is to fabricate, paint, transport and place, eighty (80), six foot concrete barriers to North Field, Military Leased Area, Tinian. Barriers will be placed on MLA beach access roads with input from CNMI resource partners on placement.

Conservation Benefit

Poaching and predation of sea turtle nests and recreational use of sea turtle nesting beaches have resulted in disturbance of habitat and illegal intentional take of these endangered species. Concrete barriers will prevent vehicles from disturbing nesting female turtles, their nests and nesting habitats.

FY19 Status

- Barriers moved in OCT 2019. They are currently stored at NW field (Figure 108).
- Due to COVID-19 administrative shortfalls, comment solicitations from CNMI partners have not taken place

EPR: 1 RP MAR CNMI ESA and MBTA Species Management Tinian; 61128NR211

2019 JRM INRMP Reference: TPS-2; 11-64



Figure 108. Photo of concrete barriers fabricated for turtle nest protection.

Mariana Common Moorhen Surveys – Tinian

Location: Tinian, CNMI **Period of Performance:** Contract Pending

Project Objective

Ongoing monitoring of nesting moorhens (*Gallinula chloropus guami*) at Hagoi and Bateha Wetlands in the Tinian MLA. (Previous Mariana Islands Range Complex [MIRC] BO Requirement, continued as an INRMP project).

Conservation Benefit

Monitor long-term trend of the moorhen population.

FY19 Status

- Award Contract is pending.

EPR: 1 S RP MAR CNMI ESA and MBTA Species Management; 61128NR211

2019 JRM INRMP Reference: TPS-3; 11-65

Tinian Forest Bird Monitoring and Assessment

Location: Tinian, CNMI **Period of Performance:** SEP2018 – FEB2021

Project Objective

Understand overall population status of forest birds of Tinian, especially the Tinian monarch and Micronesian megapode. Provide data to enable analyses of population trends over time of forest bird species on Tinian to enhance and conserve populations.

Conservation Benefit

Inform conservation and management actions for the Tinian monarch. Track the population status of the federally-endangered Micronesian megapode and other Tinian forest birds.

FY19 Status

- Awarded as a Cooperative Agreement to UoG through the CESU network in September 2018.
- Work will consist of:
    - Conducting surveys for forest birds on Tinian MLA using large-scale variable circular plot surveys.
    - Conducting Micronesian Megapode surveys.
    - Investigating the status and viability of the Tinian monarch, by assessing: 1) adult and juvenile survival, 2) reproductive success, 3) site fidelity, 4) habitat use and home range size, and 5) potential limiting factors and applying predator control measures, if appropriate, to improve nesting success and juvenile and adult survival
    - Conducting vegetation sampling within Tinian monarch nesting habitat.
- Final report due in February 2020 (requested NCE will move this date to March 2021). Due to COVID-19 travel restrictions, contract may be extended further

EPR: CHS MAR JRM Tinian Forest Bird Monitoring; EPR 61755NR303

2019 JRM INRMP Reference: TPS-4; 11-64

Surveys for Micronesian Megapodes and Mariana Fruit Bats

Location: FDM **Period of Performance:** OCT2019 – SEP2020

Project Objective

To conduct Micronesian megapode (*Megapodius laperouse*) surveys along established trails and paths to use as an index of megapode population change over time; record Mariana fruit bats (*Pteropus mariannus mariannus*) observed during surveys, and conduct habitat ground surveys to monitor habitat change over time per the 2015 Mariana Islands Training and Testing (MITT) BO terms and conditions.

Conservation Benefit

To ensure compliance with the Incidental Take Statement of the 2015 MITT BO.

FY20 Status

- No Micronesian megapode or Mariana fruit bat surveys were conducted in FY20.
- The last FDM survey conducted on April 12, 2019 at ten playback stations.
  - 20 Micronesian megapodes detected.
  - No Mariana fruit bat detections.
- Surveys are conducted every two years. Next survey anticipated in the April/May 2021.

EPR: BO MAR Mariana Islands Training and Testing (MITT) Implementation; 61128NR218

2019 JRM INRMP Reference: TPS-1; 12-34

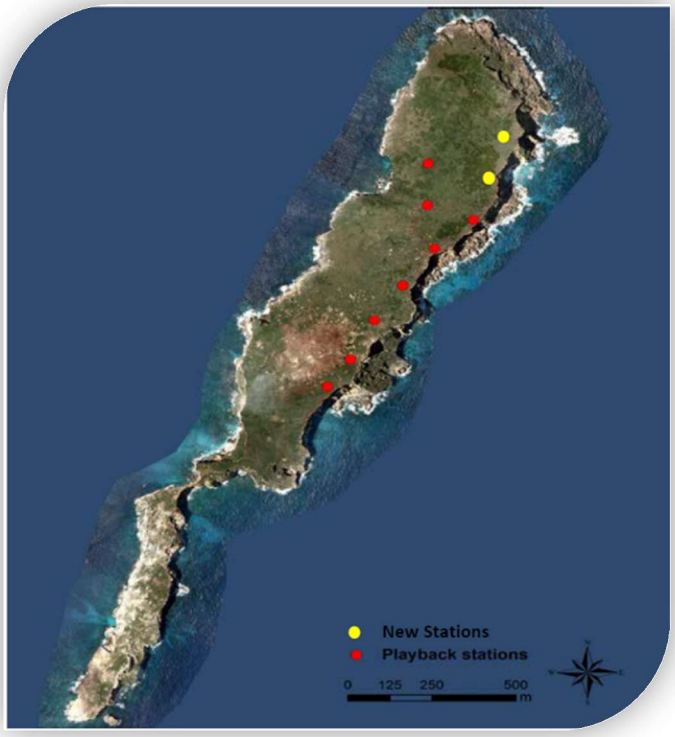


Figure 109. Map depicting FDM Micronesian megapode playback survey stations.

Horeg, Jennifer A CIV USN NAVFAC

From:	Lujan, Dana T CIV USN NAVFACMAR
Sent:	Monday, August 3, 2020 7:11 AM
To:	Sablan, Randel L CIV USN JRM
Cc:	Salas, John F CIV USN NAVFACMAR; Horeg, Jennifer A CIV USN NAVFAC; Brasuell, Timothy CIV USN JRM
Subject:	FW: FY20 Joint Region Marianas Natural Resources Metrics
Attachments:	RE: [Non-DoD Source] Re: MITT Supplemental - CNMI Federal Consistency De... (1.33 MB); [Non-DoD Source] Re: FW: FY20 Joint Marianas Natural Resources Metrics (12.9 KB)

From: Lujan, Dana T CIV USN NAVFACMAR
Sent: Friday, July 31, 2020 11:55 AM
To: Jacqueline Flores <jacqueline_flores@fws.gov>; Aguon Celestino F. <tinoaguon@gmail.com>; 'arlene.pangelinan@noaa.gov' <arlene.pangelinan@noaa.gov>; Kevin Brindock - NOAA Federal (kevin.brindock@noaa.gov) <kevin.brindock@noaa.gov>; 'Joel.Moribe@noaa.gov' <Joel.Moribe@noaa.gov>; 'steven.mckagan@noaa.gov' <steven.mckagan@noaa.gov>
Cc: Horeg, Jennifer A CIV USN NAVFAC <Jennifer.Horeg@fe.navy.mil>; Salas, John F CIV USN NAVFACMAR <John.F.Salas@fe.navy.mil>
Subject: RE: FY20 Joint Region Marianas Natural Resources Metrics

Hafa Adai Resource Partners,

After feedback from Partners, this is email is to confirm the dates for the FY20 Joint Region Marianas Natural Resources Metrics:

17 Sep: CNMI
22-23 Sep: Guam

Given the uncertainties of the COVID 19 situation, the meetings will be held virtually via video-conferencing. We will be providing more information next month.

Thank you.

v/r,

Dana

NOTE: I am currently teleworking. Temporary mobile number: (671)929-2145.

----Original Message-----
From: Lujan, Dana T CIV USN NAVFACMAR
Sent: Thursday, June 25, 2020 10:49 AM
To: Jacqueline Flores <jacqueline_flores@fws.gov>; Aguon Celestino F. <tinoaguon@gmail.com>; 'arlene.pangelinan@noaa.gov' <arlene.pangelinan@noaa.gov>; Kevin Brindock - NOAA Federal (kevin.brindock@noaa.gov) <kevin.brindock@noaa.gov>; 'Joel.Moribe@noaa.gov' <Joel.Moribe@noaa.gov>; 'steven.mckagan@noaa.gov' <steven.mckagan@noaa.gov>
Cc: Horeg, Jennifer A CIV USN NAVFAC <Jennifer.Horeg@fe.navy.mil>; Salas, John F CIV USN NAVFACMAR <John.F.Salas@fe.navy.mil>
Subject: FY20 Joint Region Marianas Natural Resources Metrics

Hafa Adai Resource Partners,

I hope everyone is safe and healthy during these unprecedented times. We'd like to make everyone's calendar's for the FY20 Joint Region Marianas Natural Resource Metrics meetings and propose the following dates:

17 Sep: CNMI
22-23 Sep: Guam

We are planning to secure venues for in-person meetings, but will also plan contingencies for remote meetings given the unknowns with the COVID-19 pandemic. In addition, we recognize the telecommunications challenges that were experienced during the FY19 Natural Resource Metrics meetings and will continue to try and alleviate those challenges.

Please let us know if the dates provided above are problematic and we will try to accommodate. My POC for the Metrics is Jen Horeg.

Thank you and stay safe.

v/r,

Mr. Dana T. Lujan

EV2, Conservation & Planning NAVFACMAR

NOTE: I am currently teleworking. Temporary mobile number: (671)929-2145.

FY20 Natural Resources/INRMP Metrics Attendee List

Frank Alig, NAVFACMAR, (671) 339-5621, Franklin.Alig@fe.navy.mil

Candice Arceo, NAVFACMAR AAFB, 671-366-5012, candice.arceo@us.af.mil

Vinney Atalig-Hocog, CNMI Office of Governor, 671-488-0550, vinney.ahocog@gov.mp

Heather Benedict, USFWS Ecological Services, 671-688-9947, Heather_benedict@fws.gov

Kevin Brindock, NMFS, 808-725-5146, kevin.brindock@noaa.gov

Jonathan Brown, NMFS, jonathan.brown@noaa.gov

Noah Burrell, NAVFACMAR, 671-339-5310, noah.burrell@fe.navy.mil

CJ Cayanan, GDAWR, 671-735-0281, cjcayanan671@gmail.com

Art Charfauros, CNMI DCRM, acharfauros@dcrm.gov.mp

Coralie Cobb, NAVFACPAC, coralie.cobb@navy.mil

Ann Colt, NAVFACMAR NBG, 671-339-2065, ann.colt@fe.navy.mil

Tammy Conkle, NAVFAC HQ, 202-685-9203, tamara.conkle@navy.mil

Sarah Diebel, NAVFACMAR AAFB, 671-366-1849, sarah.diebel@us.af.mil

Harry Elliott, Region Environmental Counsel, JRM, 671-349-2021, Harry.Elliott@fe.navy.mil

Christine Fejeran, Guam Div of Forestry, 671-300-7975, Christine.Fejeran@doag.guam.gov

Jackie Flores, USFWS Ecological Services, 671 989-6744, jacqueline_flores@fws.gov

Shermaine Garcia, NAVFACMAR, 671-339-5620, shermaine.garcia@fe.navy.mil

Jay Gutierrez, GDAWR, 671-735-0285, Jay.Gutierrez@doag.guam.gov

Lauren Gutierrez, Camp Blaz, 671-355-8050, lauren.gutierrez@fe.navy.mil

Marc Hall, NAVFACMAR, 671-339-2349, marc.hall@fe.navy.mil

Jennifer Horeg, NAVFACMAR, 671-339-7348, jennifer.horeg@fe.navy.mil

Christopher Kane, NAVFACMAR AAFB, christopher.kane.12@us.af.mil

Matt Kedziora, NAVFACMAR, 671-339-2198, matthew.kedziora@fe.navy.mil

Jill Liske-Clark, NAVFACMAR, 670-787-8983, jliskeclark@gmail.com

Adrienne Loerzel, Camp Blaz, 671-355-8058, Adrienne.loerzel@fe.navy.mil

Dana Lujan, NAVFACMAR, 671-333-1185, dana.lujan@fe.navy.mil

Steve McKagan, NMFS, 670-234-0004, steven.mckagan@noaa.gov

Suzanne Medina, GDAWR, 671-735-3995, medinasuzanne@gmail.com

FY20 Natural Resources/INRMP Metrics Attendee List (continued)

Toni Mizerek, USFWS Ecological Services, 671-989-6744, toni_mizerek@fws.gov

Joel Moribe, NMFS, 808-725-5142, joel.moribe@noaa.gov

Steve Mosher, NAVFACMAR, 671-339-2349, Stephen.Mosher@fe.navy.mil

Manny Pangelinan, Director, CNMI DFW, (670) 664-6080, mpangelinan.cnmidfw@gmail.com

Megan Parker, NAVFACMAR, 671-339-2344, charles.sayon@fe.navy.mil

Jerome Perez, Camp Blaz, 671-355-8059, Jerome.Perez@fe.navy.mil

Jeff Quitugua, GDAWR, 671-735-0294, Jeffquitugua@yahoo.com

Andres Reyes, NAVFACMAR, 671-333-1104, andres.reyes@fe.navy.mil

Glenna Reyes, CNMI Special Assistant to the Governor for Military Affairs, (670) 237-2231, glenna.reyes@gov.mp

Aaron Rieffanaugh, NAVFACMAR AAFB, 671-366-5058, Aaron.rieffanaugh@us.af.mil

John Salas, EV BLC / J45, 671-349-4420, John.F.Salas@fe.navy.mil

Randy Sablan, JRM, (671) 349-3205, Randel.Sablan@fe.navy.mil

Maria Santos, NAVFACMAR, 671-339-5148, Maria.Santos@fe.navy.mil

Lorraine Shaughnessy, lorraine.shaughnessy, 808-472-1475, lorraine.shaughnessy@navy.mil

Tammy Summers, USFWS GNWR, 671-355-5096, Tammy_Summers@fws.gov

Sheeka Tareyama, Camp Blaz, 671-355-8420, sheeka.tareyama@fe.navy.mil

Michael Tenorio, CNMI DFW, mtenorio_dfw@live.com

Brent Tibbetts, GDAWR, 671-735-0259, brent.tibbetts@gmail.com

Diane Vice, GDAWR, 671-735-3990, dianevice@gmail.com

Scott Vogt, NAVFACMAR AAFB, 671-366-2522, scott.vogt.1@us.af.mil

Tyler Willsey, USFWS, tyler_willsey@fws.gov

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D3 2021 Annual Report

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DEPARTMENT OF THE NAVY
JOINT REGION MARIANAS
PSC 455, BOX 211
FPO AP 96540-1000

5090
Ser J4/ 0033
28 Jan 22

From: Commander, Joint Region Marianas

Subj: FISCAL YEAR 2021 NATURAL RESOURCES/INTEGRATED NATURAL RESOURCES MANAGEMENT PLAN METRICS SUMMARY REPORT

Ref: (a) OPNAV-M-5090.1

Encl: (1) FY 2021 Natural Resources INRMP Metrics Results
(2) JRM INRMP Summary of FY21 Projects for Guam and CNMI
(3) FY 2021 Natural Resources INRMP Metrics Invitation and Attendee List

1. In accordance with reference (a), Navy installations are required to submit an annual report summarizing the recent Natural Resources/Integrated Natural Resources Management Plan (INRMP) Metrics meeting and status of the INRMP.

2. The Fiscal Year (FY) 21 Joint Region Marianas (JRM) Natural Resources/INRMP Metrics meeting for Commonwealth of the Northern Mariana Islands (CNMI) resource partners was held virtually on September 17 and October 8, 2021 and the JRM INRMP Metrics meeting for Guam resource partners was held virtually on September 22 and 23, 2021 via MS Teams. Enclosures (1) through (3) are provided for your review.

3. The Final 2019 JRM INRMP was finalized and signed by partner agencies (US Fish and Wildlife Service, National Marine Fisheries Service, Guam Department of Agriculture, and CNMI Department of Land and Natural Resources-Division of Fish and Wildlife) in June - August 2019. Annual updates are conducted each calendar year beginning in 2021 and a 5-year review for operation and effect will be conducted in 2024 per the OPNAVINST 5090.1E, reference (b), sections 670a-f. The FY21 JRM INRMP Update will be complete and distributed by 31 January 2021.

4. Thank you for your participation in our Natural Resources/INRMP Metrics meeting and for your support of the JRM Natural Resources Program. If you have any questions, please contact Jennifer Horeg, Natural Resources Program Supervisor, at Jennifer.horeg@fe.navy.mil or 671-339-1275.

B. R. NICHOLSON

Subj: FISCAL YEAR 2021 NATURAL RESOURCES/INTEGRATED NATURAL RESOURCES MANAGEMENT PLAN METRICS SUMMARY REPORT

Distribution:

Earl Campbell, PhD
Field Supervisor
U.S. Department of the Interior
U.S. Fish and Wildlife Service
Pacific Islands Fish and Wildlife Office
300 Ala Moana Boulevard, Room 3-122 Box 5008
Honolulu, HI 96816

Mr. Michael Tosatto
Regional Administrator
National Marine Fisheries Service
Pacific Islands Regional Office
1845 Wasp Blvd., Bldg 176
Honolulu, Hawaii 96818

Ms. Chelsa Muna-Brecht
Director
Guam Department of Agriculture
163 Dairy Road
Mangilao, Guam 96913

Mr. Anthony Benavente
Director
CNMI Department of Land and Natural Resources
P.O. Box 10007
Saipan, MP 96950

Programmatic Division U.S. Fish and Wildlife Service
Pacific Islands Fish and Wildlife Office
Marianas Office, U.S. Fish and Wildlife Service, Pacific Islands Fish and Wildlife Office
300 Ala Moana Boulevard, Room 3-122 Box 5008
Honolulu, HI 96816

Mariana Islands Refuges and Monument Complex
P.O. Box 8134, MOU-3
Dededo, Guam 96912

U.S. Fish and Wildlife Service
Ecological Services
P.O. Box BT
Hagatna, Guam 96932

CNIC Washington DC (N45) NAVFACENGCOM Washington DC (EV2)

FY21 Natural Resources/INRMP Metrics Results

2021 Natural Resources Annual Report: NSA ANDERSEN

Summary Score

Focus Area	Score
1 - Natural Resources Management	0.54
2 - Listed Species Critical Habitat	0.69
3 - Recreation Use and Access	0.95
4 - Sikes Act Cooperation	0.87
5 - Team Adequacy	0.55
6 - INRMP Implementation	0.96
7 - Support of Installation Mission	0.59
NSA ANDERSEN - Overall Score	0.74

2021 Natural Resources Annual Report: NB Guam

Summary Score

Focus Area	Score
1 - Natural Resources Management	0.70
2 - Listed Species Critical Habitat	0.90
3 - Recreation Use and Access	0.95
4 - Sikes Act Cooperation	0.91
5 - Team Adequacy	0.79
6 - INRMP Implementation	0.93
7 - Support of Installation Mission	0.64
NB Guam - Overall Score	0.83

2021 Natural Resources Annual Report: Tinian MLA

Summary Score

Focus Area	Score
1 - Natural Resources Management	0.54
2 - Listed Species Critical Habitat	0.55
3 - Recreation Use and Access	0.83
4 - Sikes Act Cooperation	0.88
5 - Team Adequacy	0.74
6 - INRMP Implementation	0.88
7 - Support of Installation Mission	0.68
Tinian MLA - Overall Score	0.74

2021 Natural Resources Annual Report: Farrallon de Medinilla FDM

Summary Score

Focus Area	Score
1 - Natural Resources Management	0.58
2 - Listed Species Critical Habitat	0.55
3 - Recreation Use and Access	N/A
4 - Sikes Act Cooperation	0.87
5 - Team Adequacy	0.84
6 - INRMP Implementation	0.75
7 - Support of Installation Mission	0.68
Farrallon de Medinilla FDM - Overall Score	0.71



Joint Region Marianas Integrated Natural Resources Management Plan Summary of 2021 Projects

Mariana Eight Spot Butterfly

GUAM REPORT

NAVFAC
Naval Facilities Engineering Systems Command
NAVFAC Marianas

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ACRONYMS AND ABBREVIATIONS

ACRONYM	DESCRIPTION
AAFB	Andersen Air Force Base
ADS	Automated Delivery System
AOR	Area of Responsibility
BO	Biological Opinion
BTS	Brown Treesnake
CESU	Cooperative Ecosystem Studies Units Network
CEMML	Center for Environmental Management of Military Land
CIS	Center for Island Sustainability
CNMI	Commonwealth of the Northern Mariana Islands
COMPACFLT	Commander, U.S. Pacific Fleet
CP	Closed Population
CRB	Coconut Rhinoceros Beetle
CRU	Cooperative Research Unit
CSU	Colorado State University
DNM	Dead Neonatal Mice
DoD	Department of Defense
EOD	Explosive Ordnance Disposal
ERA	Ecological Reserve Area
ESA	Endangered Species Act
FDM	Farallon de Medinilla
Ft	foot/feet
FY	Fiscal Year
GIS	Geographic Information System
GMK	Guam Micronesian Kingfisher
GNWR	Guam National Wildlife Refuge
GPEPP	Guam Plant Extinction Prevention Program
GDOAg	Guam Department of Agriculture
ha	hectare(s)

HACCP	Hazard Analysis and Critical Control Points
HMU	Habitat Management Unit
ISU	Iowa State University
INRMP	Integrated Natural Resources Management Plan
IRP	Installation Restoration Program
JRM	Joint Region Marianas
LFA	Little fire ant
LFTRC	Live Fire Training Range Complex
M	meter(s)
MCAG	Marine Corps Activity Guam
MCB	Marine Corps Base
MIRC	Mariana Islands Range Complex
MITT	Mariana Islands Training and Testing
MLA	Military Lease Area
MOA	Memorandum of Agreement
MSA	Munitions Storage Area
NAVFAC	Naval Facilities Engineering Systems Command
NBG	Naval Base Guam
NBGTS	Naval Base Telecommunications Site
NMS	Naval Base Guam Naval Munitions Site
NNE	Non-Nesting Emergence
NWF	Northwest Field
NWRC	National Wildlife Research Center
PACOM	Pacific Command
PIERC	Pacific Island Ecosystems Research Center
QA/QC	Quality Assurance/Quality Control
RFMP	Range Fire Management Plan
RBP	Regional Biosecurity Plan for Micronesia and Hawaii
UOG	University of Guam
USFWS	United States Fish and Wildlife Service

USGS	United States Geological Survey
USDA-WS	United States Department of Agriculture- Wildlife Services

MARINE HABITAT MANAGEMENT

Water Quality Monitoring on Joint Region Marianas Submerged Lands

Location: NBG and AAFB **Period of Performance:** JUN2021 – DEC2022

Project Objectives

- Install, deploy, and maintain four conductivity-temperature-depth (CTD) mounting frames (Figure 1) and four pH sensor mounting frames (Figure 2) at four locations in Apra Harbor (e.g., Sasa Bay, Inner Harbor, Middle Harbor, and Outer Harbor), one CTD mounting frame and one pH sensor mounting frame at one location in Orote Peninsula ERA (e.g., Spanish Steps), one CTD mounting frame and one pH sensor mounting frame at one location in Haputo ERA (e.g., Double Reef), and one CTD mounting frame and one pH sensor mounting frame at one location in Andersen Air Force Base (AAFB) (e.g., Pati Point Marine Preserve Area).
- Install, deploy, and maintain four CTD and four pH sensors at four locations in Apra Harbor (e.g., Sasa Bay, Inner Harbor, Middle Harbor, and Outer Harbor), one CTD and one pH sensor at one location in Orote Peninsula ERA (e.g., Spanish Steps), one CTD and one pH sensor at one location in Haputo ERA (e.g., Double Reef), and one CTD and one pH sensor at one location in AAFB (e.g., Pati Point Marine Preserve Area) (Figure 3).
- Analyze water quality results and examine the spatial and/or seasonal (temporal) variations in Apra Harbor, Orote Peninsula ERA, Haputo ERA, and AAFB.

Conservation Benefit

- Increase habitat for Endangered Species Act (ESA)-listed corals (e.g., *A. globiceps, A. retusa,* and *S. aculeata*)
- Support habitat areas of particular concern which align with Magnuson-Stevens Fishery Conservation Act for Essential Fish Habitat and the Marianas Fishery Ecosystem Plan

FY21 Status

- Final report available (2018-2020 data)
- FY21 CESU awarded to UOG WERI

EPR: CHS MAR JRM Monitoring and Control of Acute Impacts on Coral Reefs; 61128CN222

2019 JRM INRMP Reference: MHM-1 (5-98)



Figure 1. Conductivity-depth-temperature sensor mounted on a stainless-steel frame.



Figure 2. SeaFET sensor mounted on a stainless-steel frame.

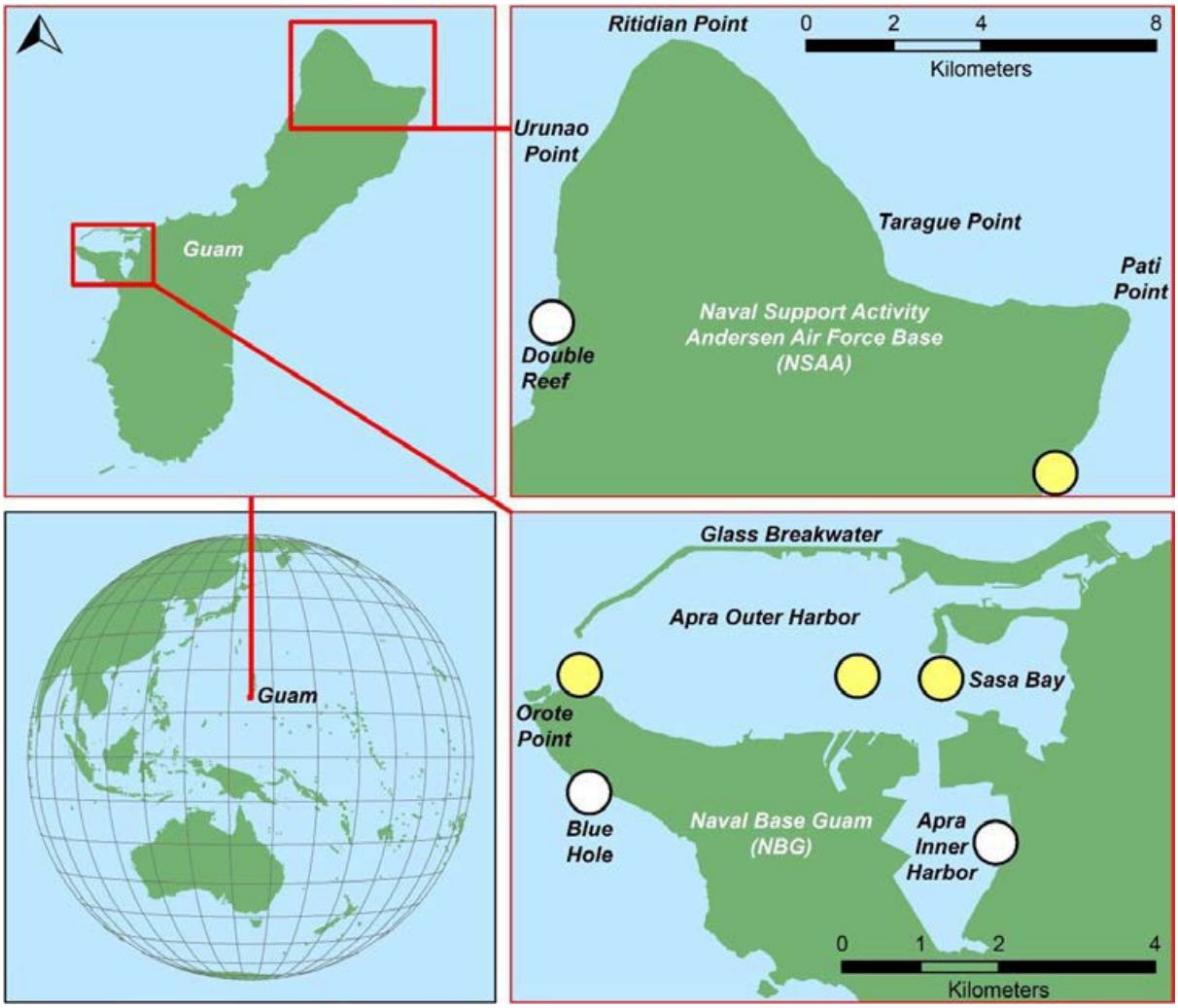


Figure 3. Deployment locations of water quality loggers. Yellow circles indicate sites for which previous water quality data is available and at which mounting frames are installed. White circles represent new monitoring stations.

Identification and Removal of Non-Permitted Buoys on JRM Submerged Lands

Location: NBG **Period of Performance:** SEP2020 - SEP2022

Project Objective

- Identify non-permitted buoys (NPBs) on JRM submerged lands
- Cross-reference NPBs with ACOE list of permitted buoys
- Remove all NPBs

Conservation Benefit

- Increase habitat for ESA-listed corals (e.g., *A. globiceps*, *A. retusa*, and *S. aculeata*).
- Support habitat areas of particular concern, which align with Magnuson-Stevens Fishery Conservation Act for Essential Fish Habitat and the Marianas Fishery Ecosystem Plan.

FY21 Status

- 26 total buoys ID (Figure 4); 19 of 26 are SWMS buoys installed in 2019 (ACOE permitted) at Outer Apra Harbor, Naval Base Guam (NBG)
- Approximately four (4) SWMS buoys lost

EPR: CHS MAR JRM Monitoring and Control of Acute Impacts on Coral Reefs; 61128CN222

2019 JRM INRMP Reference: MHM-1 (5-98); MHM-4 (5-100)



Figure 4. Map depicting locations of mooring buoys in and around Outer Apra Harbor, NBG.

Coral Bleaching and Crown of Thorns Seastar (COTS) Monitoring on JRM Submerged Lands

Location: NBG and AAFB **Period of Performance:** JUN2021 – DEC2022

Project Objective

- Host crown of thorns starfish (COTS) training workshops for Navy EXWC and NBG Dive Locker divers, JRM/NBG Natural Resource Marine Specialists, and Guam. COTS Response Team partners lead by a COTS expert; one classroom and one in-water skills COTS training workshop to include overview of COTS ecology and history on Guam, pre-culling surveillance methods, culling guidelines, and post-culling monitoring techniques.
- Implement a monitoring program for the detection of coral stressors and COTS/marine nuisance species control within Outer Apra Harbor, Orote and Haputo ERAs, and Pati Point (Firgure 5).

Conservation Benefit

- Increase habitat for ESA-listed corals (e.g., *A. globiceps, A. retusa, and S. aculeata*).
- Support habitat areas of particular concern, which align with Magnuson-Stevens Fishery Conservation Act for Essential Fish Habitat and the Marianas Fishery Ecosystem Plan.

FY21 Status

- FY21 CESU awarded to UOG Sea Grant

EPR: CHS MAR JRM Monitoring and Control of Acute Impacts on Coral Reefs; 61128CN222

2019 JRM INRMP Reference: MHM-1 (5-98)

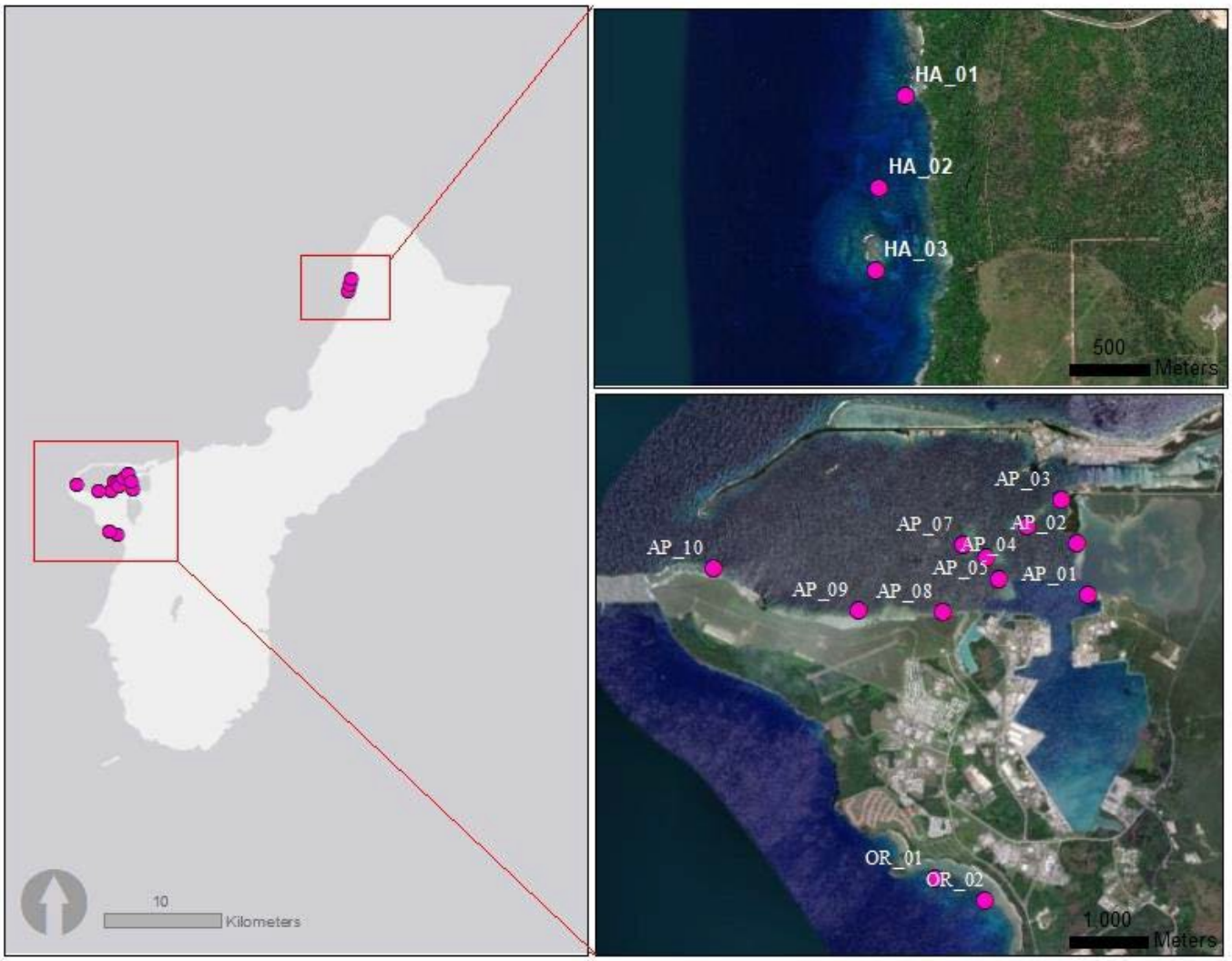


Figure 5. Map depicting survey sites at Apra Harbor, Orote ERA, and Haputo ERA from 2018 to 2019.

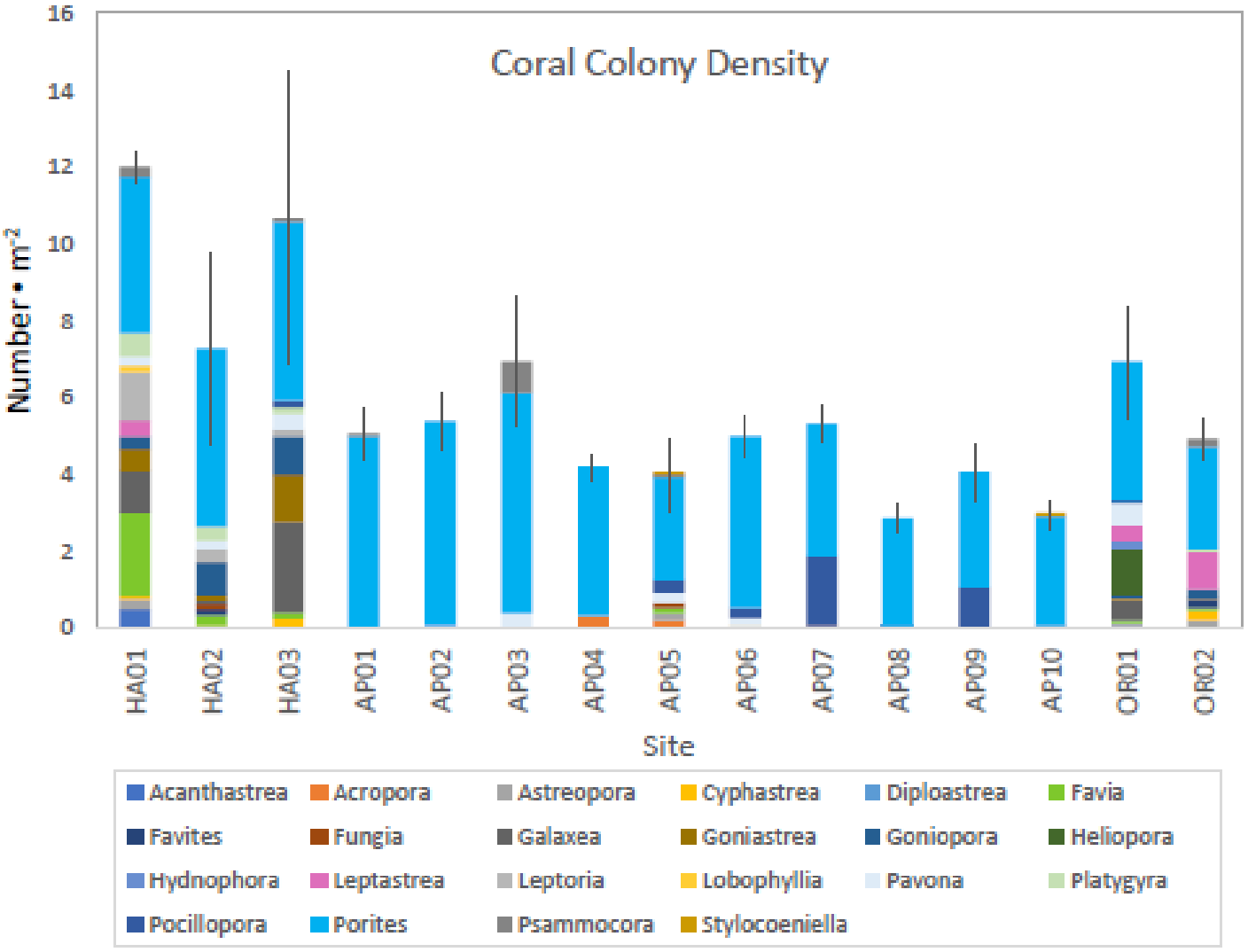


Figure 6. Mean coral colony density for each survey site from 2018 to 2019. Error bars represent standard error for the overall coral density at each site.

Characterization of Marine Benthic Habitats in Outer Apra Harbor Guam and Haputo ERA

Location: Apra Harbor, Haputo ERA **Period of Performance** SEP2019 -SEP2023
JULY2020-SEP2023

Project Objectives

- Process existing remotely sensed imagery
- Collect in situ information for habitat model and map development
- Collect in situ information to evaluate habitat model performance and map accuracy
- Outreach

Conservation Benefit:

- Increase habitat for ESA-listed species and marine mammals
- Support habitat areas of particular concern with align with Magnuson-Stevens Fishery Conservation Act for Essential Fish Habitat and the Marianas Fishery

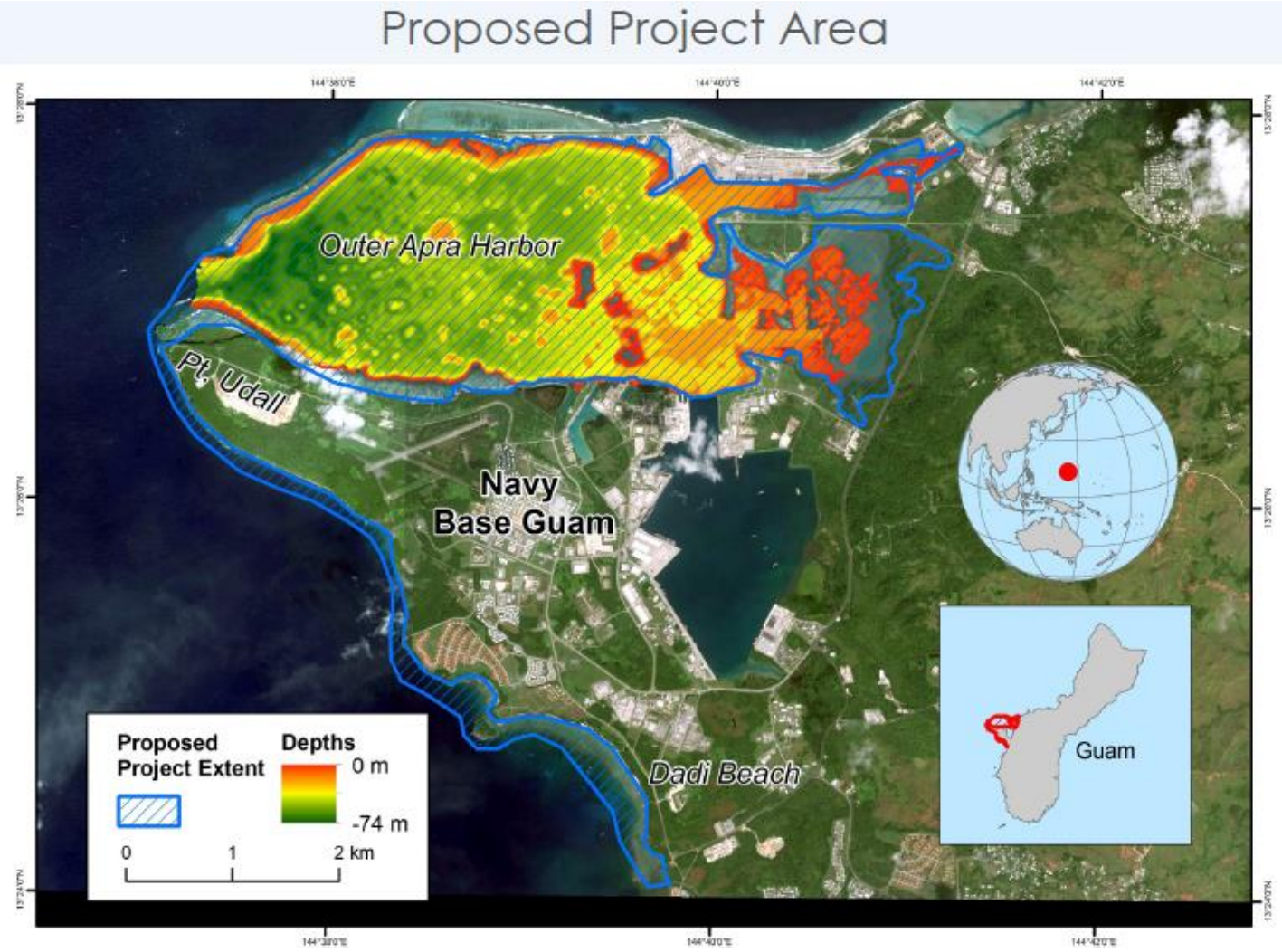
FY21 Status

- Interagency agreement established SEP2019
- Fieldwork was scheduled for JULY2020; postponed due to COVID-19

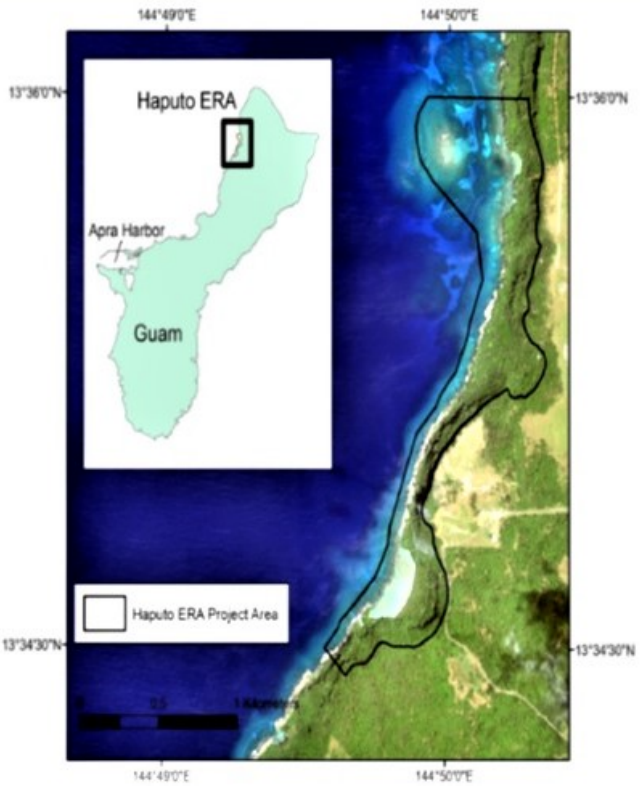
EPR: 1 CP MAR NBG Benthic Habitat and Coral Mapping and Management (CHS); 61755NR818

2019 INRMP References: MHM-1 (5-98); MHM-2 (5-99); MHM-6 (5-101); MEDU-2 (5-105)

Figures 7- 14. Project proposed areas, habitat maps, biological cover types, & substrate types for project areas



Proposed Project Area



Haputo ERA:

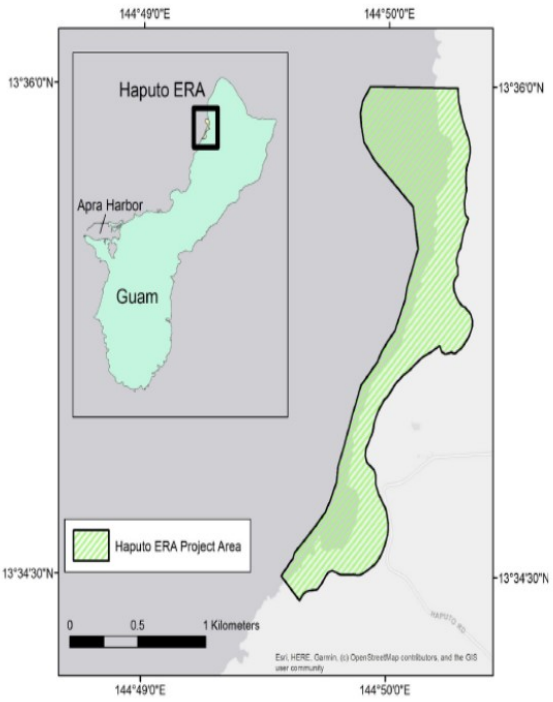
- ~1.25 km^2 area
- Submerged and terrestrial habitat

Remote Sensing Data:

- **Multispectral Satellite Imagery**
- 2019 LiDAR coverage
- sUAS (pending permission??)

BENTHIC HABITATS for Haputo ERA

Proposed Project Area

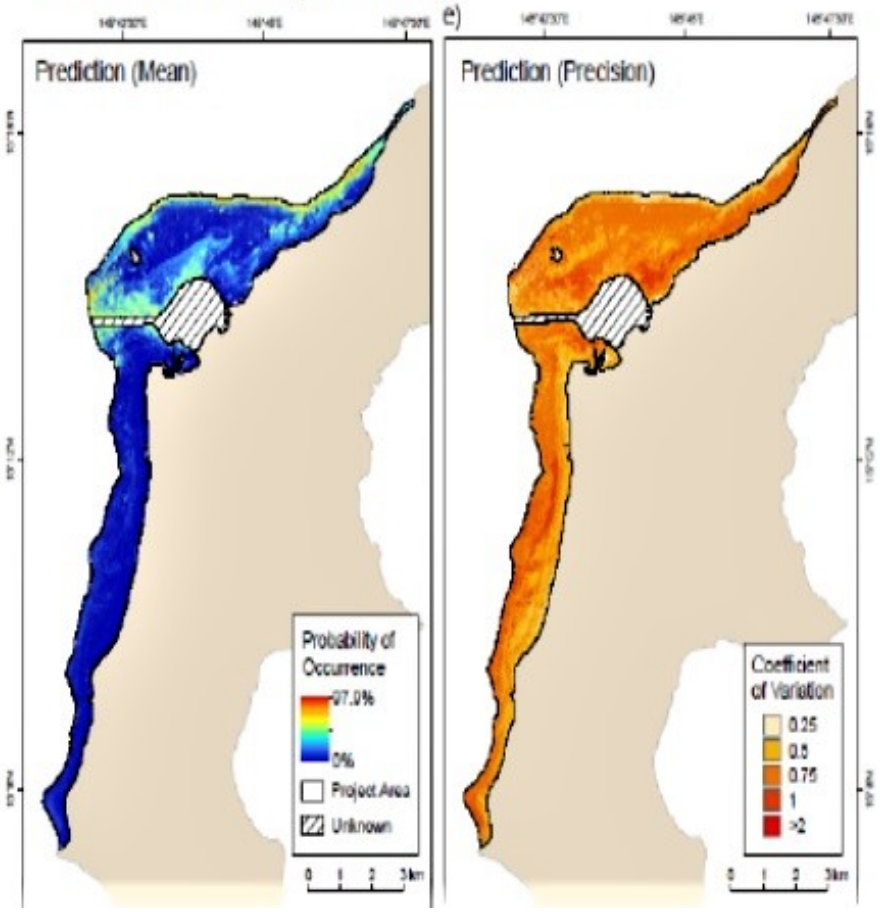


Haputo ERA:

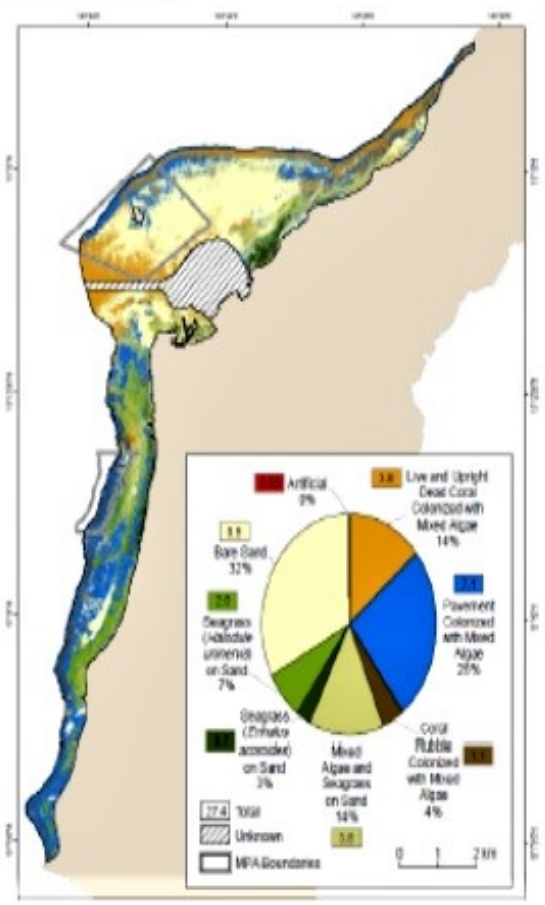
- ~1.25 km^2 area
- Submerged and terrestrial habitat

Proposed Products: (2) Habitat Predictions & Maps

Habitat Predictions (Live Coral)



Habitat Map

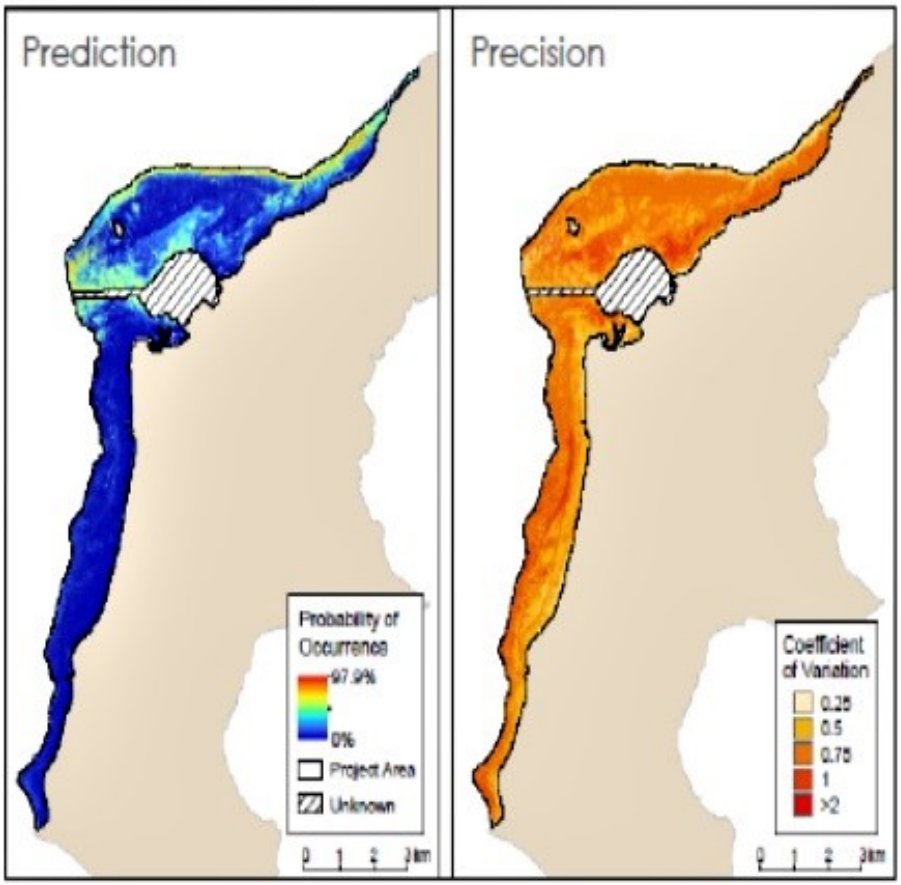


Proposed Habitat Types (16)

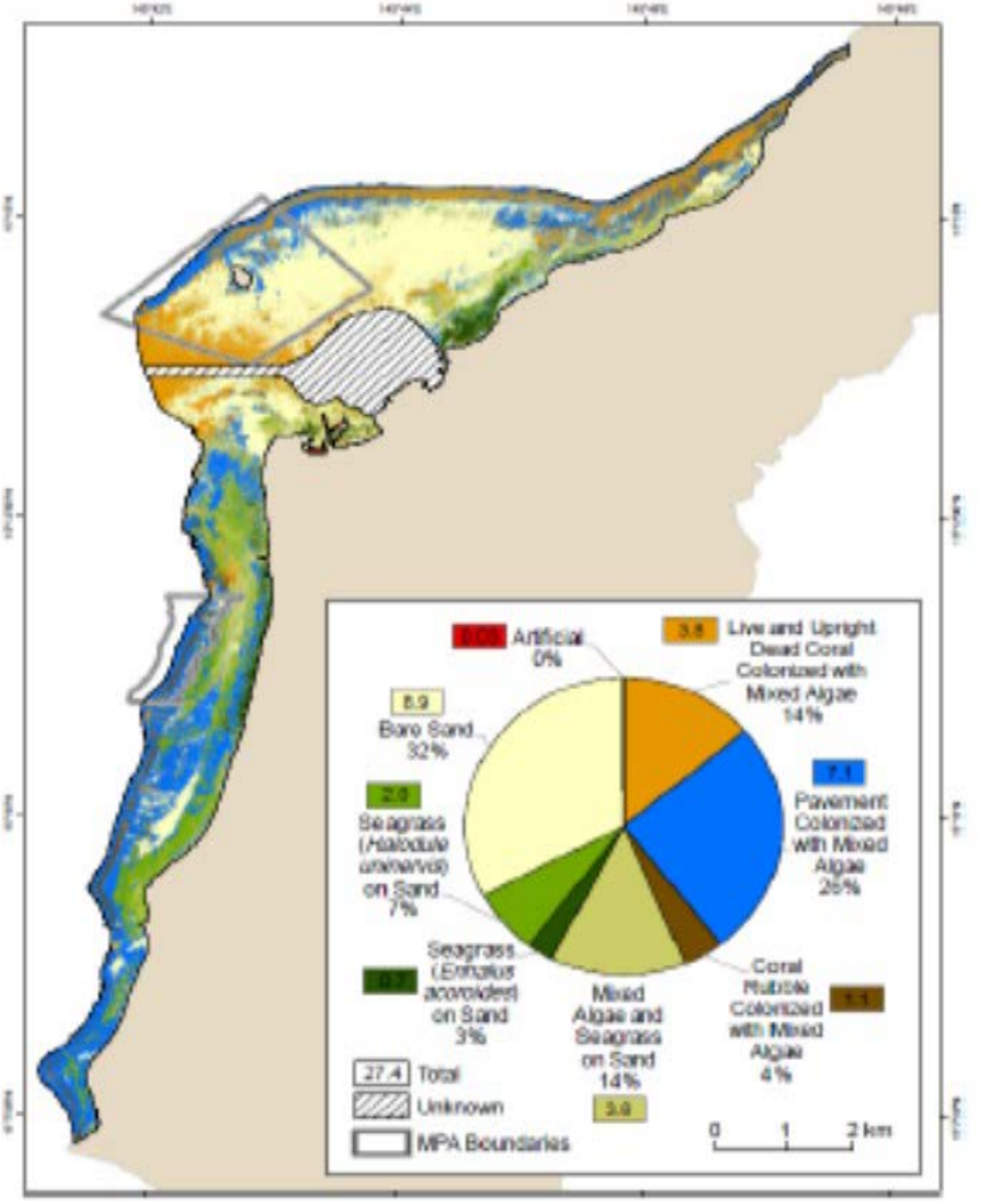
16 Habitat Types
(1 prediction for each type)

- 6 substrate
  - Live coral, All Species
  - Upright dead coral
  - Pavement
  - Coral rubble
  - Sand
  - Mud
- 10 biological cover
  - Live coral, all species
  - Live coral, *Isopora p.*
  - Live coral, Staghorn
  - Live coral, *Porites r.*
  - Live coral, Other
  - Seagrass, *Enhalus*
  - Seagrass, *Halodule*
  - Mixed algae
  - Mangrove
  - Bare

Example: Live Coral



Habitat Map (1)



Proposed Habitats: Biological Cover Types (10)

(1) Live Coral Reef (All species)



(2) Live Coral, *Isopora palifera*



(3) Live Coral, *Porites rus*



(4) Live Coral, Staghorn (*Acropora aspera, A. formosa, A. pulchra*)



(5) Live Coral, Other Species



(6) Seagrass, *Enhalus acoroides*



(7) Seagrass, *Halodule uninervis*



(8) Mixed Algae



(9) Bare



(10) Mangrove



Proposed Habitats: Substrate Types (6)

(1) Live Coral Reef, All species



(2) Upright Dead Coral Reef



(3) Pavement



(4) Coral Rubble



(5) Sand



(6) Mud



MARINE PROTECTED SPECIES MANAGEMENT

Sea Turtle Distribution and Habitat Use

Location: NBG **Period of Performance:** AUG2018 - SEP2022

Project Objective

- Conduct marine turtle surveys and in-water captures of green turtles (Chelonia mydas) and hawksbill turtles (Eretmochelys imbricata) in the nearshore waters of Guam and CNMI.
- Captured turtles are weighed, measured, biopsied, and tagged (i.e., flipper, PIT, satellite tracking) in an effort to expand our knowledge of the population demographics, population structure, and fine-scale habitat use of the turtles.
- Blood samples are also collected for two studies: 1) hormone analysis to determine population sex ratios, and 2) metabolite analysis to determine nutritional/feeding state.

Conservation Benefit

To understand the movements of Guam and CNMI foraging populations of sea turtles to maintain or increase sea turtle populations and enhance and restore habitat.
To collect data on the morphology and genetics of the nearshore sea turtle population.

FY21 Status

- This work is conducted through an Interagency Agreement (NMFS-PIC-18-007) between NOAA-PISF and JRM. The original agreement was from August 2016 – July 2019. The new agreement extends to September 2022.
- A final report was provided in January 2020
- Due to COVID travel constraints no work was conducted in FY21

EPR: 1 S CP MAR NBG Sea Turtle Distribution and Habitat Use; 61755NR815
2019 JRM INRMP Reference: MPS-2 (5-103)

Detection of Scalloped Hammerhead Sharks in Apra Harbor and Adjacent Nearshore Waters using Environmental DNA (eDNA)

Location: NBG **Period of Performance:** SEP2017 - OCT2020

Project Objective

- Collect and filter marine water samples at five targeted locations within Apra Harbor and Orote ERA.
- Develop primers designed to amplify only scalloped hammerhead shark DNA.
- Assess ability to extract and detect shark DNA, and other threatened fish species (e.g., humphead wrasse and bumphead parrotfish) through targeted quantitative Polymerase Chain Reactions and metabarcoding analyses.
- Analyze eDNA results to determine the spatial and temporal presence of scalloped hammerhead sharks in Apra Harbor and Orote ERA.

Conservation Benefit

- Increase habitat for ESA-listed species (e.g., scalloped hammerhead shark).
- Support habitat areas of particular concern, which align with Magnuson-Stevens Fishery Conservation Act for Essential Fish Habitat and the Marianas Fishery Ecosystem Plan.

FY21 Status

- eDNA detected at five locations in Apra Harbor (Figure 15)
- Final report available

EPR: 1 S MAR NBG Scalloped Hammerhead Shark (Sphyrna lewini) Survey; 61755NR891

2019 JRM INRMP Reference: MPS-1 (5-103)

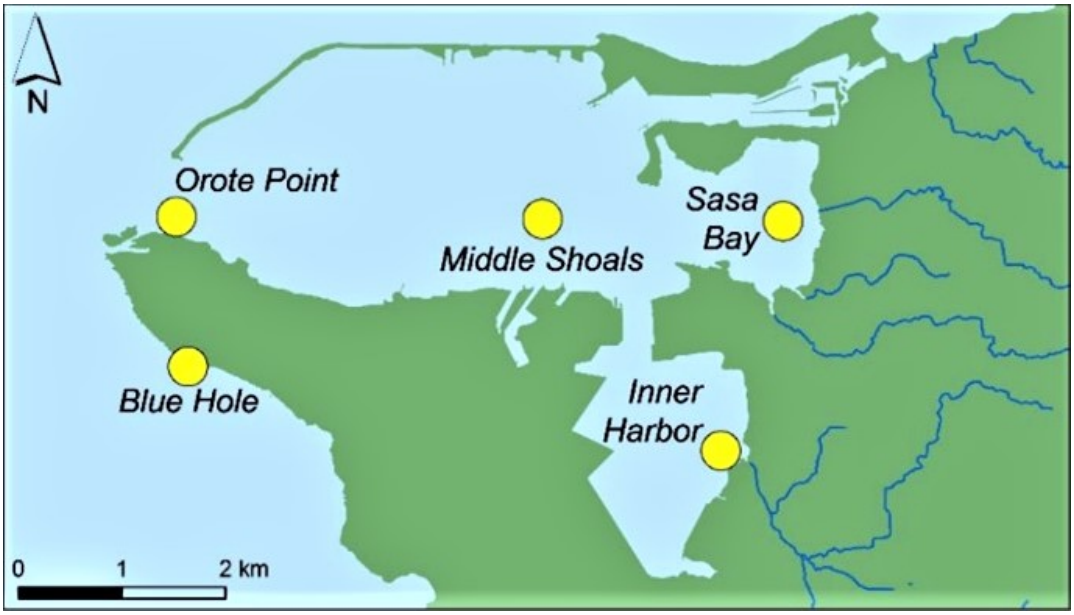


Figure 15. Sampling locations for the detection of scalloped hammerhead eDNA within Apra Harbor and Orote ERA.

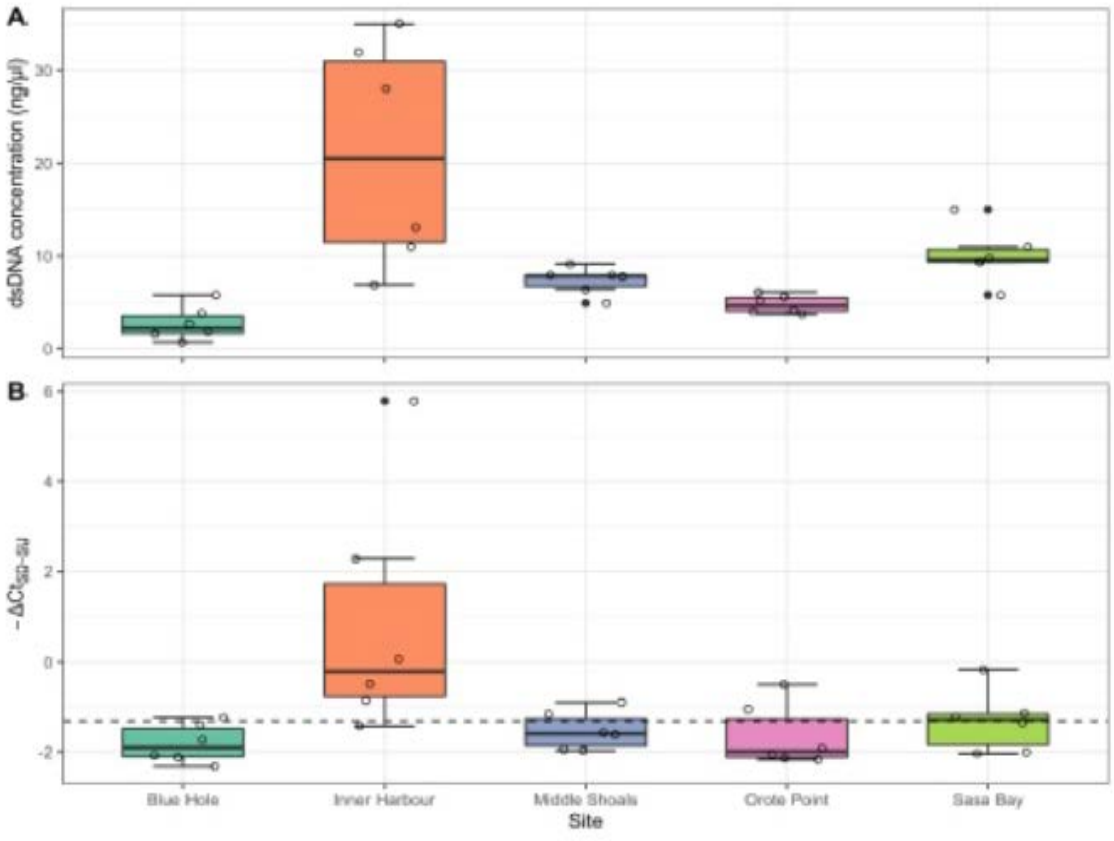


Figure 16. Mean total eDNA concentration for Apra Harbor.

TERRESTRIAL EXOTIC AND INVASIVE SPECIES MANAGEMENT

Implementation of the Regional Biosecurity Plan of Micronesia and Hawaii

Location: JRM **Period of Performance**: AUG2020-JUL2021

Project Objective

Update Attachment M (DoD Biosecurity Recommendations) of the Regional Biosecurity Plan for Micronesia and Hawaii (hereafter: RBP), and implement various actions identified within the RBP aimed at: preventing the spread of invasive species into/out of Joint Region Marianas (JRM) Area of Responsibility (AOR); controlling, managing, and eradicating invasive and nuisance species on DoD lands within the JRM AOR; providing outreach and awareness to military personnel, contractors, and their respective dependents; and increasing coordination and collaboration with regional partners and DoD stakeholders regarding biosecurity and invasive species management.

Conservation Benefit

Protect native species, particularly those that are threatened and endangered from the threat of invasive species within the JRM AOR.

FY21 Status

- The RBP Attachment M update was submitted to Navy HQ in December 2019 after reviews were completed by DoD across JRM AOR, Hawaii, DoD stakeholders in the Pacific, and PACOM.
- Implementation of biosecurity arrival and pre-departure biosecurity inspections of non-training military equipment and cargo movements into/out of JRM AOR and movements to Tinian for Seabee public works projects. Twenty (20) non-training

biosecurity inspection events took place during this reporting period with seven pre-departure biosecurity events for items going to Tinian.

- Continued interagency coordination and consultation regarding invasive species management and biosecurity concerns within the region (CRB Working Group, LFA Working Group, GISC, GISAC, RISC, CNMI DLNR, Guam Biosecurity Division).

EPR: CHS NISA MAR JRM Implementation of the Regional Biosecurity Plan; 61128NR860

2019 JRM INRMP Reference: TIS-4; 5-85, TIS-5; 6-44, TIS-5; 7-53, TIS-4; 8-51, TIS-6; 9-73, TIS-1; 11-62, TIS-1; 12-32, MIS-1; 5-102, MIS-1; 8-64, MIS-1; 9-87, MIS-1; 11-74, MIS-2; 11-74

Little Fire Ant (LFA), *Wasmannia auropunctata*, Surveys, Eradication, and Monitoring

Location: DoD Lands on Guam **Period of Performance**: AUG2020 – JUL2021

Project Objective

To implement LFA Early Detection Surveys (EDS); control and eradicate LFA on DoD lands; coordinate and collaborate with resources partners; and provide outreach materials to reduce impacts to native ecosystems and military readiness activities.

Conservation Benefit

Enhance and restore habitats by prevention of the spread and establishment of the invasive LFA.

FY21 Status

Cooperative Agreement with Colorado State University, Center for Environmental Management of Military Lands (CSU CEMML):

- LFA Early Detection Surveys
    - 133 LFA surveys at 102 sites out of 149 total sites covering approximately 150 miles
    - AAFB: 55 LFA surveys at 40 sites out of 49 total sites
    - NBG: 71 LFA surveys at 56 sites out of 81 total sites
    - MCBCB: 6 LFA surveys at 6 sites out of 6 total sites
- Three (3) new LFA infestations detected along installation borders
    - NBG: Two (2) locations (Naval Base Guam Naval Munitions Site (NMS) Route 12)
    - AAFB: One (1) location (Housing fenceline)
- Two (2) LFA positive locations on NBG had ongoing treatment (Dadi Beach and NMS-Cross Island Road) during this reporting period.

- LFA redetected at Haputo Beach Trailhead during post-treatment monitoring in July 2021.
- Secured FY21 funding to implement LFA treatment at AAFB Housing Fence line, NMS-Route 12 (two locations), and Polaris Point Fence line

- LFA Infestation Status
    - NMS – Route 12, NBG, On January 25, 2021 LFA were detected at two locations along Route 12 fence line and across from NMS front gate with a total treatment area of 0.7 and 1.0 acres respectively (Figure 17-18). LFA treatment to begin during September 2021.
    - Housing Fence line, AAFB, On May 13, 2021 LFA detected along the housing fence line with a treatment area of 1.0 acres (Figure 19). LFA treatment to begin during September 2021.
    - Dadi Beach, NBG – LFA detected in April 2020 with a treatment area of 19.8 acres (Figure 20). Three of eight LFA eradication treatments completed.
    - NMS – Cross Island Road, NBG – LFA detected in 2017. Ongoing LFA border treatment on 3.0 acres and eradication of a 4.4 acre interior infestation (4 of 8 eradication treatments completed) (Figure 21).
    - Haputo Beach Trailhead, NBG TS – Eight (8) LFA insecticide treatments completed (September 2019 – July 2020). The third post treatment monitoring effort on June 5, 2021 detected LFA (Figure 22). LFA treatment area covers 0.5 acres that will begin during September 2021.
    - Polaris Point – Fence line, NBG – LFA detected in June 2020 with a treatment area of 3.1 acres (Figure 23). LFA treatment to begin during September 2021.

EPR: CHS EO 13751 MAR Little Fire Ant Surveys and Eradication; 61128NR207 CHS NISA MAR JRM Implementation of the Regional Biosecurity Plan; 61128NR860 USMC HQ MITT Biological Opinion Conservation Measures Implement (FY21 Non-EPR)

2019 JRM INRMP Reference: TIS-5; 5-86, TIS-6; 6-44, TIS-4; 7-52, TIS-6; 8-52, TIS-5; 9-72

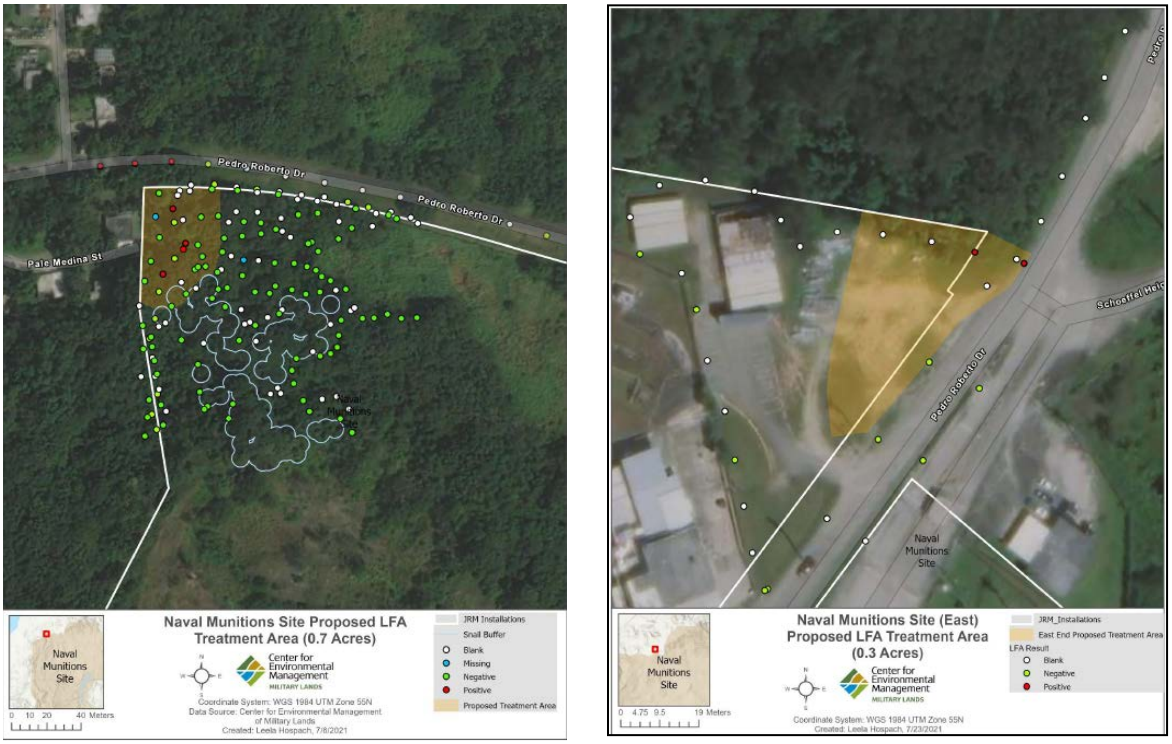


Figure 17 - 18. (A) Details of the LFA infestation at NMS Route 12 Fence line and (B) Route 12 across from NMS front gate as of July 2021. Green and white dots indicate no LFA detected, blue dots indicate missing survey bait stick, and red dots indicate LFA detected during surveys. The yellow shaded areas indicate proposed LFA treatment areas that total 1.7 acres.



Figure 19. Details of the LFA infestation at AAFB Housing fence line as of July 2021. Red dots indicate LFA detected during surveys. The yellow shaded area indicates proposed LFA treatment area of 1.0 acres.



Figure 20. Details of the LFA infestation at Dadi Beach area of NBG. Red dots indicate LFA detected during surveys. The blue shaded area indicates the ongoing LFA treatment area of 19.8 acres.

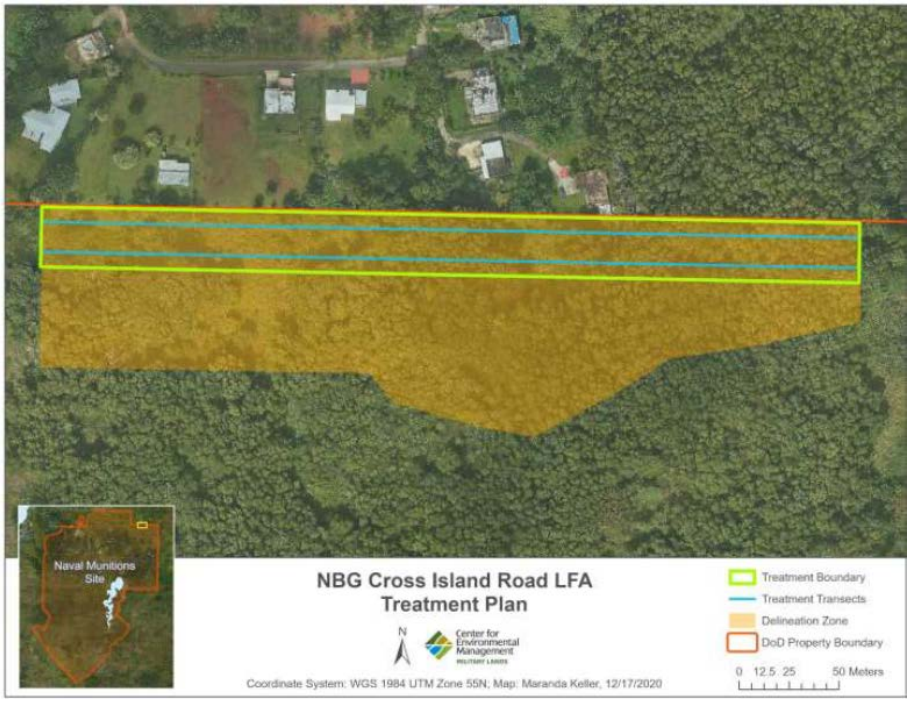


Figure 21. Orange shaded area depicts the original delineation zone. Blue polygon indicates the ongoing LFA border treatment area of 3.0 acres.

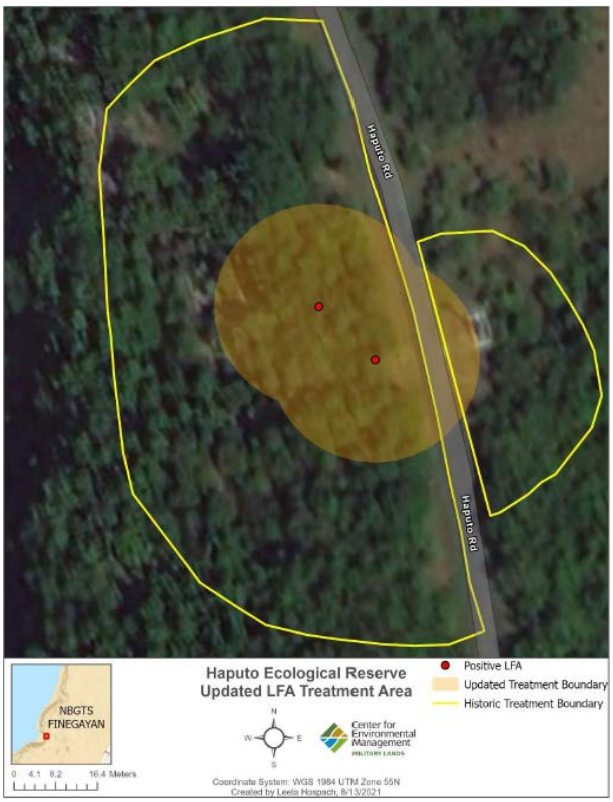


Figure 22. Details of the LFA infestation at Haputo Beach Trailhead area of NBG TS. Red dots indicate LFA detected during surveys. The orange shaded area indicates the proposed LFA treatment area of 0.5 acres.



Figure 23. Detail of the LFA infestation at the Polaris Point fence line area of NBG. Red dots indicate LFA detected during surveys. The orange shaded area indicates the proposed LFA treatment area of 3.1 acres.

Little Fire Ant (LFA), *Wasmannia auropunctata*, Surveys, Eradication, and Monitoring – Andersen South

Location: Andersen South **Period of Performance:** AUG2017 - DEC2021

Project Objective

- To eradicate LFA within the Andersen South property to reduce impacts to native ecosystems and military readiness activities.

Conservation Benefit

Enhance and restore habitats by prevention of the spread of the invasive LFA.

FY21 Status

- 5 of the 8 known LFA sites have been successfully eradicated at the Andy South property
- Completion of the delimiting surveys at site 7
- On-going delimiting surveys for newly discovered site 8 snail area
- Delimiting surveys for LFA spread at sites 1, 6, 7 and 8
- On-going consultation with USFWS for helicopter eradication at site 1 and ground-based eradication of LFA from site 8 snail area
- On-going development of revised work plan to include ground-based treatments for newly discovered LFA sites and containment of the site 1 infestation
- On-going planning for the commencement of helicopter aerial treatments

EPR: DPRI: Marine Corps Relocation 2017 amendment to 2015 BO, Conservation Measures to Minimize the Effects of Invasive Species; CHS EO 13751 MAR Little Fire Ant Surveys and Eradication; 61128NR207

2019 JRM INRMP Reference: TIS-5; 5-86, TIS-5; 9-72

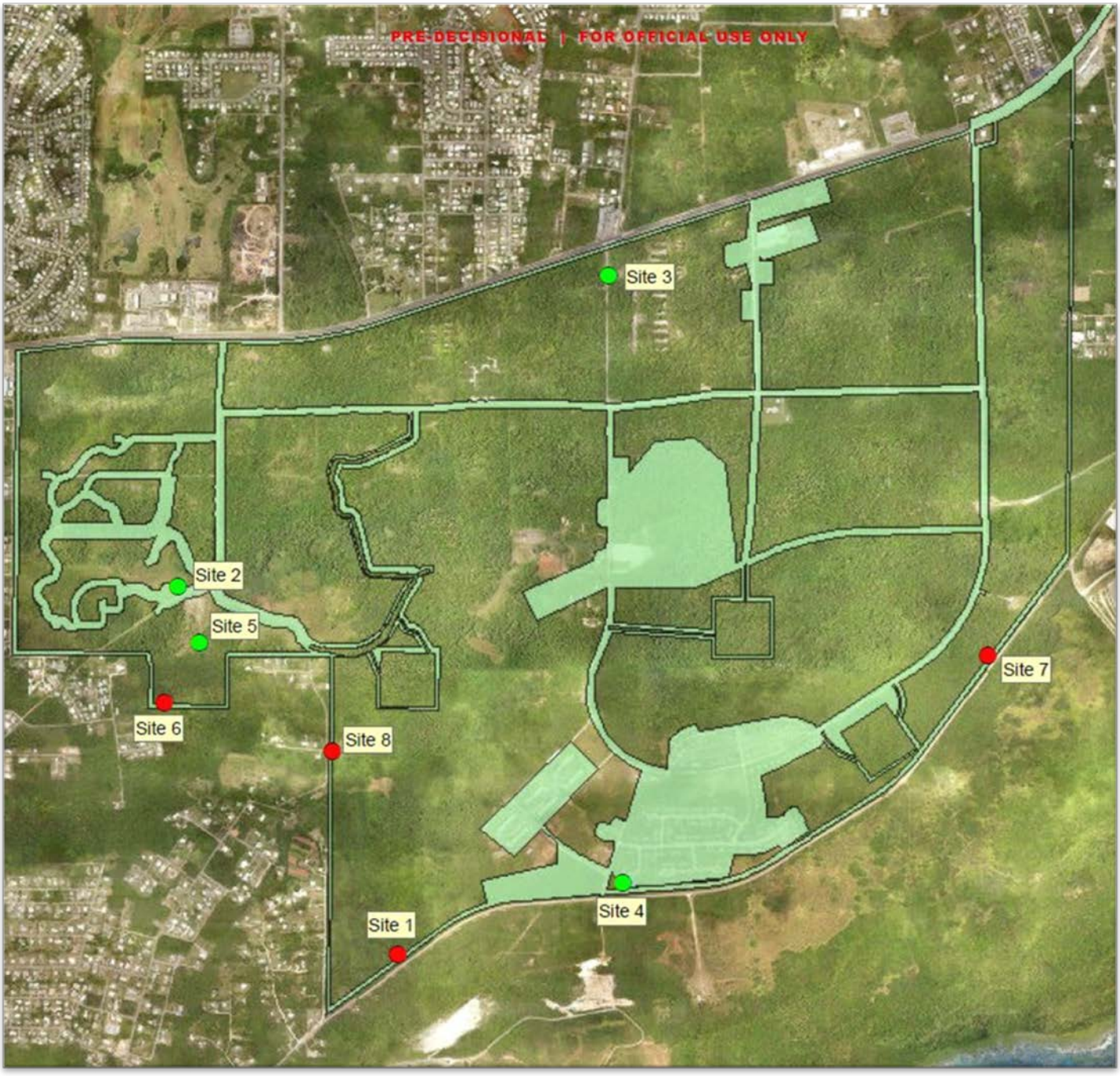


Figure 24. Andersen South eradication sites

Invasive Species Management within the Joint Region Marianas Area of Responsibility

Location: JRM **Period of Performance**: AUG2020 – JUL2021

Project Objective

In support of Mariana Islands Training & Testing (MITT) activities, 1) conduct Early Detection Surveys (EDS) non-native species at training and cargo staging locations within the JRM AOR (Guam and CNMI (Tinian Ports, Military Leased Area, Rota Ports); 2) develop and implement standard operating procedures for the control and removal of high-risk invasive species; 3) develop and implement invasive species rapid response protocols; 4) develop and implement bio-sanitation standards along with quality assurance/quality control standards; and 5) development of a programmatic pathway risk analysis for the movement of equipment and personnel within the JRM AOR; and 6) targeting high risk invasive arthropod species for control and eradication.

Conservation Benefit

Prevent the movement and establishment of invasive species into and out of Guam and the CNMI during training exercises.

FY21 Status

- Ongoing cooperative agreement CSU, CEMML
- Early Detection Surveys Conducted
    - All-Taxa Surveys – AAFB: 12 of 29 sites; NBG: 9 of 27 sites
    - Weed Surveys – AAFB: 11 of 28 sites; NBG: 27 of 47 sites
    - Tinian MLA – 1 of 3 All-Taxa sites and Weed Surveys conducted at North Field (runways, taxiways, Dankulo beach)
- Development of SOPs for the Control/Eradication of High-Risk Species
    - Little Fire Ant (LFA; *Wasmannia auropuncta*) revised
    - Yellow-jacket wasps (*Vespula pensylvanica* & *V. germanica*)

- Invasive Species Rapid Response
    - No rapid response deployment events occurred during FY21
    - Five CSU CEMML personnel BTS Rapid Response certified
- Bio-sanitation QA/QC Biosecurity Inspections during Military Training Events
    - Four major training events (>100 cargo items; Valiant Shield 20, Cope North 21, Forager 21, Freedom Banner 21)
    - Eight minor training events (25 – 100 cargo items)
    - Six unit level training events (<25 cargo items)
    - >3,000 items inspected during arrival and pre-departure biosecurity inspections to meet AFPMB TG-31 cleanliness standards
    - Bio-material interceptions (plant material, seeds, soil/gravel, insects, spiders/webs/eggs, wasp nests, dead frog, etc.)(Figure 25)
- Development of a Programmatic Pathway Risk Analysis for Movements into the Mariana Islands and between Islands
    - Ongoing data collection to support the risk analysis
- FY20 Cooperative Agreement with CSU CEMML ongoing (Jul2020 – Dec2021)

EPR: 2 BO MAR Mariana Islands Training and Testing (MITT) Implementation; 61128NR218 CHS NISA MAR JRM Implementation of the Regional Biosecurity Plan; 61128NR860 USMC HQ MITT Biological Opinion Conservation Measures Implement (FY21 Non-EPR)

2019 JRM INRMP Reference: TIS-6; 5-86, TIS-7; 6-44, TIS-6; 7-53, TIS-5; 8-51, TIS-7; 9-73, TIS-2; 11-62, TIS-1; 12-32; TIS-2; 12-33



Figure 25. Examples of biomaterial interceptions during Guam Maritime Prepositioning Force (MPF) cargo/equipment biosecurity arrival inspections on Guam. Items identified during arrival inspections included live scale insects, spider egg cases, bird nest, and a desiccated frog.

Coconut Rhinoceros Beetle (CRB; *Oryctes rhinoceros*) Surveys, Interdiction, and Monitoring - Guam

Location: DoD Lands on Guam **Period of Performance:** AUG2020 – JUL2021

Project Objective

To implement CRB best management practices: 1) identify and remove breeding sites, 2) implement interdiction and sentinel trapping, and 3) implement CRB awareness; coordinate and collaborate with resources partners, and provide outreach materials to installation and military training participants to reduce impacts to native ecosystems and military readiness activities.

Conservation Benefit

Enhance and restore habitats by prevention of the spread and establishment of the invasive LFA.

FY21 Status

- CRB Best Management Practices
- CSU CEMML implementing CRB management
- Conducted biannual CRB breeding site surveys on NBG/AAFB
- 287 CRB sentinel/interdiction traps deployed and serviced on NBG (143 traps) and AAFB (144 traps) starting in August 2020 through June 30, 2021. During this 10-month period a total of 9,197 CRB were captured (AAFB: 5,079 & NBG: 4,118;)(Figure 26)
- During the most recent trapping period (April to June 2021) at AAFB 130 of 141 traps had at least one CRB capture (92%) and at NBG 128 of 143 traps had at least one CRB capture (89%). Heat maps in Figures 27 - 28 depict CRB capture rates.
- Coordination with regional partners (USDA-PPQ, GovGuam Dept. Ag., & CNMI DLNR)

EPR: 2 BO MAR MITT Implementation; 61128NR218 CHS NISA MAR JRM Implementation of the Regional Biosecurity Plan; 61128NR860 USMC HQ MITT Biological Opinion Conservation Measures Implement (FY21 Non-EPR)

2019 JRM INRMP Reference: TIS-5; 5-86, TIS-6; 5-87, TIS-6; 6-44, TIS-7; 6-45, TIS-4; 7-53, TIS-6; 7-53, TIS-5; 8-52, TIS-6; 8-52, TIS-5; 9-72, TIS-7; 9-73, TIS-1; 11-62, TIS-2; 11-63, TIS-1; 12-32, TIS-2; 12-33

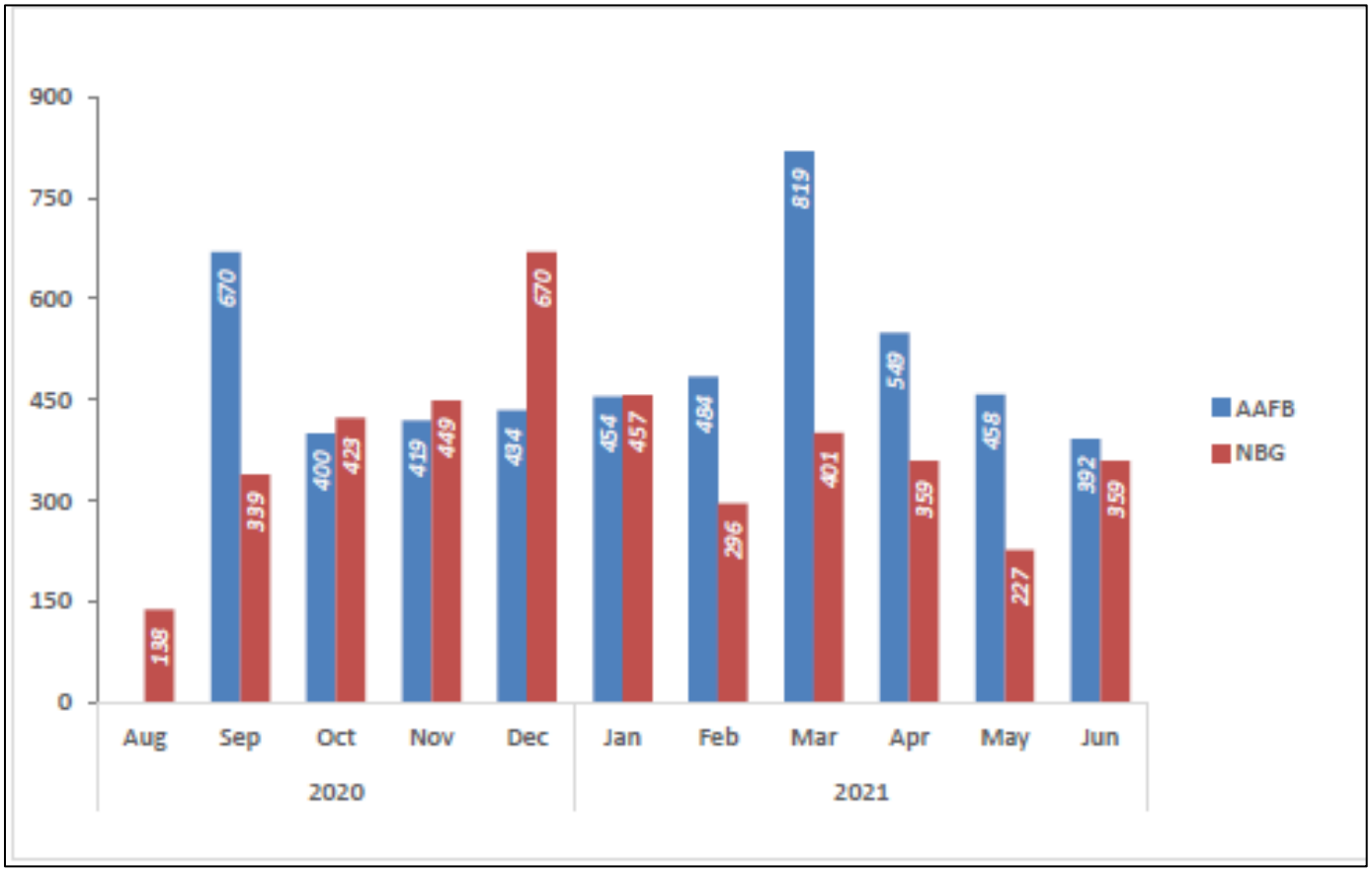


Figure 26. Monthly total CRB captures shown for AAFB (blue) and NBG (red) since initial trap activation on August 24, 2020 (NBG) and August 31, 2020 (AAFB) through June 30, 2021.

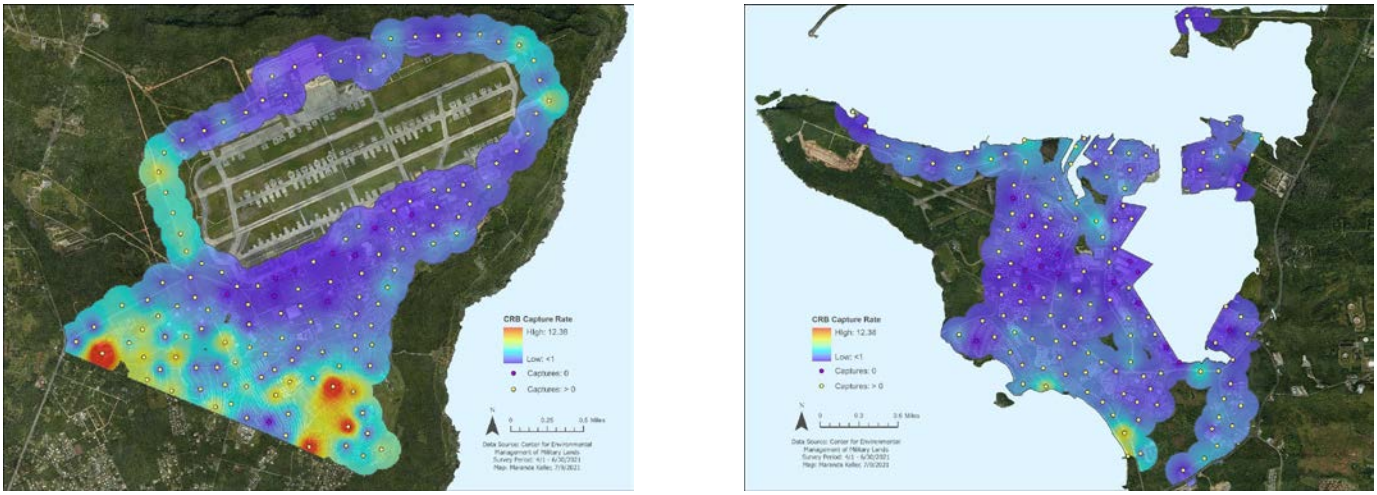


Figure 27-28. Heat map of AAFB and NBG depicting capture rates from April through June 2021 across the CRB survey area (225 meter buffer zone) shown.

Brown Treesnake Interdiction to Prevent the Spread Via the DOD Transportation Network Originating On Guam

Location: JRM **Period of Performance:** OCT2020 – SEP2021

Project Objective

To prevent the spread of BTS (Figure 29) to other Pacific islands including the CNMI and Hawaii, this JRM project is funded to conduct BTS control and interdiction efforts (Figure 30) on NBG and AAFB to prevent snakes from getting into the DoD transportation network. Methods include BTS trapping, toxicants, nighttime visual fence line searches, and canine inspections of outbound items. The BTS Interdiction program also supports training events occurring in the region that originate from Guam. Joint Region Marianas develops BTS control and interdiction plans for each training exercise that requires the movement of personnel and assets to the CNMI from Guam. Additional BTS inspections and control measures implemented in the CNMI when determined necessary by the stakeholders.

Conservation Benefit

Preventing the spread of BTS via the military transportation network keeps BTS on Guam and from establishing in other ecologically sensitive areas in the Pacific region where vulnerable island species would be susceptible to BTS predation.

FY21 Status

- Ongoing and enduring JRM requirement
- Interdiction support provided to four (4) major exercises FY21: COPE NORTH/PACIRON/FORAGER/FREEDOM BANNER 2021
- 5 missed Inspection (99.999%)
- No BTS detections in outbound cargo
- Data from AUG2020-JUL2021



Figure 29. (a) BTS on AAFB fenceline;

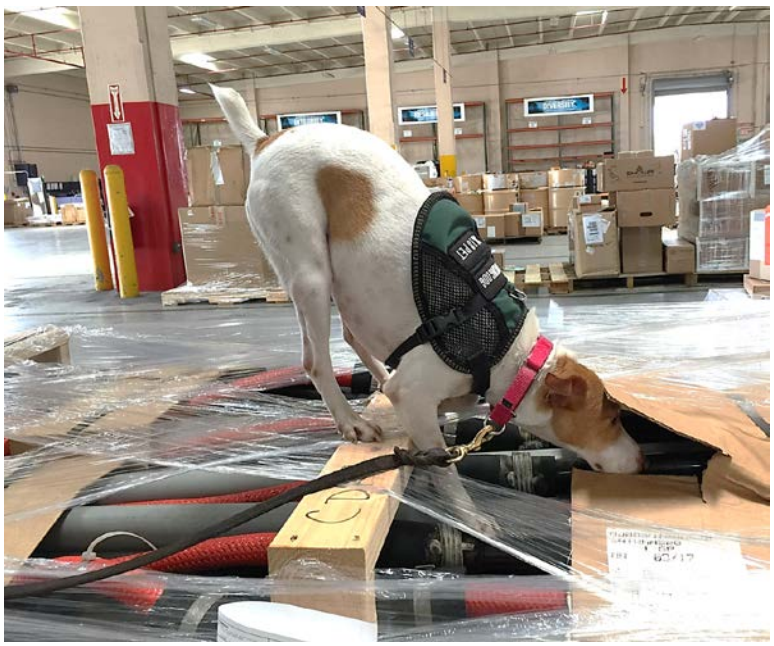


Figure 30. (b) USDA-WS BTS detector dog inspecting cargo at Warehouse 9, NBG.

Photos U.S. Navy, Guam

Brown Treesnake Control at Mariana Swiftlet Caves

Location: NBG; NMS **Period of Performance**: OCT2018 – Ongoing

Project Objective

To provide long-term protection for the Mariana Swiftlet (*Aerodramus bartschi*) from the BTS predation. Protection consists of oral toxicants for BTS around the areas surrounding Mahlac, Fachi, and Maemong caves, NMS.

Conservation Benefit

Protection from predation by BTS is focused on maintaining or increase swiftlet populations at the three occupied caves and enhance or restore habitat by reducing predation by BTS.

FY21 Status

- Ongoing project with CEMML
- 100% bait tubes since October 2019
- Baiting once per week to reduce disturbance
- 5380 baits deployed since August 2021
- Average annual toxicant take rate = 27% (1455/5380)

EPR: 1 RP NBG Mariana Swiftlet Population Protection; 67155NR834: BTS Trapping

2019 JRM INRMP Reference: TIS-2; 6-43

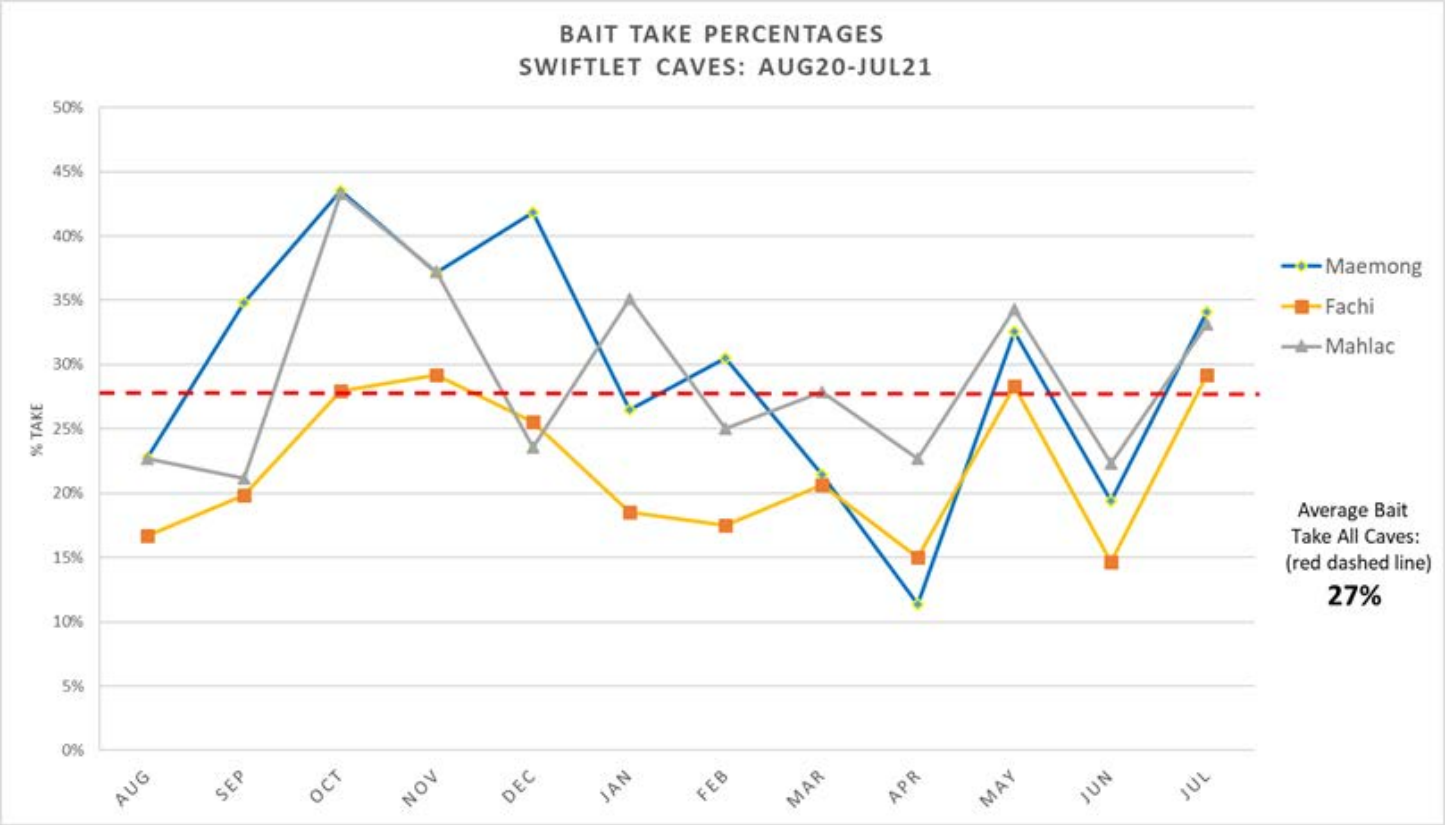


Figure 31. Monthly bait take percentages for swiftlet caves. Red dashed line is annual average bait take (27%).

Evaluation of Brown Treesnake Control via Bait Delivery around the Swiftlet Caves and Investigation of Brown Treesnake Control to Support Swiftlet Range Expansion

Location: NBG **Period of Performance:** SEP2020 – FEB2022

Project Objective

This project will assess the overall efficacy of current control around the swiftlet caves by evaluating trapping, hand captures, and visual surveys capture data. This project will evaluate data based on seasonality, demographic, and behavioral aspects of BTS. Snakes captures in and out of caves (occupied and unoccupied) will be tracked via transmitters to determine movement, and if there are any potential dietary preferences.

Conservation Benefit

Swiftlet protection is a long-term effort that helps support goals of the swiftlet recovery plan. Since mid-2018 it has been 100% toxicant-based control, and while slightly more effective than trapping the impacts to BTS have not been adequately assessed. Additionally, a better understanding of BTS population dynamics near a rich prey base needs to be improved. The data collected will contribute to understanding if there is any measurable impact from the current baiting methods on the BTS populations around the caves. Improved BTS population data will inform future conservation efforts for listed species on Guam.

FY21 Status

- Funded via an interagency agreement with USGS – Fort Collins.
- COVID delayed the start of data collection.
- 19 BTS captures in or near Maemong (10) and Mahlac (9) – transmitters have been inserted in nine (9) BTS.
- BTS captured inside caves larger than BTS outside the caves.

- No BTS captured outside the caves located inside the caves.

EPR: 1 RP NBG Mariana Swiftlet Population Protection: BTS Trapping; 67155NR834

2019 JRM INRMP Reference: TIS-2; 6-43

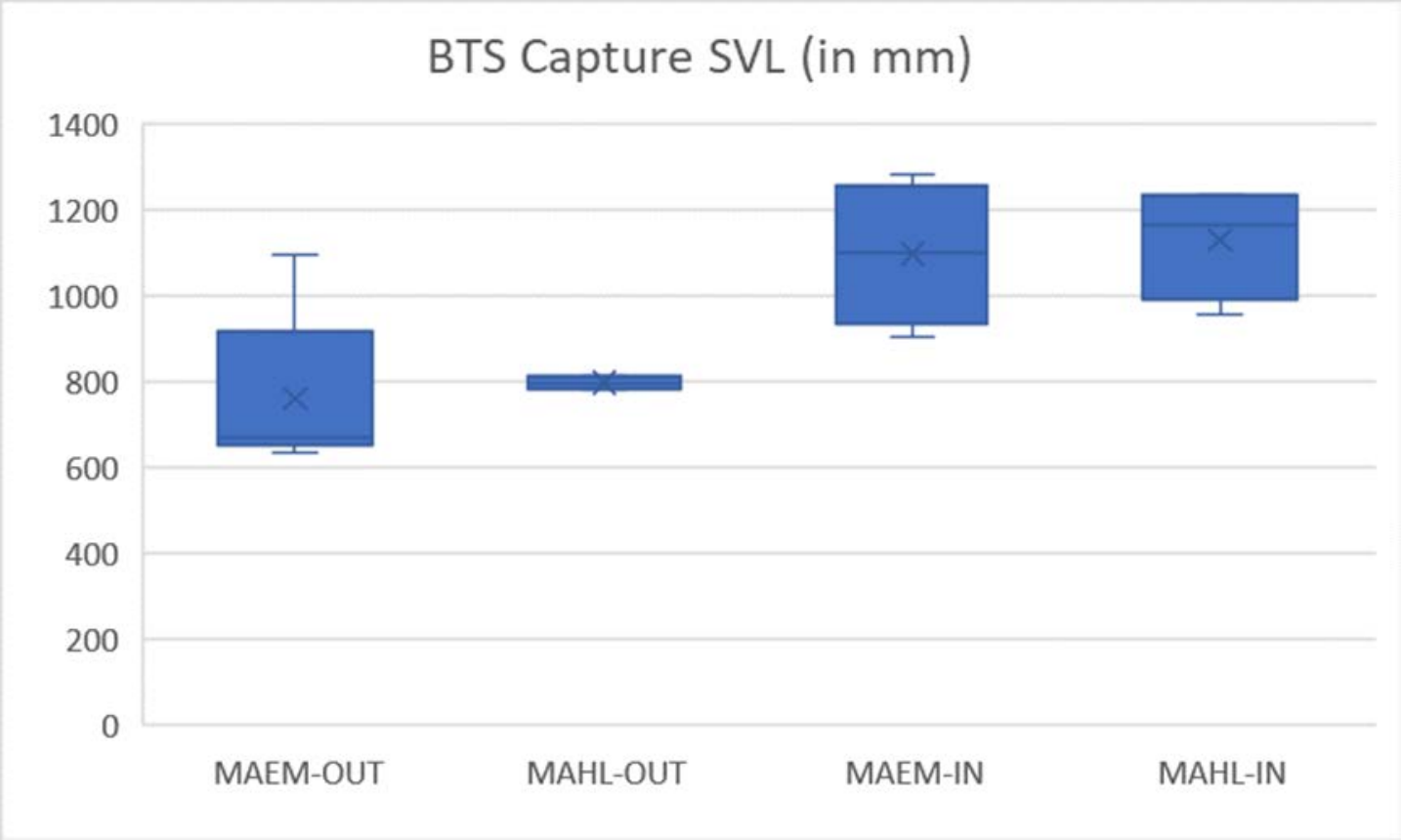


Figure 32. Box and Whisker plot showing snake capture sizes by site. MAEM = Maemong cave, MAHL = Mahlac cave, -IN = inside the cave, and -OUT = outside the cave. Note that though the sample sizes are small (four snakes captured inside each cave, for instance), snakes inside the cave are consistently large.

Aerial Baiting Operations and Ground Support for Suppression in the HMU, AAFB

Location: JRM **Period of Performance**: JAN2020 – JUL2021

Project Objective

To provide operational helicopter support, including a pilot, mechanic, technical support, and on-site monitoring of bait drops during aerial baiting applications within the HMU, AAFB.

Conservation Benefit

The development and performance of aerial delivery system for BTS suppression, demonstrates the potential for meaningful impacts on BTS populations at the landscape level. Dropping aerial baits in the HMU will provide data and insight into BTS responses to aerial baiting over time. Aerial baiting increases the amount of landscape that can be targeted for BTS suppression and control. Landscape level control would likely improve JRM conservation efforts in support of the recovery of listed species on JRM lands and assist with interdiction efforts.

FY21 Status

- Funded via an interagency agreement with USDA –WS; project ongoing
- 14-month delay between February 2020 and April 2021 due to COVID
- Six (6) treatments, eighteen, (18) applications since September 2018: >110,000 baits deployed (Figure 33)
- Six (6) applications, April 2021 and June 2021: 39,600 baits deployed
- Aerial Delivery System performs to specifications.
- Further three (3) drops proposed for November or December 2021
- No Cost Extension until July 2022

EPR: 1 RP JRM BTS Eradication and Control to Support Recovery of ESA-Listed Species; 61128NR202

2019 JRM INRMP Reference: TIS-1, TIS-2, TIS-3; 5-85, 6-43; 7-52, 8-50-51, 9-71



Figure 33. USDA-WS deploying brown treensnake baits over AAFB Habitat Management Unit. Photo U.S. Navy.

Habitat Management Unit Biomonitor Support and ESA-Listed Species Identification Training

Location: AAFB **Period of Performance**: JAN20 – JUL2021

Project Objective

To provide biomonitor support during aerial baiting project by the ADS, to observe for presence of Mariana Fruit Bat (*Pteropus mariannus mariannus*, Fanihi) and observe for take.

Conservation Benefit

Allow for the continuance of the ADS project while monitoring for the presence of fanihi per requirements of the 2018 HMU ADS Biological Opinion.

FY21 Status

- Agreement via the CESU network with UOG – Center for Island Sustainability (CIS).
- Zero (0) bats observed over six (6) scheduled drops, April and July, 2021
- Refresher trainings for ESA-listed species surveys conducted with 10 attendees from field support staff.

EPR: 1 RP JRM BTS Eradication and Control to Support Recovery of ESA-Listed Species; 61128NR202

2019 JRM INRMP Reference: TIS-2, TIS-3; 5-85, 6-43; 7-52, 8-50-51, 9-71

Evaluating the Effect of Bait Size and Species on Removal of Brown Treesnakes That Are Not Susceptible to ADS Control

Location: AAFB **Period of Performance:** JUL2020 – JAN2020

Project Objective

The project will evaluate a multi-tool/multi bait approach to eradicating a small, known population of BTS in the Closed Population (Closed Pop) area on AAFB. The project will use a phased approach continuing with replicating aerial baiting (suspending baits form vegetation); adding a perimeter of larger rodent and bird baits in bait tubes; and use live bird and rodent lures. The baits will have transmitters to track the fate of the snakes. The same approach will be taken within the interior of the Closed Pop to analyze for any spatial effects. As the population of BTS within the Closed Pop is known, following the impacts by the multi-tool approach to provide useful data towards improving BTS suppression and eradication within enclosures.

Conservation Benefit

Aerial baiting can distribute bait across the landscape quickly, but we still do not have enough data to state conclusively if eradication is achievable. Aerial baiting is the only method used to attempt suppression/eradication of BTS in the HMU. Data projections indicate aerial baiting alone may not be enough to meet the goal of eradication. This is, in part, due to a sub-set of the BTS population not consuming bait (too small/too large). The ability to better target all size classes of BTS with a complex of control tools could help achieve eradication within enclosures but also may provide a substantial benefit to recovery of listed species by severely suppression the population to allow population recruitment to stay ahead of predation.

FY21 Status

- Funded via an interagency agreement with USGS-FORT.
- Continuation of previously funded simulated aerial baiting 2018-19.

- Data collection is ongoing with two treatments complete so far.
- Population continues to decline over time for ~120 BTS to ~9-15 BTS

EPR: 1 RP JRM Brown Tree Snake Eradication and Control to Support Recovery of ESA-Listed Species; 61128NR202

2019 JRM INRMP Reference: TIS-2, TIS-3; TPS-6, 5-85, 6-43; 7-52, 8-50-51, 9-71, 9-77

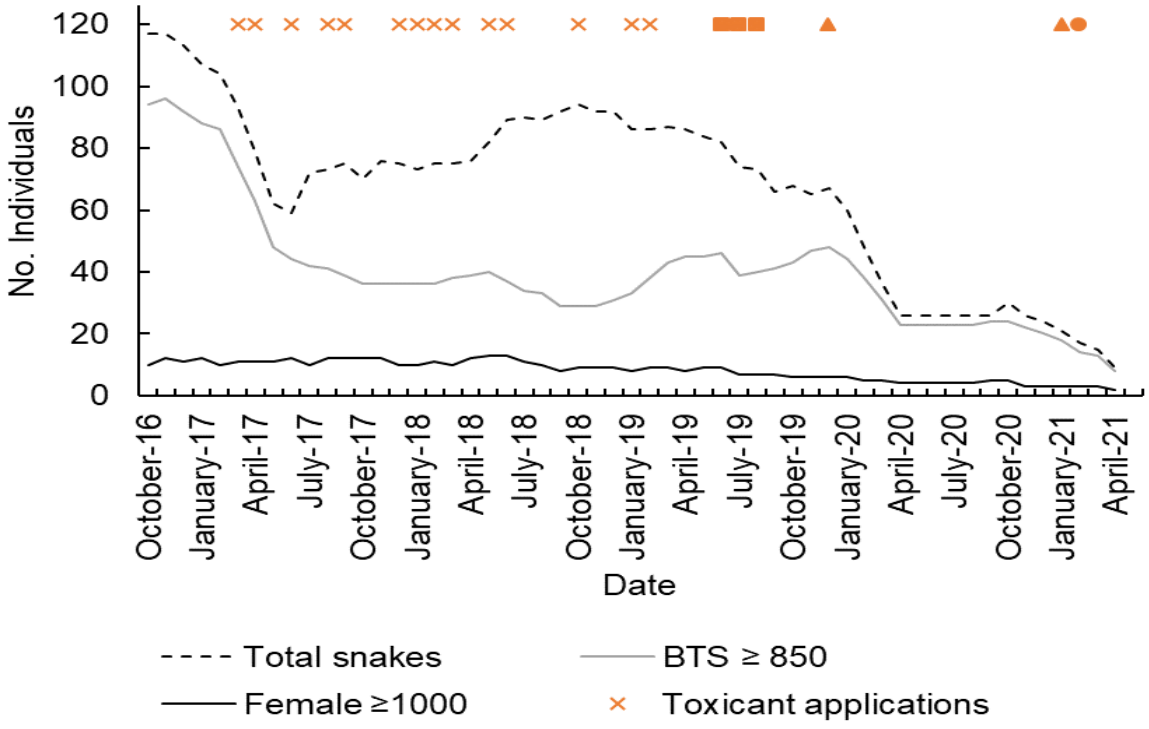


Figure 34. The change in the number of snakes in the 5 ha USGS Closed Population following extended toxicant application. 'x' indicates standard ADS bait applications. 'd'indicates the addition of large ground mouse baits to the treatments. 'd' indicates addition of multispecies bait tubes containing mice, rats, quail, and chickens. 'd' indicates start of live trapping.

Monitoring of Reduction in Brown Treesnake Abundance during Eradication Activities in the HMU and Evaluation of Alternative Ground Baits for Large Brown Treesnakes

Location: AAFB **Period of Performance:** SEP2019 – MAR2021

Project Objective

To continue monitoring BTS population levels after a series of 12 aerial bait drops within the HMU and continue monitoring populations before, during, and after the next proposed series of drops. Abundance of BTS will be measured through analysis of non-toxic bait take, cameras captures. The camera captures will help determine abundance and potential size-class of BTS less susceptible to aerial baiting. Captured BTS in the HMU will be radio-tagged and tracked for a known-fate component. A bait trial for large BTS will be conducted to help assess the need for alternative baits for BTS not attracted by standard baits, and well-water is being monitored for acetaminophen percolation.

Conservation Benefit

To increase effectiveness of large BTS control that currently have limited susceptibility to aerial bait application to enhance and restore habitat, and to assist in potential reintroduction of ESA-listed species to the wild on Guam. Determining the level of impact from landscape scale BTS control is an essential requirement to evaluate success and future investment when considering species restoration on Guam.

FY21 Status

- Funded via an interagency agreement with USDA –NWRC.
- Take rate before COVID break 5%; rates rose to 20% during COVID break.
- Camera platform accurate estimation of size of BTS “captured” in image.
- No detection of acetaminophen in ground water.

- Project period of performance extended to February 2022.

EPR: No EPR - funded under the Guam Micronesian Kingfisher MOA and EPR: 1 RP JRM Brown Tree Snake Eradication and Control to Support Recovery of ESA-Listed Species; 61128NR202

2019 JRM INRMP Reference: TIS-1, TIS-2, TIS-3; 5-85, 6-43; 7-52, 8-50-51, 9-71





Figure 35. (a) BTS bait cartridge suspended from tree after deployment; (b) camera platform used to monitor for BTS after bait treatments.

Assessment of BTS Fates after Toxicant Delivery to the Habitat Management Unit

Location: AAFB **Period of Performance:** APR2020 – OCT2021

Project Objective

To determine the fate of known BTS previously captured and marked with scale-clipping or radio transmitters. Two groups of BTS will be capture and will have radio transmitters surgically implanted. Individuals were followed before and after a series of aerial baiting treatments in the HMU on AAFB. Data based on survivorship and demographics to be analyzed and compared to previously collected data from previous iteration of this project, 2018-2021.

Conservation Benefit

Determining size-based susceptibility is essential for developing accurate demographic models to help inform suppression and eradication techniques. Moreover, identification of whether there is an upper threshold in susceptibility to aerial baiting exists for large individuals will inform development of BTS management strategies i.e., using other tools in combination with aerial baiting. Understanding the proportion of known individuals that are targeted by toxicants and their demographics prior to a toxicant drop is essential for methodological refinement and informing other suppression efforts. Understanding individual variation in susceptibility to aerial baiting is also vital to prescribing toxicant application at an intensity and frequency that will result in effective suppression or eradication of BTS.

FY21 Status

- Funded via an interagency agreement with USGS – Fort Collins.
- COVID delays reduced number of data points collected due to suspension baiting.
- 86% of tracked BTS survived aerial baiting treatments for April and July 2021.

- Size effect detected, smaller BTS (SVL < 1136) showing higher death rate (Figure 36).

EPR: 1 RP JRM BTS Eradication and Control to Support Recovery of ESA-Listed Species; 61128NR202

2019 JRM INRMP Reference: TIS-2, TIS-3; 5-85, 6-43; 7-52, 8-50-51, 9-71

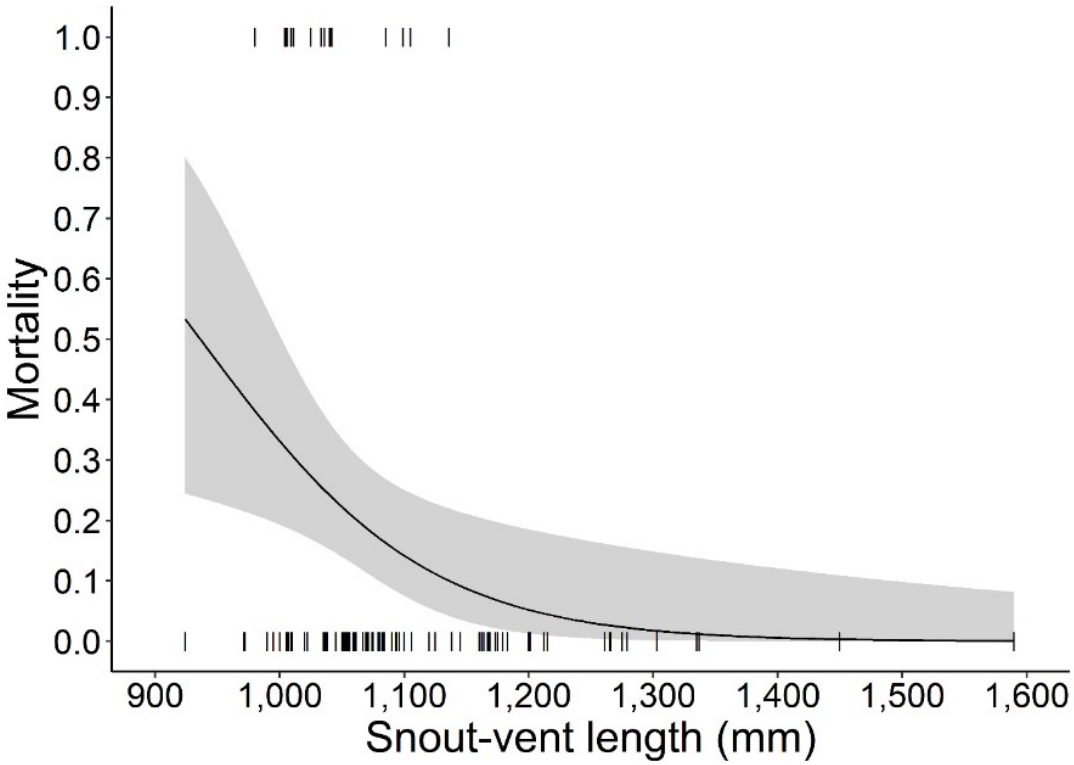


Figure 36. The effect of snout-vent length (SVL) on BTS (N = 89) mortality probabilities (black line) surrounded by 95% confidence intervals (gray band) during the 2-week treatment periods for Treatments 3, 4, and 5 on AAFB, Guam, USA. Tick marks indicate the snout-vent length of individual radio-tagged snakes that survived (0.0) or died (1.0) during the treatment periods. Note the pronounced decline in mortality of snakes from 1,000 to 1,150 mm SVL and the overall low mortality for individuals greater than 1,150 mm SVL. Snakes ranging from 980-1136 SVL (N = 16) died during treatments and all snakes greater than 1,136 mm SVL (N = 26) survived.

Monitoring Demographic and Ecological Effects of Sustained Automated Delivery System Treatment in the Habitat Management Unit

Location: AAFB **Period of Performance:** APR2020 – NOV2021

Project Objective

The project seeks to evaluate visual searching along minimally cleared transects versus trackless areas within 5 sub-plots of the HMU and compare visual searching versus bait tubes and camera surveillance as a low-density monitoring tools for BTS and monitor demographic change in encounter frequency of BTS during visual searches before and after aerial baiting in the HMU.

Conservation Benefit

Monitoring for BTS after aerial baiting is an important method for evaluating impacts to a target population of snakes. Assessing and using effective monitoring tools for targeted BTS populations and their small mammal prey (rodents) are important for adaptive management. Rodent prey have been determined to have strong effects on efficacy of snake suppression; monitoring their populations is likely to improve efficacy of individual landscape-scale level applications. Improved demographic information and levels of suppression will inform future conservation efforts for listed species on Guam.

FY21 Status

- Funded via an interagency agreement with USGS – Fort Collins.
- Captures per unit effort (CPUE) declined at similar rates across all sub-plots (Figure 37).
- Visual surveys and bait tube takes correlate strongly as means of detecting declines in BTS population after baiting.

- Sub-sampling will be effective for monitoring.
- No significant rodent detections.
- Data from April and July 2021 drops not available at this time.

EPR: 1 RP JRM BTS Eradication and Control to Support Recovery of ESA-Listed Species; 61128NR202

2019 JRM INRMP Reference: TIS-2, TIS-3; 5-85, 6-43; 7-52, 8-50-51, 9-71

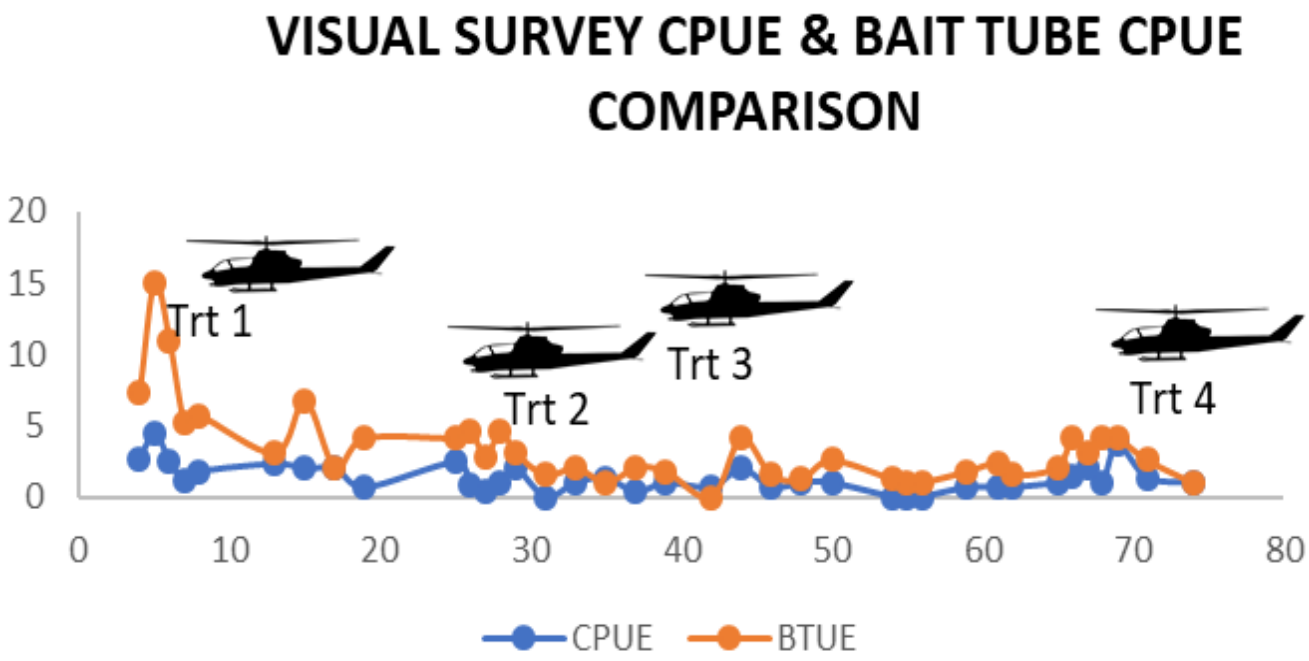


Figure 37. Catch-per-unit effort (CPUE) for nocturnal visual surveys (blue) and bait tubes (orange) over time (when both methods occurred within the same week). Automated Delivery System (ADS) treatment events are depicted with arrow. CPUE of bait tubes was much greater than CPUE from visual surveys. The correlation between the two sampling methods was strong and significant ($r = 0.731$; prob > $|r|$ = <0.0001).

Artificial Toxic Bait for Landscape-scale Brown Treesnake Suppression: Refinement and Capacity

Location: AAFB **Period of Performance**: SEP2020 – FEB2022

Project Objective

This project will further develop the program for artificial BTS bait production (Figure 38) focusing on improving efficacy, automate production, and increase capacity for bait production and testing. Other objectives include evaluating the form of the bait for production, how to integrate acetaminophen into the bait, integration of artificial bait into bait cartridge assembly, scaling up production, how to deter invertebrates, establish a testing facility to trial formulations, and testing genetic susceptibility of birds to acetaminophen (enzyme testing). This project will collaborate with experts from USDA-ARS; the Oak Ridge Institute for Science and Education (ORISE), NWRC Hawai'i; and researchers at Clemson University, South Carolina.

Conservation Benefit

Further development and improvement of artificial bait to replace the standard dead neo-natal (DNM) mouse is an important technological goal. It will reduce overall cost and maintain the same level of impact to BTS populations as the DNM. If the bait component of the aerial bait cartridge can be achieved, cost savings would keep costs lower but potentially increase the amount of landscape that covered by toxicants. Aerial baiting on a landscape scale is an important tool that can support recovery goals for listed species in Guam.

FY21 Status

- COVID restrictions limited USDA-ARS efforts related to scaling bait production.
- To scale capacity and efficiency specialized equipment may be necessary.
- Data collection for genetic susceptibility, invertebrate deterrence, is ongoing.
- Facility is online for lab grade testing.

EPR: No EPR - funded under the Guam Micronesian Kingfisher MOA

2019 JRM INRMP References: TIS-1, TIS-2, TIS-3; 5-85, 6-43; 7-52, 8-50-51, 9-71





Figure 38. (a) Artificial bait packaged for shipping; (b) Artificial bait portion and dead neo-natal mouse (DNM for comparision – weights approximately 5 grams. Photos USDA-NWRC.

Comparing Take of Mice and Artificial Brown Treesnake Baits from Operational Bait Tubes and Extension of Brown Treesnake Threat Reduction Monitoring in the Habitat Management Unit

Location: AAFB **Period of Performance:** SEP2020 – FEB2022

Project Objective

The project will conduct an evaluation incorporating artificial baits with camera verification of species taking baits. Bait tubes will be in current operational locations on AAFB. Alternating dead neo-natal mouse (DNM) baits and artificial bait will be deployed in the same transect. Cost savings will be evaluated by comparing the traditional operational schedule (every 2-3 days) while replacing artificial baits every 14 days. Metrics will be, a) cost per tube per unit time, including costs of bait acquisition, preparation, and deployment; and b) cost per bait consumed by a snake. The project will characterize the level of non-target bait takes for both DNM and artificial baits by identifying species and frequency of take with cameras. The project also supports further camera-based data collection in the HMU post aerial baiting.

Conservation Benefit

Previously funded artificial bait studies have confirmed their attractiveness to BTS and can be produced at a lower cost than purchasing DNM. Past testing has been in controlled environments or in limited field trials. Directly testing bait in an operational setting and with DNM mice as alternative will help provide greater certainty of viability for artificial baits. The operational use of artificial baits has the potential to reduce cost if aerial baiting is scaled-up and support other operational uses of acetaminophen-based toxicant. The use of acetaminophen-based toxicant is an important tool for managing BTS on a landscape scale to support recovery goals for listed species on Guam.

FY21 Status

- Funded via an interagency agreement with USDA-NWRC.
- Potential quality control problem with artificial bait separating after sealed in pouch.
- Artificial baits last longer in the field but appear less attractive.
- DNM changed every 2-3; artificial bait every 14 days or when taken.

EPR: 1 RP JRM Brown Tree Snake Eradication and Control to Support Recovery of ESA-Listed Species; 61128NR202

2019 JRM INRMP Reference: TIS-2, TIS-3; TPS-6, 5-85, 6-43; 7-52, 8-50-51, 9-71, 9-77





Figure 39. (a) Camera set-up for monitoring bait takes on AAFB; (b) BTS investigating artificial bait at night on AAFB. Photos USDA-NWRC

Using Brown Treesnake Behavior and Movement to Refine Control on AAFB & for Improved Management of Native Forest Birds

Location: AAFB **Period of Performance:** SEP2019 – MAR2021

Project Objective

This project seeks to understand movement pathways and habitat preferences of BTS on AAFB with abundant prey present, estimate abundance of BTS in relation to resources important to birds, and conduct known-fate evaluation of BTS susceptibility to control based on size, sex, and food preferences of snakes. This project is one of four projects that, collectively, will further develop information on BTS behaviors related to predation and movement in the presence of abundant avian species.

Conservation Benefit

Better understanding of hotspots of BTS activity, travel pathways, and decision-making during foraging are critical to improve the coverage and efficacy of BTS control in a cost- effective manner Knowledge of BTS movements and behaviors can help determine BTS management strategies for maximizing snake suppression within critical conservation and transportation sites. The anticipated products include recommendations for spatial locations of control arrays to support cost-effective control of BTS on AAFB or in conjunction with future restoration projects.

FY21 Status

- Funded via an interagency agreement with USGS –Fort Collins
- 1172 trees marked and surveyed – Casurina and Ficus species had highest capture per unit effort for BTS.
- 230 BTS captured and tagged, 95 unique recaptures.
- Potential impact of artificial light added to analysis for new PoP.
- Some moderate habitat separation by BTS and Sali.
- Period of performance extended through February 2023.

EPR: No EPR - funded under the Guam Micronesian Kingfisher MOA. Refunded through 1 RP JRM Brown Treesnake Eradication and Control to Support Recovery of ESA-Listed Species; 61128NR202.

2019 JRM INRMP Reference: TIS-2, TIS-3; 5-85, 6-43; 7-52, 8-50-51, 9-71

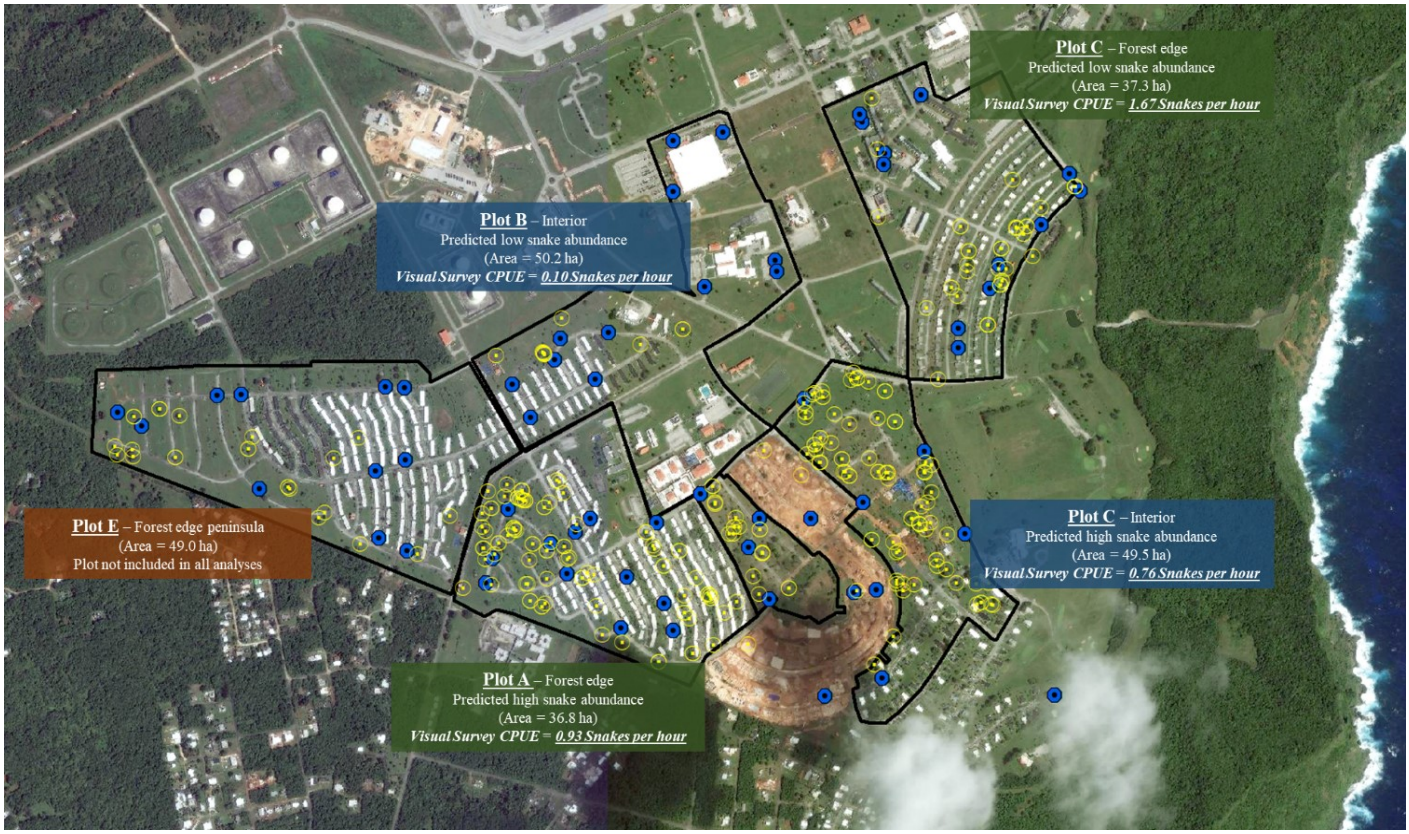


Figure 40. Location of 325 snakes captured during visual surveys (hollow yellow circles) and Såli (Micronesian Starling) nest boxes (filled blue circles). Paired study plots include two forest edge plots (green text boxes; Plot A, predicted high snake abundance; Plot C, predicted low snake density) and two interior plots (blue text boxes; Plot B, predicted high snake abundance; Plot D, predicted low snake density). Catch per unit effort is included at the plot level

Tracking Movement of Micronesian Starlings and Brown Treesnakes on AAFB with an Automated Telemetry Tracking Network

Location: AAFB **Period of Performance:** SEP2019 – MAR2021

Project Objective

The goal of this project is to track the movement of Micronesian starlings (*Aplonis opaca*, Sali) and BTS on AAFB to identify areas of high use and routes of transit through a network automated telemetry towers, and to document areas where BTS and Sali may interact. This project is one of four projects that, collectively, will further develop information on BTS behaviors related to predation and movement in the presence of abundant avian species.

Conservation Benefit

Tracking animals across the landscape over time can provide important information on habitat selection, resource needs, and factors influencing distribution and density. For a predator such as BTS, tracking movement can provide information on hunting patterns, dispersal potential, and identify areas that may be particularly susceptible to predation. Overlapping simultaneous movement from both predators and their prey can help identify areas of greatest contact, which may vary spatially and temporally. Additionally, population demographics that could be useful for supporting future avian restoration projects and controlling BTS in low density with competing food sources in the presence of control regimes.

FY21 Status

- Funded via an interagency agreement with USGS –PIERC
- 85 network nodes arrayed across the landscape, eight base stations collect data
- Good data collection for Sali, problems with tags for BTS
- More data needed to improve analytic software
- Period of performance renewed through July 2022.

EPR: 1 RP JRM Brown Treesnake Eradication and Control to Support Recovery of ESA-Listed Species; 61128NR202

2019 JRM INRMP Reference: TIS-2, TIS-3; TPS-6, 5-85, 6-43; 7-52, 8-50-51, 9-71, 9-77

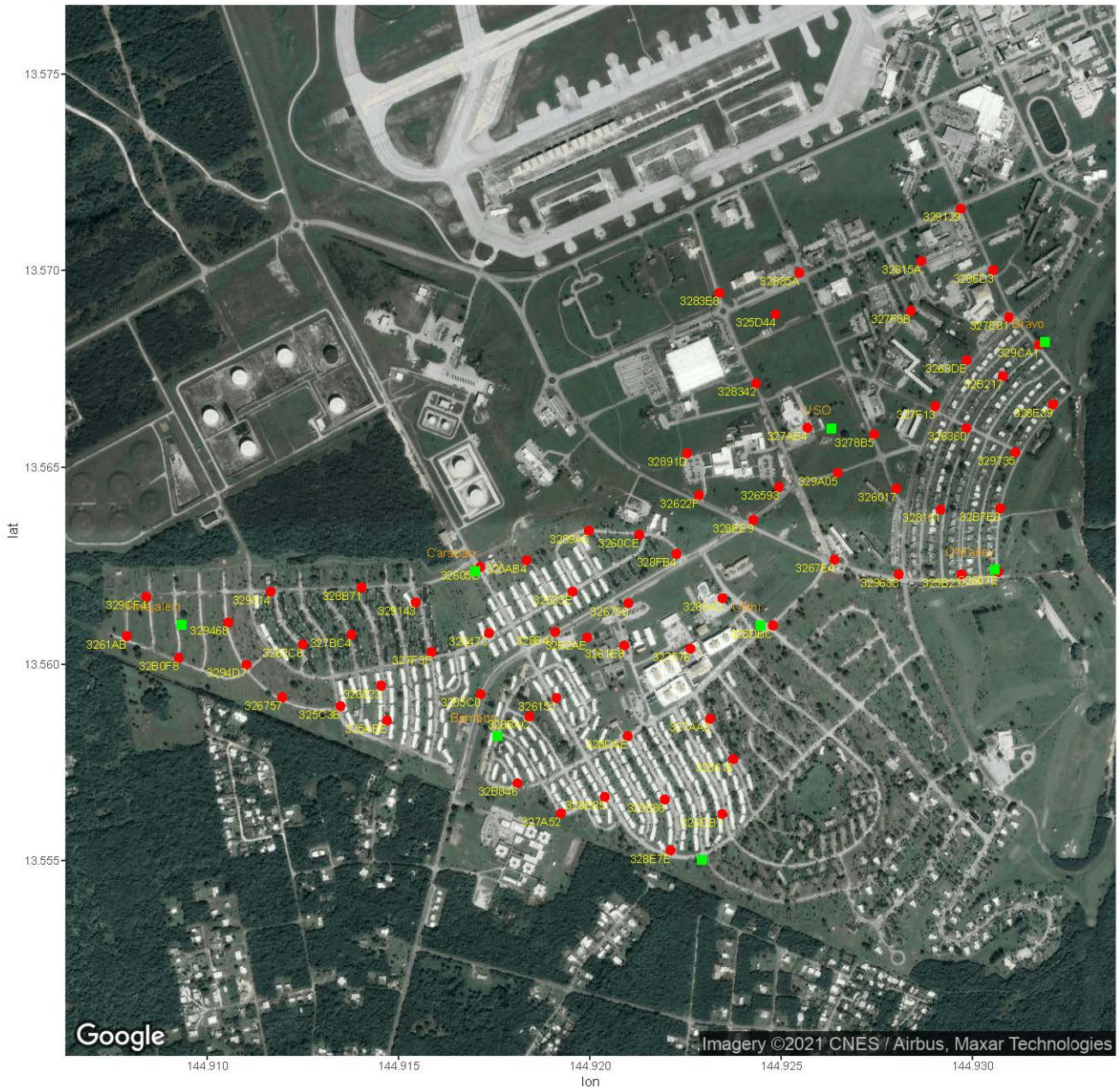


Figure 41. Map of nodes (red dots) and base stations (green squares) on AAFB.

Evaluating and Reducing Brown Treesnake Predation Threat in Urban Micronesian Starling Habitat

Location: AAFB **Period of Performance:** SEP2019 – MAR2021

Project Objective

This project will evaluate BTS control tools for suitability and efficacy in urban habitat, and use camera monitoring to index the decrease in Micronesian starling (*Aplonis opaca*, Sali) predation threat following snake removal. BTS suppression will occur in experimental high and low snake density plots and monitor the relative abundance of BTS via contact rates with baited camera devices. This project is one of four projects that, collectively, will further develop information on BTS behaviors related to predation and movement in the presence of abundant avian species.

Conservation Benefit

Studies have indicated that snakes in the AAFB housing area have a detrimental impact on Micronesian Starling survival in all age classes. Snakes in urban areas also constitute a greater risk for accidental export of live snakes to other vulnerable regions because of routine shipments of household. Additionally, research has shown that very large snakes, which pose the greatest predation and reproduction risk, are more often found in urban areas. Contact rates can be interpreted as an index of relative abundance and as a proxy for the residual level of predation threat posed by BTS in snake-suppressed areas. Traditional tools for estimating BTS density and relative abundance are costly and impractical for long-term and broad-scale monitoring (e.g., mark-recapture) or provide no information on the snake (e.g., DNM bait tubes).

FY21 Status

- Funded via an interagency agreement with USDA –NWRC.
- Phase I: Non-toxic bait deployment.
- 482 baits with radio transmitters deployed: 20 baits taken by BTS (4.1%).

- Phase II: Toxic bait deployed in high/low BTS density areas and concentrations of Sali nest boxes.
- 16,000 deployed, 289 (1.68%) baits taken by BTS.
- Indications that acetaminophen is safely deployable in urban areas.
- Period of performance renewed through February 2023.

EPR: 1 RP JRM Brown Tree Snake Eradication and Control to Support Recovery of ESA-Listed Species; 61128NR202

2019 JRM INRMP Reference: TIS-2, TIS-3; TPS-6, 5-85, 6-43; 7-52, 8-50-51, 9-71, 9-77

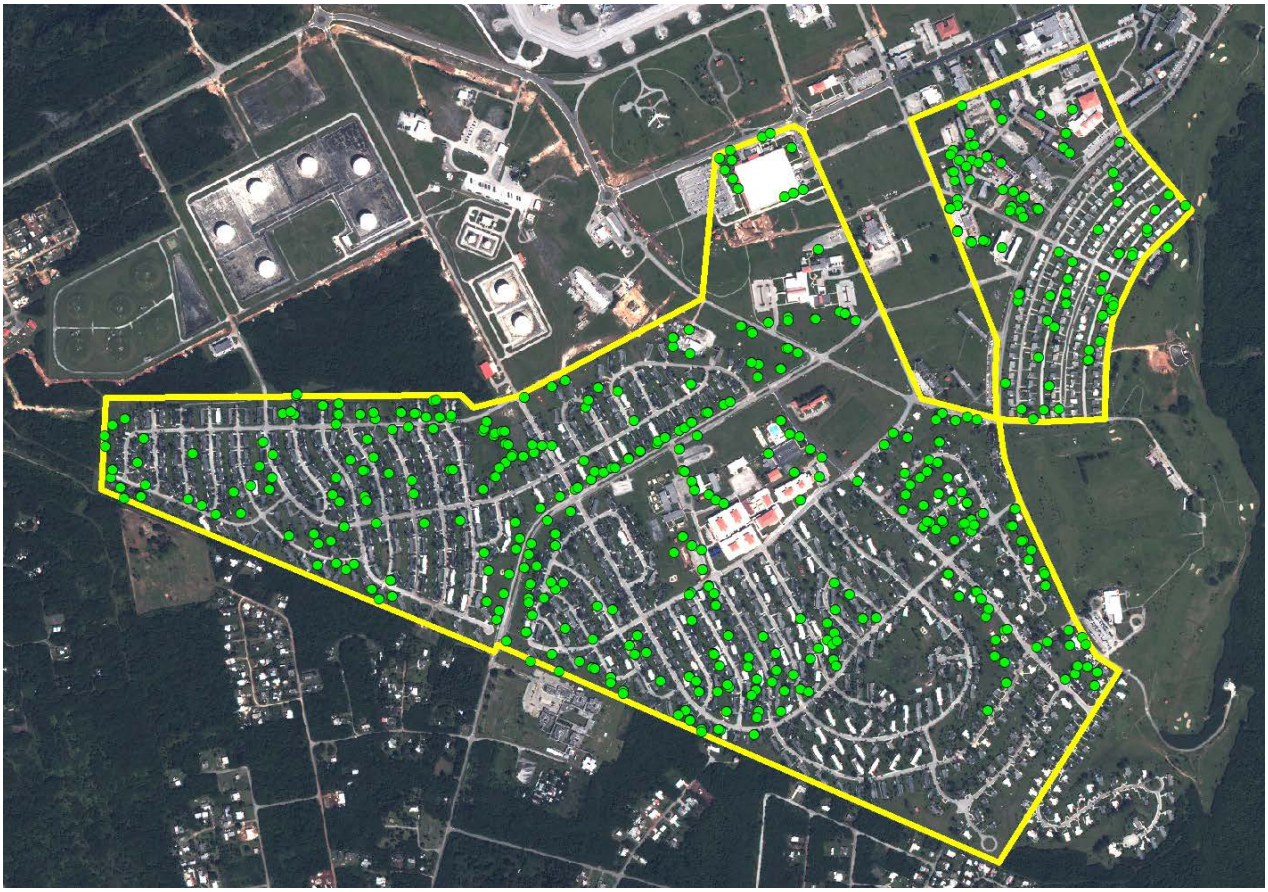


Figure 42: The yellow polygon describes the extent of the study area on AAFB, comprising residential areas and associated structures (barracks, schools, commissary, etc.). Green points indicate locations of baits offered.

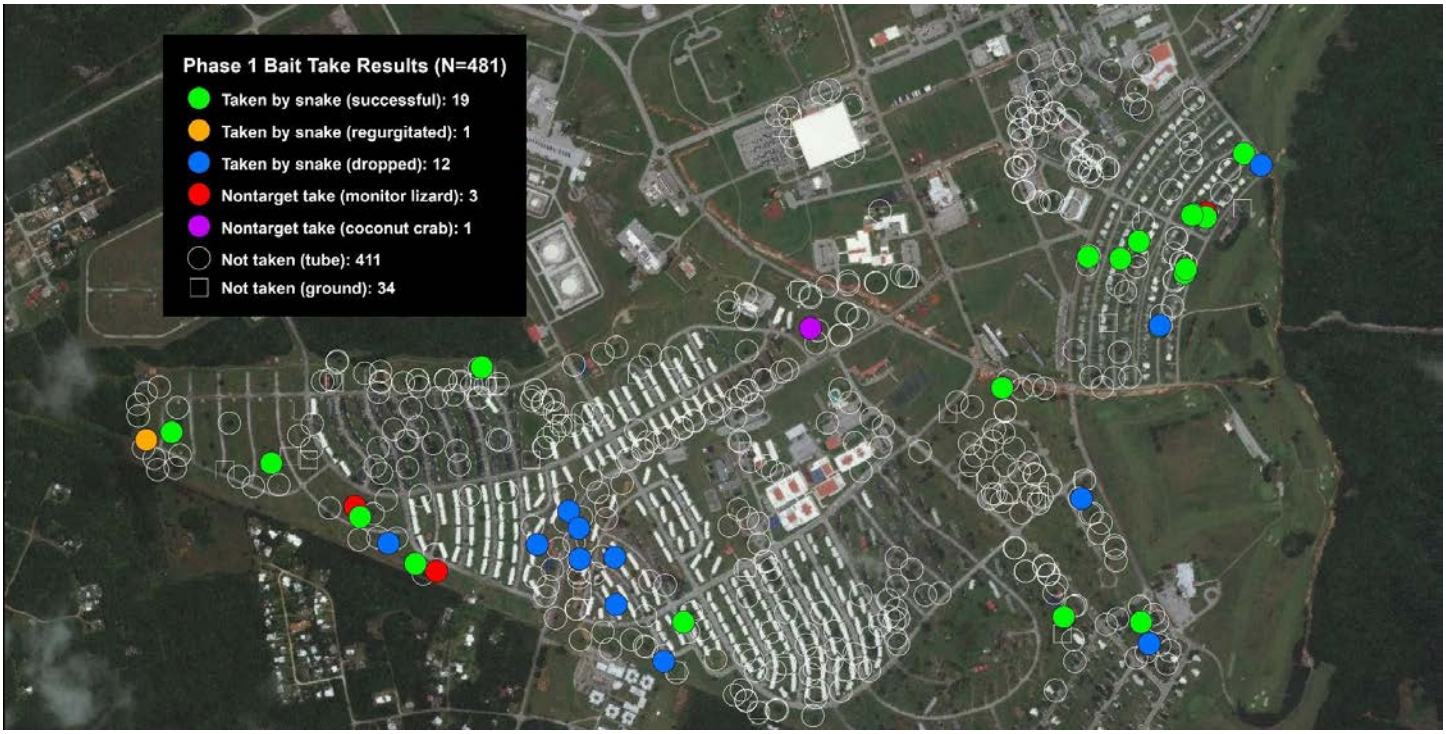


Figure 43: Locations of all bait deployments and bait takes. One of the 482 baits offered was tampered with by a feral cat and is not depicted here.

Replacement and repair of the USGS Closed Population Mesh to Maintain Viability as a Study Site for Brown Treesnake Management

Location: AAFB **Period of Performance:** JUL2020 – DEC2021

Project Objective

The goal of this project is to replace the mesh on the USGS Closed Population unit on AAFB. The mesh has decayed beyond the point where patching and painting can sustain the integrity of the barrier. This increases the risk of BTS movement through the barrier both ways and thus, impacting ongoing data collection. The project will replace the entire outer mesh material, as well as use and anti-rust coating for the mesh and internal chain-link fence.

Conservation Benefit

The USGS Closed Population facility was constructed in 2004 and functions as a study site to improve understanding of the effects of ungulate exclusion, BTS control tool efficacy, BTS behavior under controlled condition, and numerous other studies that have helped refine implementation of management programs for BTS. The loss of the Closed Population as an operational site would eliminate the only study plot that is large enough to replicate approximate conditions for understanding landscape-level condition but small enough to conduct projects under controllable conditions and enumerate the BTS population. Such long-term project management and data collection allows for in depth understanding of the effects of BTS control tools and methods.

FY21 Status

- Funded via an interagency agreement with USGS –FORT.
- Primarily will replace the mesh and coat with anti-rust treatment.
- Contract awarded for fence refurbishment starting September 2021.
- Anticipated completion December 2021.

EPR: No EPR - funded under the Guam Micronesian Kingfisher MOA.

2019 JRM INRMP Reference: TIS-2, TIS-3; TPS-6, 5-85, 6-43; 7-52, 8-50-51, 9-71



Figure 44. Rust and corrosion on Closed Population 2-way BTS barrier, Northwest Field, AAFB. Photo. USGS Fort Collins.

Optimized Monitoring for Brown Treesnakes

Location: Washington State/Guam **Period of Performance:** APR2020 – OCT2021

Project Objective

This project will simulate the movement of snake populations under various ecological conditions and the interactions based on available data from previous USGS-FORT studies. The project will develop a simulation and analytical framework that will analyze detection data from different monitoring strategies; evaluate the resulting estimates of monitoring metrics; and plot efficiency against cost, with cost data developed from a cost model informed by estimated labor and materials costs associated with BTS monitoring programs. The project will also gather data from a controlled-environment study looking at PIT tag readers as a means for identifying known snakes (PIT tagged) pre- and post-aerial baiting as a means for monitoring.

Conservation Benefit

Developing improved, refined monitoring methods is an important goal to help increase confidence in outcomes for landscape-scale management for BTS. Monitoring goals might include determining the density of BTS, the presence of BTS, or identification of characteristics of individuals that have evaded ongoing management effort. The ability to monitor suppressed BTS populations will be critical in determining success for reintroduction of avian populations. Low-cost monitoring or robust population models can reduce costs and improve outcomes for propose reintroduction programs.

FY21 Status

- Funded via an interagency agreement with USGS-CRU.
- Testing of modified PIT tag reader conducted at USGS-FORT, Potts Junction.
- Analysis of data is ongoing with some emphasis on standardizing the data and analytical parameters e.g., time, size class.

EPR: 1 RP JRM Brown Treesnake Eradication and Control to Support Recovery of ESA-Listed Species; 61128NR202

2019 JRM INRMP Reference: TIS-2, TIS-3; TPS-6, 5-85, 6-43; 7-52, 8-50-51, 9-71, 9-77

Figure 45. (a) Front view of proto-type PIT Tag reader; (b) at angle view of PIT Tag reader.

Trial Restoration and Probabilistic Evaluation of Vertebrate Reintroduction Techniques Using Species Traits in a Barrier Undergoing a Brown Treesnake Eradication

Location: AAFB **Period of Performance:** SEP2020 – FEB2022

Project Objective

The project seeks to develop a conceptual demographic model for reintroduction strategies. Using three unlisted native lizard species *Nactus pelagicus* (Pacific slender-toed gecko), *Perochirus ateles* (Micronesian saw-tailed gecko), *Gehyra oceanica* (Oceania gecko) the objective sis develop a predictive response model to BTS predation based on species traits e.g., reproduction, habitat preference, behaviors, sensitivity to predation, etc. Once a model is built, a release strategy will be developed for hard and soft releases in plots controlled and uncontrolled for BTS. Success to be defined under the following two criteria: evidence of reproduction (juvenile lizards detected) and persistence of the species > 6 months following release.

Conservation Benefit

For reintroductions to occur, managers on Guam will need to understand if species 1) require snake eradication to establish or what level of suppression is required for establishment to occur; and 2) snake abundance thresholds that support persistence of prey species. Some of these metrics are likely to be dependent on the desirability of the species as a prey item and therefore their sensitivity to snake abundance. The use of native lizards presents a relatively safe species to study and inform decisions. In a system with numerous unknowns, their benefits include only small areas to establish populations, are not a federally listed species, have species with high variation in sensitivity to BTS predation, and furthermore may be used as a monitoring metric/tool to evaluate BTS suppression actions and inform reintroduction goals.

FY21 Status

- Funded via an interagency agreement with USGS – Fort Collins.
- Start delayed by COVID.
- Gecko demographic modeling in progress.
- Gecko release into Closed Population and control site expected Sept-Nov 2021.
- No substantive data to report at this time.

EPR: 1 RP JRM Brown Treesnake Eradication and Control to Support Recovery of ESA-Listed Species; 61128NR202

2019 JRM INRMP Reference: TIS-2, TIS-3; 5-85, 6-43; 7-52, 8-50-51, 9-71



Figure 46. *Nactus pelagicus* found on Habitat Management Unit fence, AAFB. Photo U.S. Navy, Guam

Developing a Framework for Coordinated Management of Vertebrate Restoration and Brown Treesnake Control on Guam

Location: JRM **Period of Performance:** SEP2019 – MAR2021

Project Objective

This project consisted of developing a decision-analytic framework to guide coordinated BTS control and vertebrate species restoration in Guam. The project brought together a group of subject matter experts to collaborate in building a decision model. The group were from management agencies, regulators, stakeholders, and scientific experts and used a workshop model to together for the purpose of framework development.

Conservation Benefit

This is an indirect way towards operational management decisions through a decision analysis process to engage in a more robust planning phase. This can include prioritization, management application, problem solving, evaluate specific action, and collaboration to manage long-term, costly complex conservation problems. The process should help reduce real-time problems and provide a more structured approach to addressing conservation challenges.

FY21 Status

- Funded via an interagency agreement with USGS – CRU: Washington University Extension.
- Group members from DoN; CNMI DLNR; USFWS; USGS; UoG; DAWR; The Nature Conservancy; Massey University, New Zealand
- Project complete, final report pending – September 2021
- Phase II funded to focus on specific sites and species.
- New Period of Performance September 2021 – March 2023

EPR: 1 RP JRM Brown Tree Snake Eradication and Control to Support Recovery of ESA-Listed Species; 61128NR202

2019 JRM INRMP Reference: TIS-3; 9-72

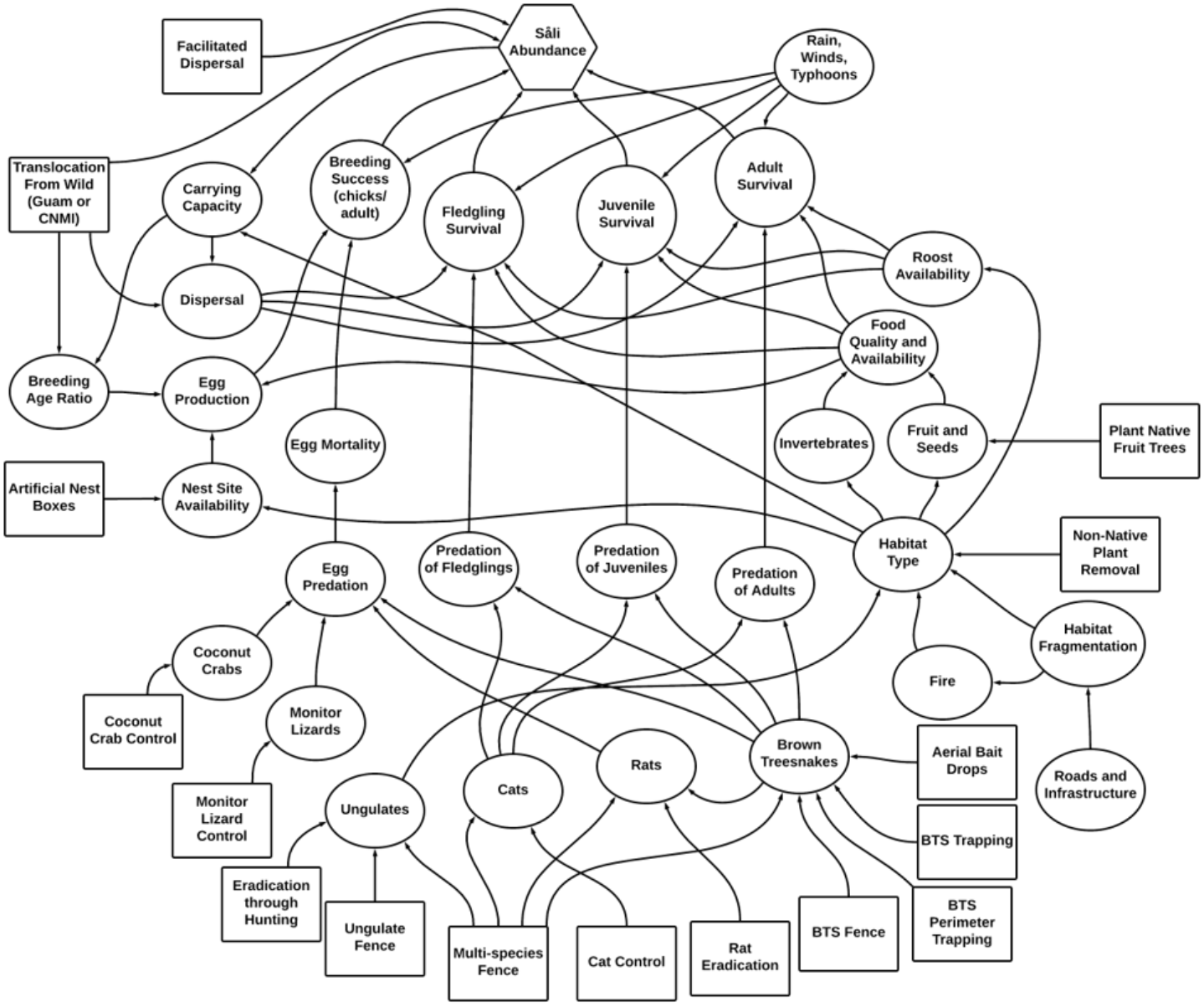


Figure 47. Influence diagram demonstrating the pathways to consider for restoration planning. Diagram USGS-CRU.

Estimation of Brown Treesnake Predation Threat Thresholds for Persistence of Reintroduced Birds on Guam

Location: AAFB **Period of Performance**: SEP2019 – MAR2021

Project Objective

To evaluate the levels of snake suppression that might enable persistence of reintroduced birds under some acceptable level of BTS predation. It is unknown what snake density is tolerable when considering the reintroduction of avian species. The project will simulate nest contact rates with cameras and model the levels of nestling mortality that can be sustained while maintaining a stable or growing population of birds.

Conservation Benefit

It is widely recognized that eradication of BTS from Guam is not currently achievable; however, severe suppression is viewed favorably. Through considering avian species persistence in the presence of a suppressed BTS population it may help facilitate reintroductions in areas where management can be sustained and supported allowing for limited recovery of extirpated species.

FY21 Status

- Funded via an interagency agreement with USDA –NWRC
- All bird species would recover without BTS present; potentially up to 10 years to reach stability.
- All bird species recovery vulnerable to BTS presence at differing level, favoring larger birds; no other limiting factors considered.
- Significant initial suppression with long-term active management required.
- Project complete.

EPR: No EPR - funded under the Guam Micronesian Kingfisher MOA.

2019 JRM INRMP Reference: TIS-2, TIS-3; 5-85, 6-43; 7-52, 8-50-51, 9-71

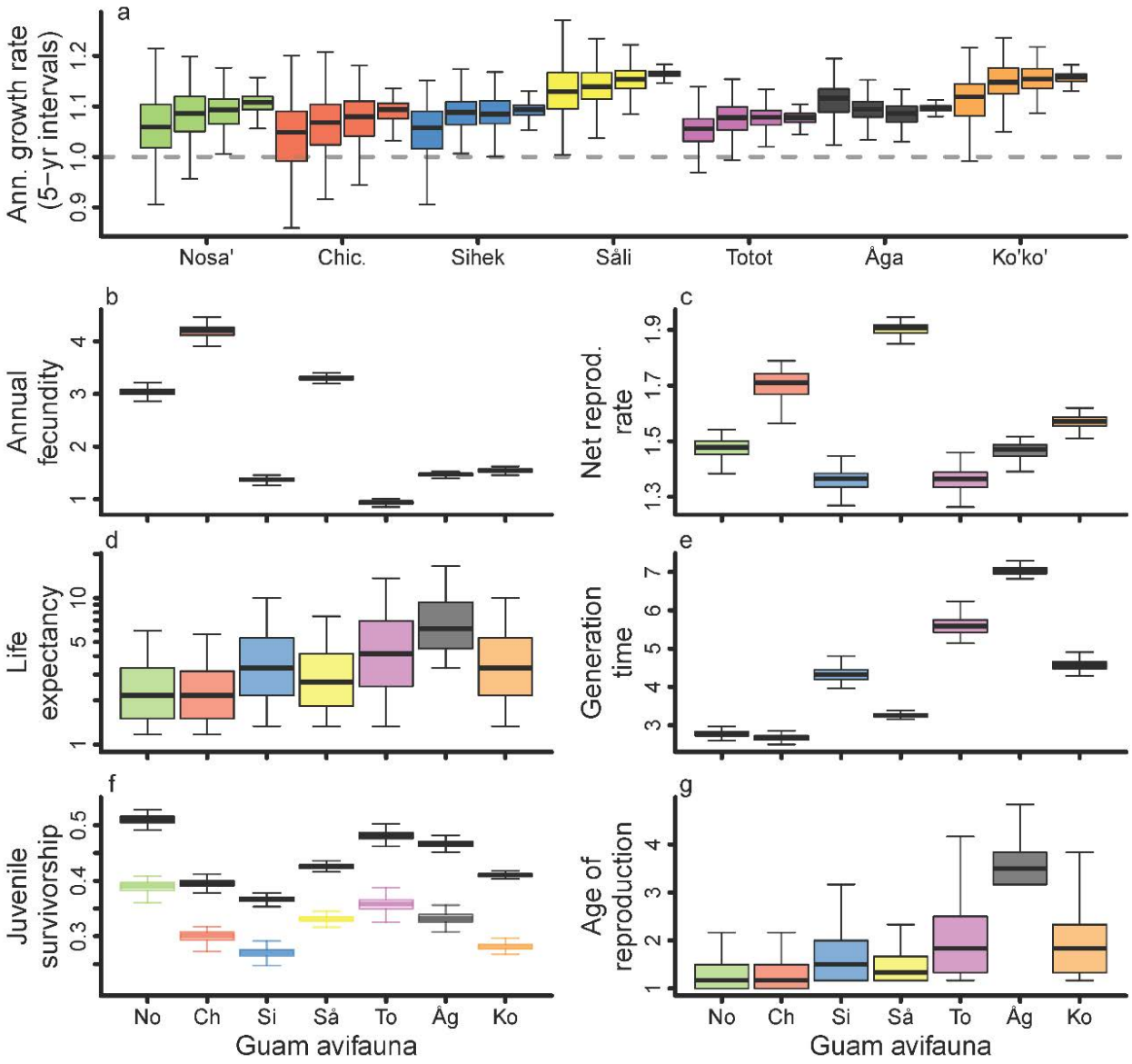


Figure 48. Comparison of demographics and life history among Guam avifauna (No = Nosa', Ch = Chichirika, Si = Sihek, Så = Såli, To = Totot, Åg = Åga, Ko = Ko'ko'). Boxplots display the quantiles and range of output from 200 simulated populations. (a) Annual growth rate was calculated in four consecutive five-year intervals (e.g., 0-5, 6-10 years). (b) Annual fertility (number of young fledged per year), (c) net reproductive rate, (d) life expectancy (in years), (e) generation time (in years), (f) survival probability to adulthood (black outline) shown together with survival probability to first reproduction (color-coded outline), and (g) age of first reproduction (in years).

Feral Dog and Cat Control and Management on NBG and NMS

Location: NBG **Period of performance:** SEP2020 – SEP2021

Project Objectives

- Commence live trapping of target feral animals (roadside)
- Develop efficiencies of trapping activities

Conservation benefit

Control of invasive species includes wild, free-roaming or feral animals (dogs and cats) that directly or indirectly impact native species or their habitats

FY21 Status

In FY19, trail camera studies were conducted to determine population of feral dogs and cats on NBG and NMS, determining population estimates. An Implementation Plan for Feral Dog and Cat Control on NBG Lands was completed in 2020. USDA-WS began conducting control operations in fall 2020 within Zones established during population studies (trail camera studies) completed in 2019. A total of four (4) trapping sessions were completed, with each trapping session having 280 trap nights (20 traps over 14 nights). A total of nine (9) feral dogs and five (5) feral cats were removed from the NMS during FY21 control operations (Figure 49). Open property boundaries allow continuous immigration of dogs and cats, however. Future efforts will focus on wetland habitats occupied by the Mariana common moorhen, to quantify and reduce potential stressors of the sensitive resource.

EPR: 61755NR358

2019 JRM INRMP Reference: TIS-2, TIS-3; 5-85, 6-43; 7-52, 8-50-51, 9-71

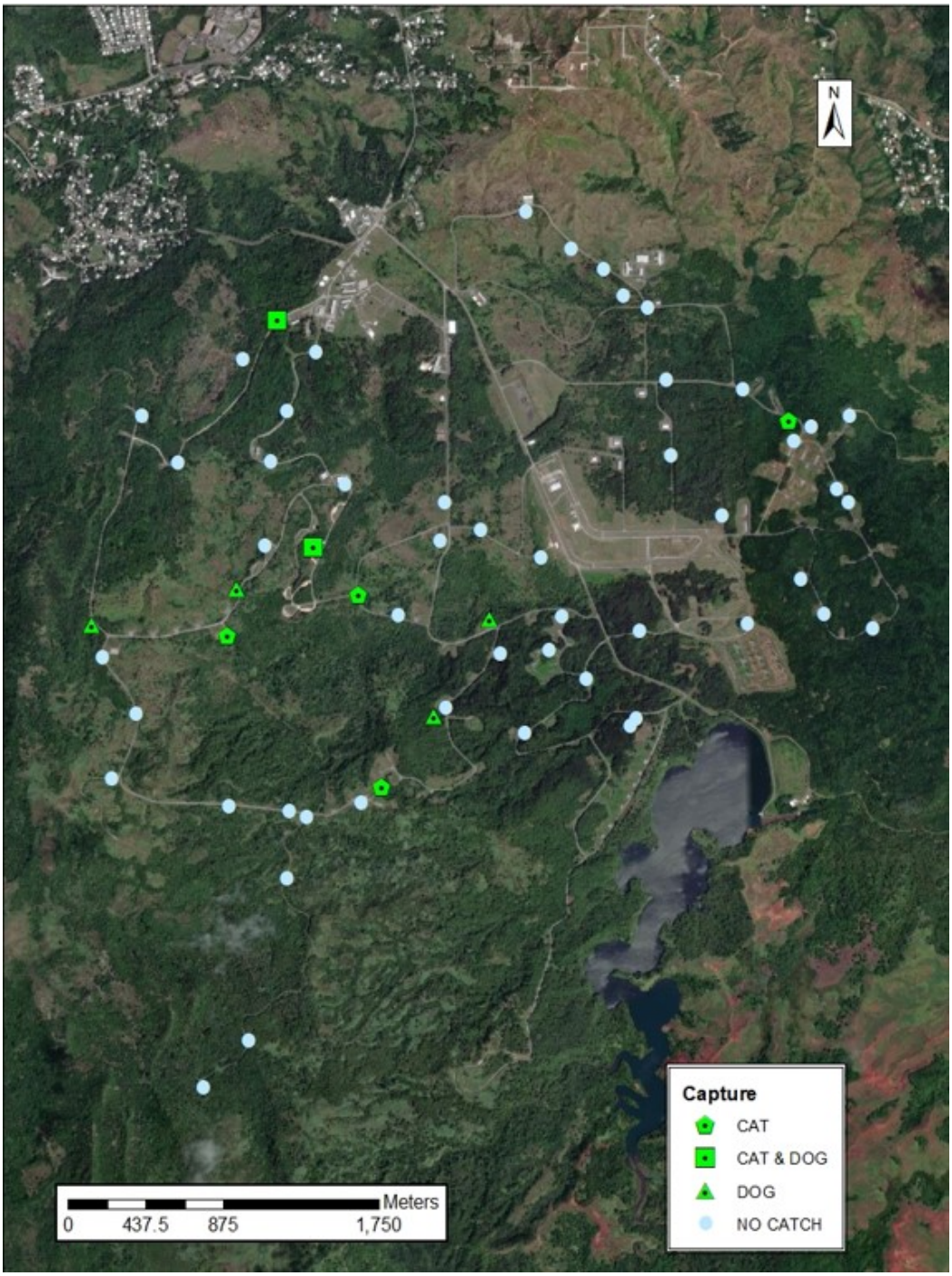


Figure 49. Locations of feral dog and cat removal on NMS.

Ungulate Management Population Control on NBG-Administered Lands

Location: NBG **Period of performance:** July 2021- December 2023

Project Objectives

- Following installation of ungulate fencing on NMS, work to eradicate ungulates within enclosures
- Conduct population control in at-large NBG-administered lands
- Sterilize Water buffalo (*Bubalus bubalis*, Carabao) on NMS to limit breeding

Conservation benefit

Enhance and restore native habitats and increase populations of native species, particularly threatened and endangered species.

FY21 Status

The main goals of the ungulate management program are control, eradication and research related to feral pigs (Figure 42), Philippian deer and/or caribou on JRM AOR. Ungulates are controlled in unfenced areas and eradicated within fenced enclosures (no immigration). Additionally, carabou population control consists of sterilization of the male breeding population. Prior to 2018, periodic feral pig control operations were conducted by USDA-WS on NBG Main Base. In 2018, services were then contracted with White Buffalo Inc. (WBI) for NBG Main Base control and NMS ungulate fence #1 eradication. Construction of conservation fence #2 was not yet complete when WBI de-mobilized. In FY21, WBI was again contracted for a period of 18 months. Tasks include eradication in NMS fence #2 and fence #3 and #4 (construction not complete), additional control work on NBG Main Base, Polaris Point, as well as contracted services on AAFB.

EPR: 61755NR807

2019 JRM INRMP Reference: TIS-2, TIS-3; 5-85, 6-43; 7-52, 8-50-51, 9-71

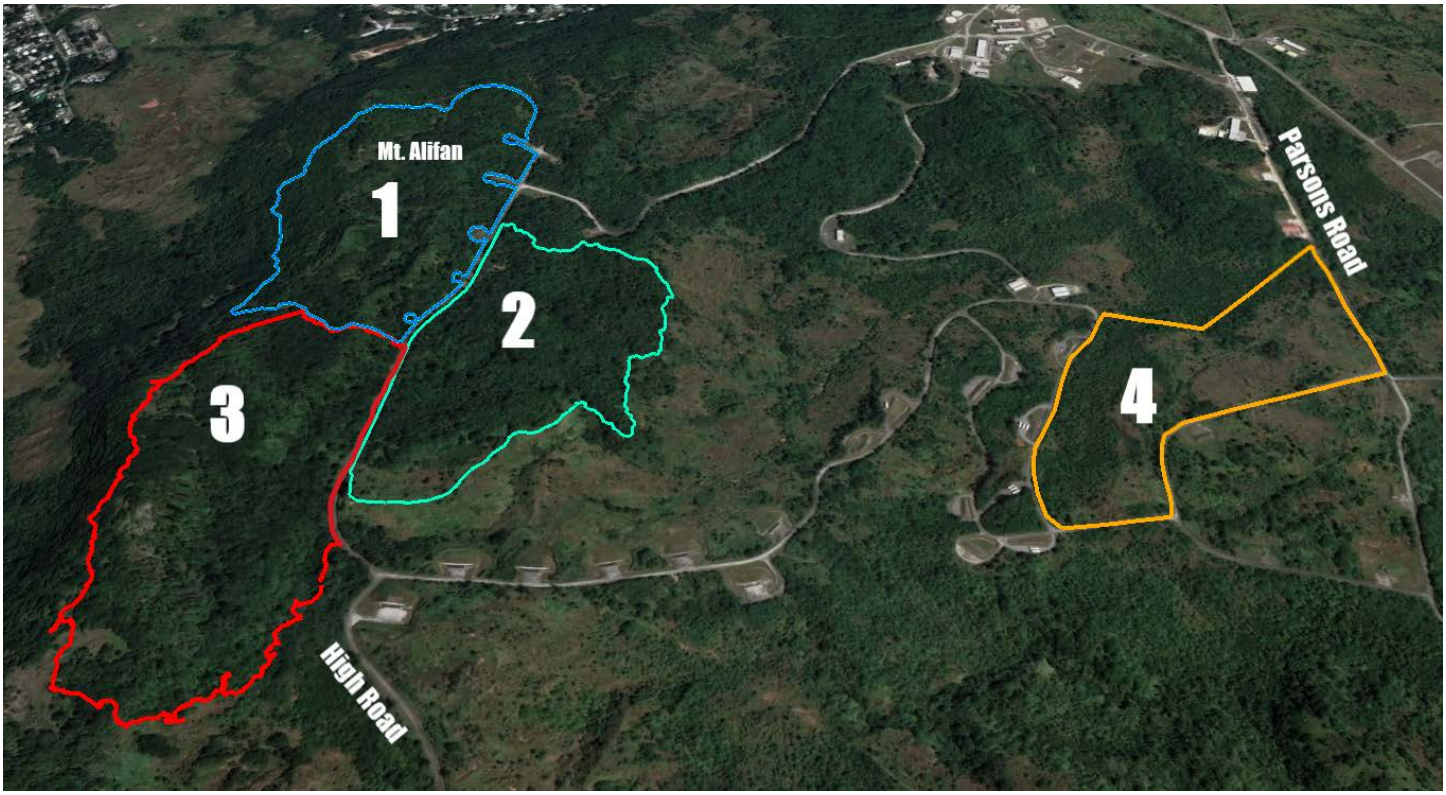


Figure 50. Ungulate fence areas on NMS.

AAFB Invasive Plant Species Monitoring and Control

Location: AAFB **Period of Performance:**

Project Objective

Conduct surveys to document the spread of invasive plant species.

Conservation Benefit

Knowledge of which invasive species are dominant and most likely to spread further.

FY21 Status

- Resampling of 517 plots previously sampled in 2018.
- Plots are circular and 100 square meters in size.
- All trees with DBH >2cm, identified to species and measured for DBH. Trees <2cm identified to species, not measured for DBH.
- All herbaceous species identified.
- Species composition, density, and non-native to native percentages will be documented.
- Fieldwork complete and analyses is presently being performed.



Figure 51. Location of Vegetation Plots

Monitoring to Evaluate Effectiveness of HACCP Plan Implementation at Construction Sites

Location: AAFB, NBG, NBGTS, AAFB NWF **Period of Performance:** Multiple

Project Objective

- Long-term monitoring program for terrestrial vegetation to aid in evaluating the success of implemented HACCP plans.

Conservation Benefit

To minimize the spread and effects of invasive plant species due to construction activities.

FY21 Status

Ongoing previous FY contract awards for construction activities:

- J-755 Urban Combat Training
- P-103 Water Well Field
- P-295 Ordnance Ops
- P-715 Live-Fire Training Range Complex Known Distance Ranges
- P-735 Multi-Purpose Machine Gun Range

Newly awarded

- P-296 Ordnance Ops Admin Facility
- P-290 Earth Covered Magazines (MSA)
- P-103 Water Well Field (modification)

Completed previous FY contract awards for construction activities:

- J-001B Finegayan Utilities and Site Improvements Phase 1
- J-006 Apra Medical Clinic
- J-007 Waterfront Headquarters
- P-102 Power Upgrade Harmon

Results

- No new species recorded in Guam as a result of on-going construction activities

EPR: DPRI: Marine Corps Relocation 2017 amendment to 2015 BO, Conservation Measures to Minimize the Effects of Invasive Species.

NATURAL RESOURCES EDUCATION AND OUTREACH

Outreach and Education – NBG

Location: NBG **Period of Performance:** AUG2021 - AUG2022

Objectives

Develop, design, and produce custom outreach materials for use by Public Works EV and NBG to educate incoming military personnel, their families, and civilian employees on the importance of conserving and protecting natural resources on NBG and their role in acting appropriately to conserve threatened and endangered species. Outreach can be in the form of educational signs in sensitive areas, educational handouts such as brochures or calendars, and outreach events.

Conservation Benefit

Educational material provides military and civilian personnel and base visitors the ability to understand their role in protecting Guam resources. When NBG personnel are aware of sensitive resources, it not only protects those resources, but it also improves relationships among communities on and off base.

FY21 Status

For the past year, all NBG outreach activities have been organized in-house. This past fiscal year, NBG hosted the release of Shelly the sea turtle at GabGab beach (Figure 52 - 53), where she had been found and rescued in December 2019. Shelly was rescued by the Guam department of Agriculture and with the help of Underwater World she was brought back to full health. Shelly's release back into her home was attended by a group of military personnel who kept their distance to minimize stress to the turtle. Attendees learned about sea turtle rescue, rehabilitation and being proactive if they see

turtles in stress. The experience will promote interest in sea turtles amongst the young people present.

NBG also hosted a beach cleanup at Spanish Steps (Figure 54 - 55), which is the most active beach on NBG for sea turtle nesting during the nesting season. Due to the sensitivity of the location, participation was limited to Internal Navy Natural Resources personnel. The purpose of the cleanup was to maintain the beach and ensure that the movement of future hatchling turtles to Apra Harbor was not impeded by trash. The event was held in May 2021, during daylight hours when turtles are not actively laying eggs. All activity was limited to the beach area, and all participants were instructed to avoid going into the vegetation where turtle nests were potentially located. The result of the cleanup was the removal of 25 bags of trash.

A new outreach contract was awarded for the 2021 to 2022 fiscal year. The project is still in the planning phase. Once complete the outcome will be a new informational tide calendar for public distribution, and five (5) educational signs. The signs will cover; the Ecological Reserve Area, the purpose of the reserve area along with regulations and behavioral rules, and the locations of the reserve areas; Rip current safety for general awareness; Fishing regulations on NBG; Coconut Crab information and protection on Navy property.

EPR: Listed Species Outreach Material; 61755NR306

2019 JRM INRMP Reference: TEDU-1; 5-91, MEDU-1; 5-104





Figure 52 - 53. Release event of Shelly the Turtle





Figure 54 - 55. Spanish Steps Beach Cleanup

Biosecurity Outreach and Education on Guam

Location: Various locations **Period of Performance:** SEPT 2020-SEPT 2021

Project Objective

The DON has initiated and will continue to implement a targeted, comprehensive outreach and education program for DoD and civilian populations for biosecurity focused on prevention.

Conservation Benefit

Minimize the effects of invasive species by educating DoD and civilian populations through prevention. Provide awareness of introduced and invasive species, the impacts of invasive species on native species and ecosystems, and what can be done to prevent and control invasive species.

FY21 Status

- FY20 Biosecurity outreach and education contract was awarded on 20 September 2020
- DON worked with Department of Agriculture Biosecurity division to link their homepage with social media ads
- Completed views exceeded the requirements of the PWS, except for the 30-second view requirements
- Social media efforts included Google ads in addition to YouTube, Facebook and Instagram
- FY21 Biosecurity Outreach and Education on Guam contract scheduled award date 15 September 2021
- DON to continue collaborating with Department of Agriculture Biosecurity division
- Project to incorporate recommendations obtained from FY20 Final Report in an effort increase overall reach and effectiveness.

- Placement of ads to run on a 24-hour cycle for 7-days a week rather than only during certain timeframes.
- Increase in view requirements for the 15-second ads and decrease in view requirements for the 30-second ads.

EPR: DPRI: Marine Corps Relocation 2017/2018 amendment to 2015 BO, Conservation Measures to Minimize the Effects of Invasive Species.

2019 JRM INRMP Reference: TEDU-1; 5-91, MEDU-1; 5-104

Table 1. Total ad views for the Biosecurity Outreach and Education on Guam.

VIEWING TIME	TARGET FOR FY21 CAMPAIGN	TOTAL FIRST VIEWING PERIOD	PERCENT OF CAMPAIGN TARGET
30 SECONDS	425,000	1,559	.36%
15 SECONDS	525,000	76,679	14%
VIEWING TIME	**TARGET FOR FY21 CAMPAIGN**	**TOTAL SECOND VIEWING PERIOD**	**PERCENT OF CAMPAIGN TARGET**
30 SECONDS	425,000	134,235*	32%
15 SECONDS	525,000	339,991*	65%
VIEWING TIME	**TARGET FOR FY21 CAMPAIGN**	**TOTAL THIRD VIEWING PERIOD**	**PERCENT OF CAMPAIGN TARGET**
30 SECONDS	425,000	231,917	55%
15 SECONDS	525,000	143,542	27%
VIEWING TIME	**TARGET FOR FY21 CAMPAIGN**	**TOTAL CAMPAIGN**	**PERCENT OF CAMPAIGN TARGET**
30 SECONDS	425,000	367,711	87%
15 SECONDS	525,000	560,212	107%

JRM Natural Resources Stewardship Outreach & Public Engagement Program

Location: JRM AOR **Period of Performance**: AUG2020 - AUG2021

Project Objective

To develop materials and training enabling JRM Natural Resource (NR) managers to effectively and efficiently implement a NR stewardship engagement program. This program aims to better educate uniformed and civilian staff, their dependents, JRM contractors, and the general public in order to improve NR stewardship and awareness within the AOR. The AOR includes DoD lands within Guam and the CNMI.

Conservation Benefit

The 2019 INRMP outlines JRM NR responsibility to reach as many uniformed and civilian staff, their dependents, and JRM contractors with focused, consumable environmental education and outreach. The development and production of NR education materials and training is a beneficial support to increasing awareness of T&E species, proper stewardship behavior, and threats to local ecosystems.

FY21 Results

- Swag materials produced
- Planned dissemination of swag materials throughout JRM AOR by DEC 2021
- Training and Outreach presentations created and delivered
- Project finalized AUG 2021

2019 JRM INRMP Reference: TEDU-1; 5-91, MEDU-1; 5-104

PACFLT Funded JRM Natural Resources Stewardship Outreach & Public Engagement Program

Location: JRM **Period of Performance:** SEP2020 - OCT2021

Project Objective

Improve NR stewardship and awareness within DoD lands within Guam and the CNMI

FY21 Results

- Planned expansion of outreach to CNMI
- Development of Stewards of the Sea branded sustainable products
- Continued implementation of Young Environmental Stewards (YES!) youth educational program
- Art contest for YES! logo
- Rash guards and stickers for YES! participants produced with logos from art contest

EPR: NA

2019 JRM INRMP Reference: TEDU-1; 5-91, MEDU-1; 5-104

MIGRATORY BIRD MANAGEMENT

Migratory Bird Surveys on NBG-Administered Lands

Location: NBG **Period of performance:** AUG2020- JUL2021; ongoing

Objectives

Conduct monthly bird surveys on NBG-administered lands

Examine trends in abundance and habitat preference of migratory birds

Conservation benefit

To improve long-term understanding of species protected by the MBTA and their preferred habitats and migratory patterns, in support of military readiness, and to avoid and minimize impacts to migratory birds.

FY21 Status

Migratory bird abundance was monitored at 20 sites on NBG between August 2020 and July 2021, for a total of 265 in-house surveys. Twice monthly surveys are conducted from September through April; single surveys are conducted May-August. A total of 23 unique species were recorded from a total of eight (8) families (Table 2). Plovers, sandpipers and snipes accounted for 79% of all migratory birds observed. Pacific golden plovers *(Pluvialis fulva)* were the most abundant (49%). Abundance was higher October- April compared to May- September (Figure 56). Migrants used grass fields and paved surfaces more often than shoreline or wetland habitats; however, habitat use varied among species. Navy plans to continue conducting migratory bird surveys on NBG.

EPR: 1 S MAR NBG Endangered Species Monitoring; 61755NR142

2019 JRM INRMP Reference: MIG-1; 12-35

Table 2. FY21 Migratory Bird Species recorded on NBG.

Order	Family	Descriptor	Common Name	Scientific name
ANSERIFORMES	ANATIDAE	Ducks, Geese and Swans		
			Pintail	*Anas acuta*
			Tufted Duck	*Aythya fuligula*
GRUIFORMES	RALLIDAE	Rails		
			Mariana common moorhen	*Gallinula chloropus guami*
CHARADRIIFORMES	CHARADRIIDAE	Plovers		
			Black-bellied Plover	*Pluvialis squatarola*
			Pacific Golden Plover	*Pluvialis fulva*
	SCOLOPACIDAE	Sandpipers and Snipes		
			Bristle-thighed Curlew	*Numenius tahitiensis*
			Whimbrel	*Numenius phaeopus*
			Long-billed Curlew	*Numenius americanus*
			Grey Tailed Tattler	*Tringa brevipes*
			Ruddy Turnstone	*Arenaria interpres*
			Common Sandpiper	*Actitis hypoleucos*
			Wandering Tattler	*Tringa incana*
	LARIDAE	Gulls and Terns		
			Black Headed Gull	*Chroicocephalus ridibundus*
			Brown Noddy	*Anous stolidus*
			White Tern	*Gygis alba*
			Black Napped Tern	*Sterna sumatrana*
			Common tern	*Sterna hirundo*
SULIFORMES	FREGATIDAE	Frigatebirds		
			Great Frigatebird	*Fregata minor*
	SULIDAE	Gannets and Boobies		
			Brown Booby	*Sula leucogaster*
			Red-footed Booby	*Sula sula*
PELECANIFORMES	ARDEIDAE	Herons, Egrets and Bitterns		
			Great Egret	*Ardea alba*
			Pacific Reef Heron	*Egretta sacra*
			Cattle Egret	*Bubulcus ibis*

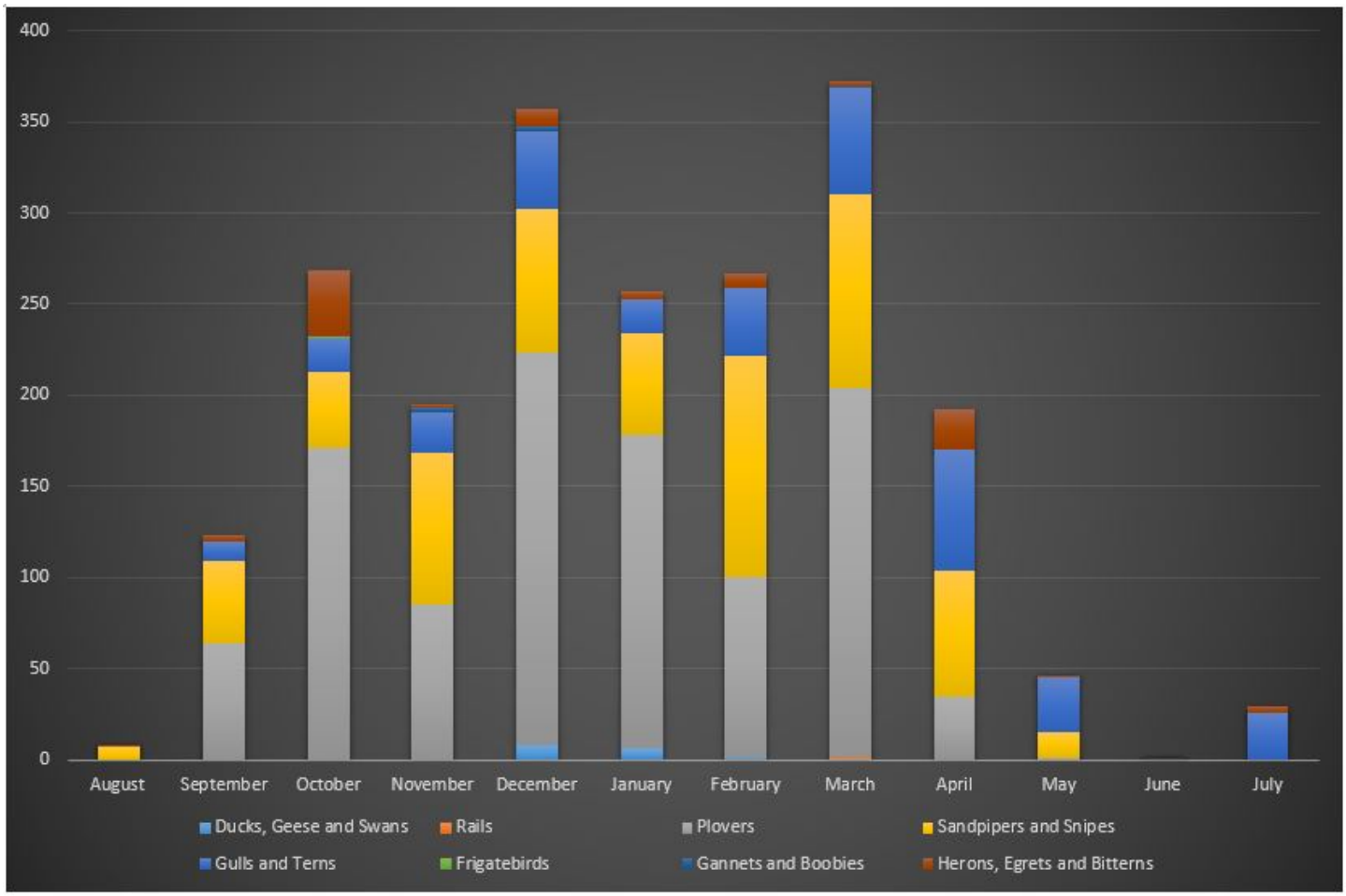


Figure 56. ESA-listed species recorded at Spanish Steps.

TERRESTRIAL HABITAT MANAGEMENT

Listed Plant and Invertebrate Surveys

Location: JRM **Period of Performance:** AUG2019- JUL2021

Project Objective

This purpose of this project is to conduct plant and invertebrate surveys and to implement management techniques to provide a conservation benefit to ESA-listed threatened and endangered species under the Endangered Species Act.

Conservation Benefit

Identifying locations of ESA-listed plant and invertebrate species will allow for management actions to reduce habitat fragmentation, enhance, and restore habitat, buffer protected areas, and implement new conservation strategies.

FY21 Status

- An FY21 MOD added locations to survey for ESA-listed plants and invertebrates in Andersen South and NBG for plant and invertebrate surveys as well as continue ongoing survey efforts on all JRM lands and other lands on Guam.
- *Tuberolabium guamense* surveys on non-DOD lands:
    - Surveys have been conducted for *Tuberolabium guamense* in support of the *Tuberolabium guamense* Species Action Plan (SAP), which was developed to increase our understanding of the range-wide status of the species, threats, and conservation actions that could lead to a potential change in the listing status. Surveys for *Tuberolabium guamense* have been conducted from November 2019 through July 2021 on non-DOD lands (primarily Government of Guam lands) at Bolanos Conservation Area, Mati Point, and the forested area near the Yigo Raceway (Table 3 and Figure 58).
- A total of 28,451 *Tuberolabium guamense* have been observed to date (Table 4).

Table 3. ESA-listed species recorded during non-DOD lands at the Bolanos Conservation Area, Mati Point, and the forested area near the Yigo Raceway from November 2019 through July 2021.

All Non-DoD												
Species	November	December	January	February	March	April	May	June	July	August	September	Total
Bulbophyllum guamense	1	31	16	60	13	17	2	7	3	1	0	151
Cycas micronesica	54	87	33	43	4	49	1	629	244	4	0	1174
Dendrobium guamense	25	228	182	295	14	68	2	10	6	0	0	831
Eugenia bryanii	2	46	0	6	0	0	0	0	0	0	0	54
Hedyotis megalantha	0	0	0	0	0	0	0	0	0	0	0	0
Heritiera longipetiolata	0	0	0	0	0	0	0	16	12	1	0	29
Nervilia jacksoniae	0	0	0	0	0	0	0	0	0	0	0	0
Phyllanthus saffordii	0	3	0	0	0	0	0	0	0	0	0	3
Serianthes nelsonii	0	0	0	0	0	0	0	0	0	0	0	0
Solanum guamense	0	0	0	0	0	0	0	0	0	0	0	0
Tabernaemontana rotensis	0	1	0	0	0	0	0	35	12	3	0	54
Tinospora homosepala	0	0	0	0	0	0	0	0	0	0	0	0
Tuberolabium guamense	54	5	1066	5520	3,952	3,898	0	9556	3221	1157	0	28451
Hypolimnas octocula mariannensis	0	0	0	0	0	0	0	4	3	1	0	8
Vagrans indica	0	0	0	0	0	0	0	0	0	0	0	0
Partula gibba	0	0	0	0	0	0	0	0	0	0	0	0
Samoana fragilis	0	0	0	0	0	0	0	108	14	0	0	122
Partula radiolata	0	0	0	0	0	0	0	111	87	0	0	198

- ESA-listed species surveys on AAFB:
  - In October 2020 surveys at Tarague basin area near the CATM range began and are ongoing.
  - 404 acres surveyed through July 2021. *Cycas micronesica* (6,931), *Tabernaemontana rotensis* (218), *Partula radiolata* (5,670), and *Hypolimnas octocula mariannensis* (1034 eggs, 60 larvae, 30 chrysallids, and 9 adults) were found

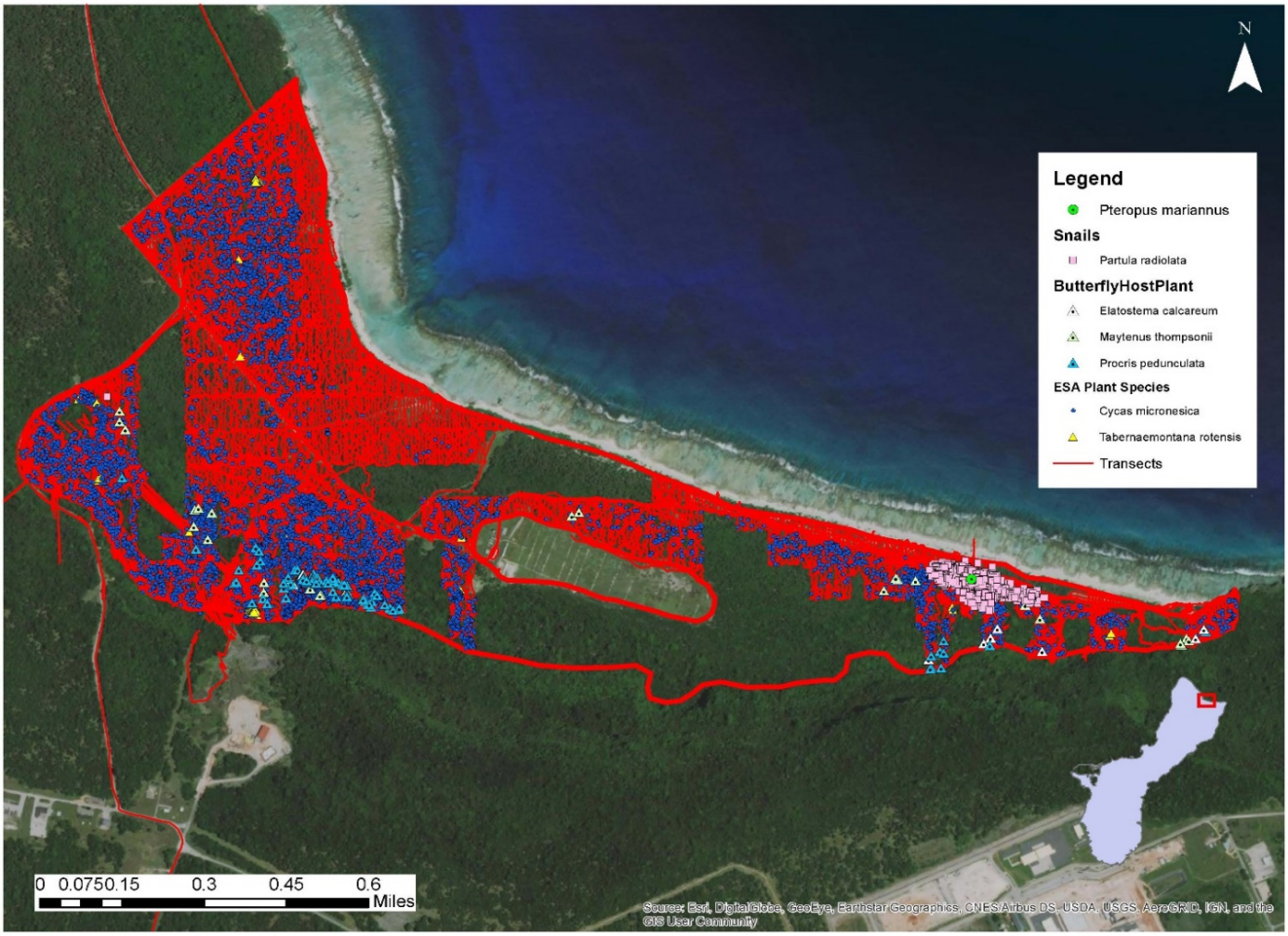


Figure 57. ESA listed species found through July 2021 at Taragüe basin near the CATM range.

- ESA-listed species surveys on AAFB (Northwest Field):
    - Transect surveys (10 m) for listed plants were conducted over approximately 1,285 acres from January 2020 through July 2021. A total of 662 mature *Cycas micronesica, Tuberolabium guamense* (17,527), *Dendrobium guamense* (24), *Tabernaemontana rotensis* (43) and *Bulbophyllum guamense* (176). Host trees were *Vitex parviflora*, *Meiogyne cylndrocarpa, Ficus prolixa, Aglaia mariannensis, Morinda citrifolia, Ficus tinctorial*, and *Ochrosia oppositifolia* (Figure 58). Three (3) *Elatostema calcareum* plants were found, but no ESA-listed larvae were observed. Surveys are still underway.

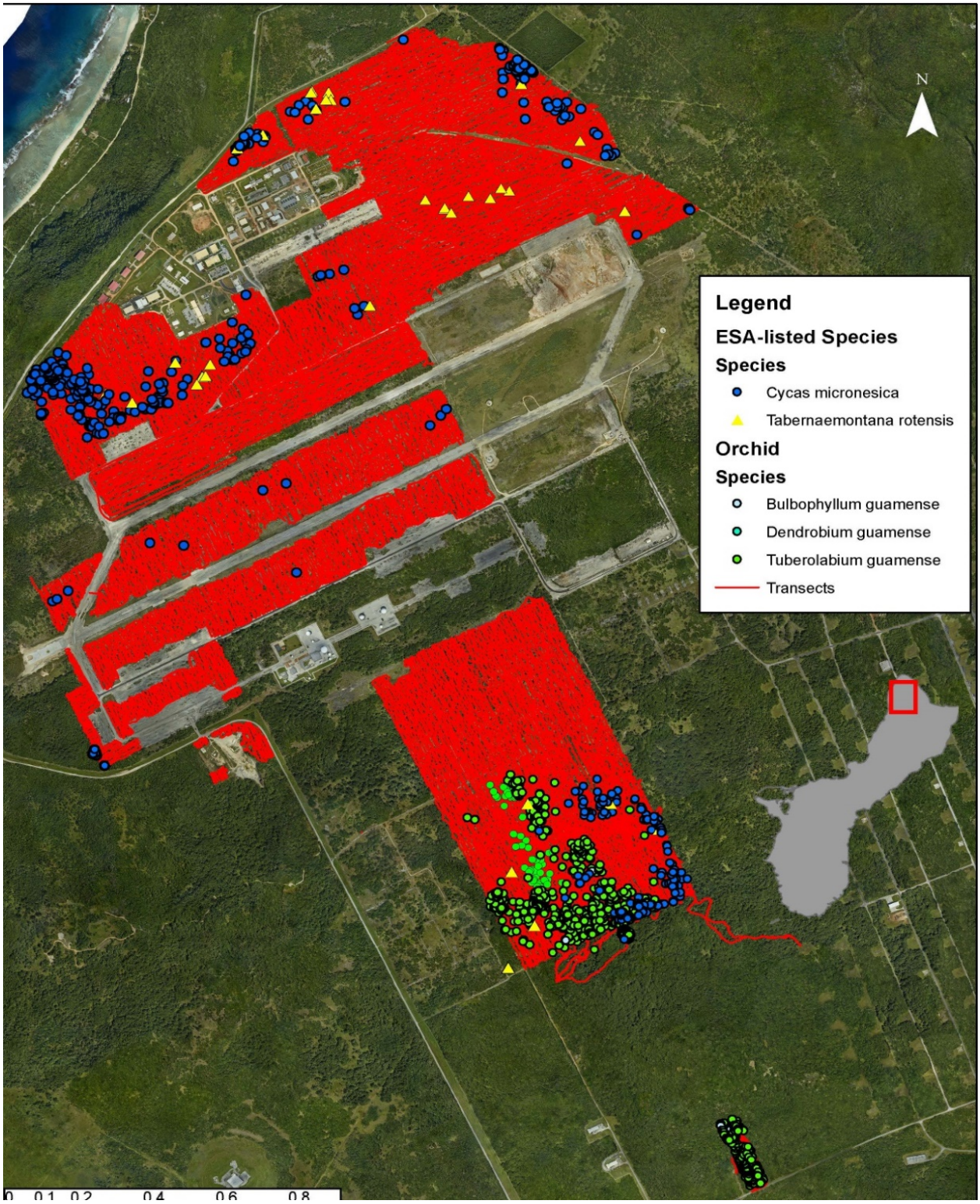


Figure 58. ESA-listed species found through July 2021 at Northwest Field

ESA-listed species surveys on NMS:

- Transect surveys are ongoing in the NMS (Figure 59). Forest types include Vitex and Ravine forests. From July 2020 through July 2021, 227 acres have been surveyed and the following ESA-listed species were found*: Bulbophyllum guamense* (5,113), *Cycas micronesica* (36), *Dendrobium guamense* (2,660), *Tabernaemontana rotensis* (2), *Tuberolabium guamense* (3,063*), Partula radiolata* (1), and *Samoana fragilis* (1,896) (Figure 59).
- Transect surveys in a separate 100-acre site on NMS are ongoing. Through July 2021 approximately 20 acres have been surveyed. ESA-listed species occurring in the area included*: Bulbophyllum guamense* (46), *Cycas micronesica* (35), *Dendrobium guamense* (18), and *Tabernaemontana rotensis* (10).

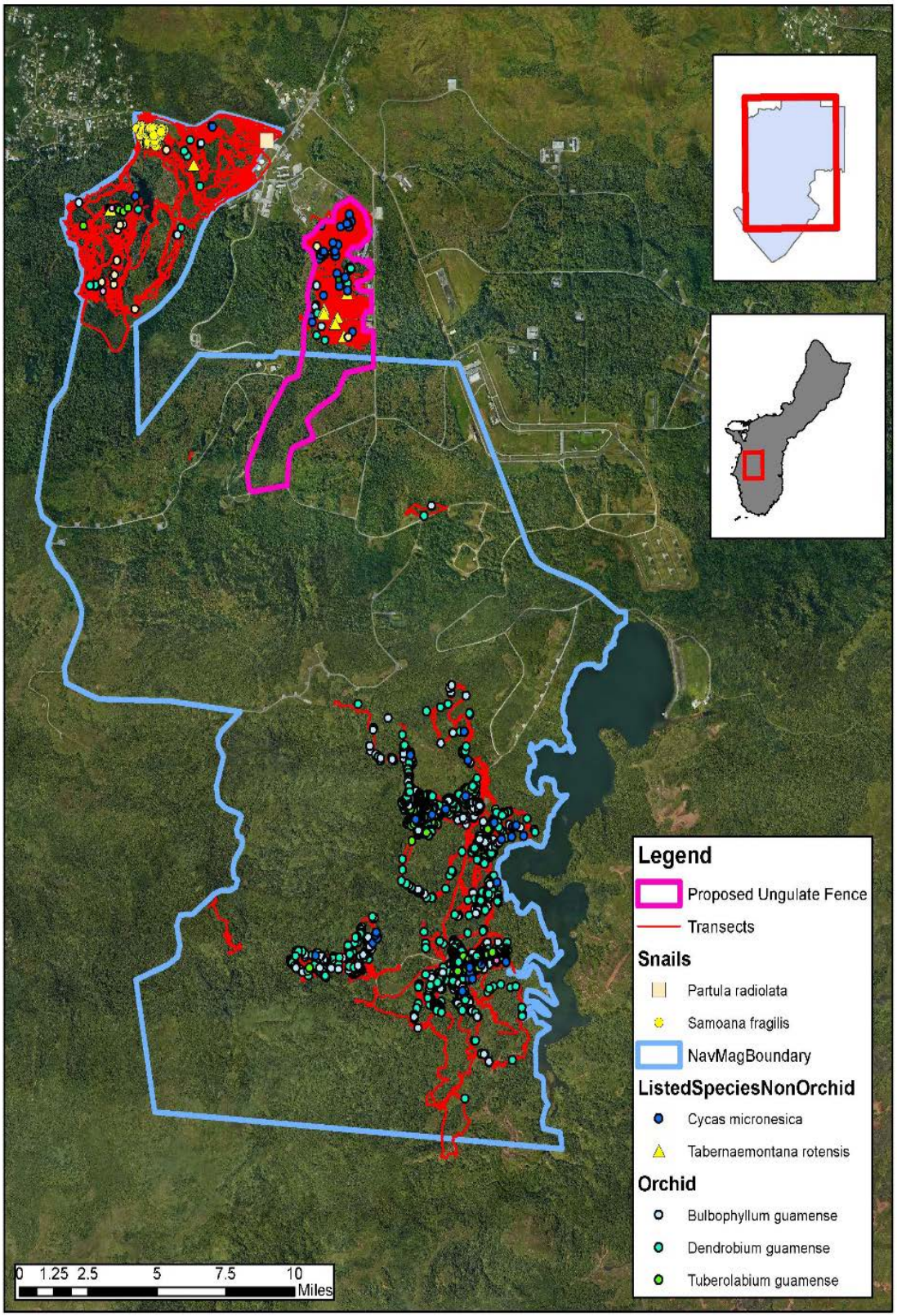


Figure 59. ESA-listed species found through July 2021 at NMS.

- ESA-listed species surveys on Andersen South (Figure 60):
    - About 400 acres have been surveyed in Andersen South. ESA-listed species found include: *Cycas micronesica* (43), *Dendrobium guamense* (2), *Tabernaemontana rotensis* (31), and *Partula radiolata* (150).

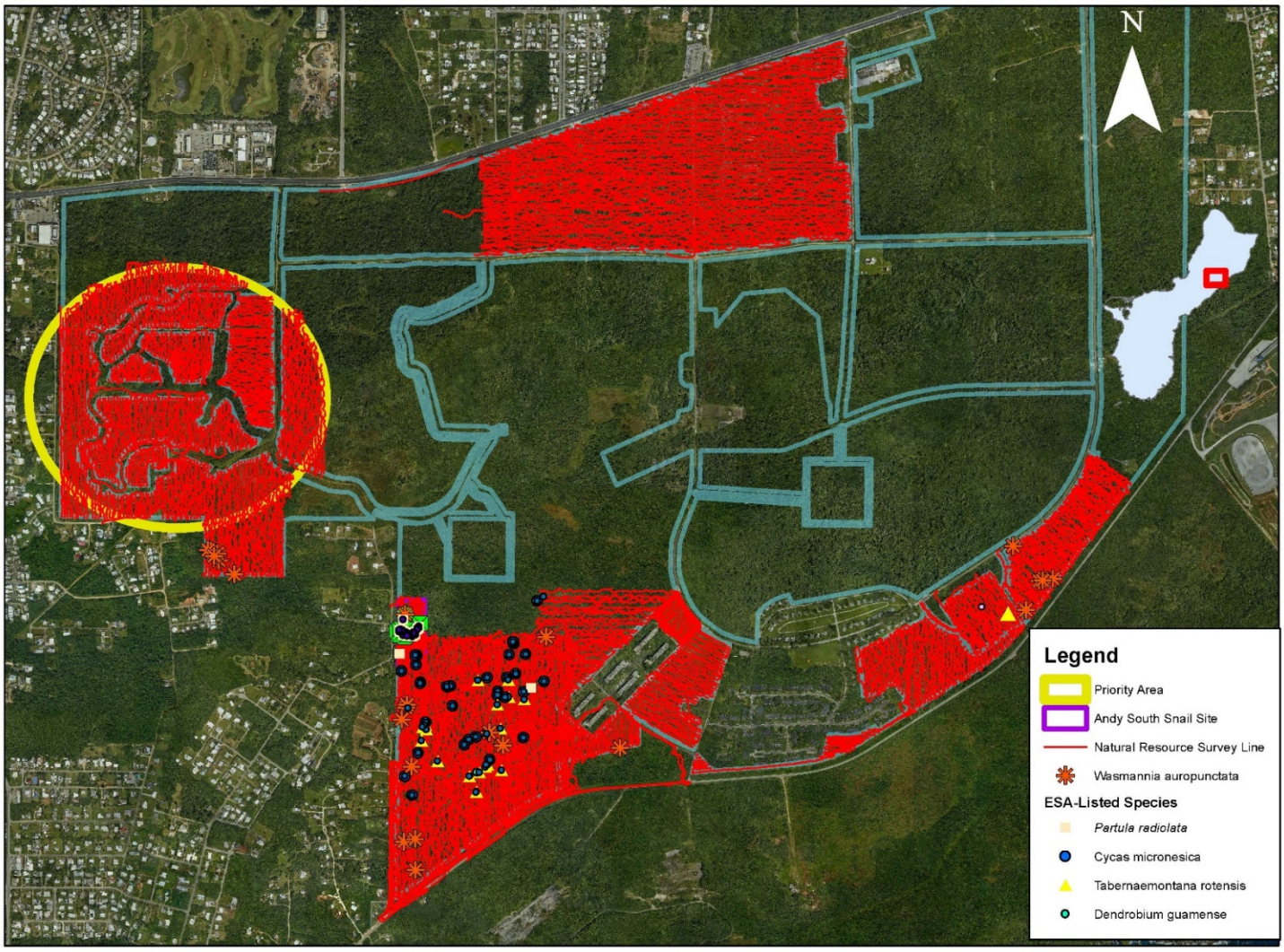


Figure 60. ESA-listed species found through July 2021 at Andersen South.

EPR: Listed plant surveys, Propagation, planting, and Establishment in the Wild; 61128NR209 and 1 S JRM AAFB - Monitoring and Surveys for Listed Tree Snails, Butterfly, Plants; M5240CN048

2019 JRM INRMP Reference: THM-2; 6-39, TPS-5; 9-77

Listed Plant and Invertebrate Surveys - NBG-Administered Lands

Location: NBG **Period of performance:** JUL2020- AUG2021

Project Objectives

- To collect baseline population, demographic and habitat data on ESA-listed plants, butterfly host plants, and treesnails (*Samoana fragilis*, *Partula gibba* and *Partula radiolata)*

Conservation benefit

Identifying locations of ESA-listed plant and snail species will allow for management actions to avoid and conserve locations of protected species

FY21 Status

FY 21 survey locations included 384 acres on Orote Peninsula and Sasa Valley Fuel Farm. Surveys on Orote Peninsula included north facing ridges in the Spanish Steps (28 acres) and San Luis beach (77 acres) regions. Surveys at Sasa Valley Fuel Farm included a total of 279 acres. Surveys utilized parallel fixed transects at 5-10 meters depending on terrain and habitat.

A total of 4,806 *Partula radiolata* were found at San Luis and Spanish Steps (Table 4), completed by January 2021. Surveys at the Sasa Valley Fuel Farm were conducted from February through July, 2021. *Samoana fragilis* (669 individuals) and *Partula radiolata* (2,799 individuals) were observed.

ESA-listed plants and butterfly host plants were also documented (Table 4 and Figure 61). Interestingly, a new population of *Tinospora homosepala* was identified at Sasa Valley Fuel Farm. The population will be monitoring for phenology to determine if there female individuals, since the plant is dioecious (male and female flowers occur on separate plants). Other interesting documentation was *Eugenia bryanii* at Spanish

Steps, as well as butterfly host plants *Procris pendunculata* (332 at San Luis; 90 at Spanish Steps) and *Elatostema calcareum* (44 at Spanish Steps).
Under separate contract with the University of Guam, Photo Mark Recapture (PMR) surveys were conducted in 2020 at NMS, Haputo Beach and Pugua Point, and San Luis Beach. Results and reporting are pending completion.

EPR: 1 S MAR NBG Endangered Species Monitoring; 61755NR142

2019 JRM INRMP Reference: THM-2; 6-39, TPS-5; 9-77

Table 4. ESA-Listed species found at San Luis, Sasa Valley, and Spanish Steps on NBG.

Species	San Luis	Sasa Valley	Spanish Steps	Total
Cycas micronesica	281		897	1178
Elatostema calcareum			44	44
Eugenia bryanii			171	171
Heritiera longipetiolata	76		179	255
Partula radiolata	2007	2799		4806
Procris pendunculata	332		90	422
Samoana fragilis		669		669
Tabernaemontana rotensis	2			2
Tinospora homosepala		120		120

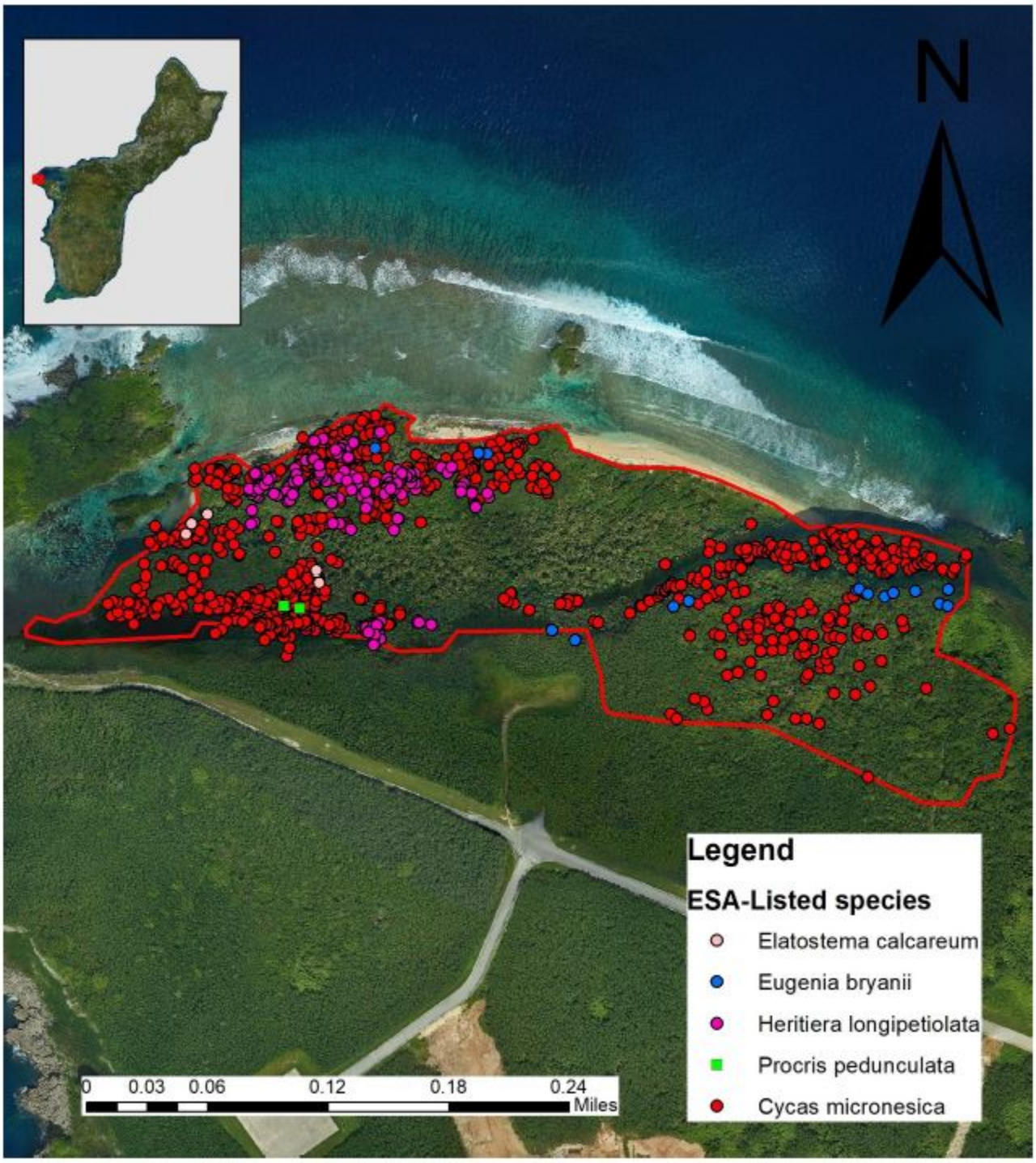


Figure 61. Location of ESA-listed species recorded at Spanish Steps on NBG.

Listed Plant and Invertebrate Surveys, NBG-Administered Lands

Location: NBG **Period of performance:** JUL2020- OCT2021

Objectives

- To collect baseline demography (life history) data on ESA-listed orchids (*Bulbophyllum guamense, Dendrobium guamense* and *Tuberolabium guamense)*

Conservation benefit

Identifying locations of ESA-listed snail species will allow for management actions to avoid and conserve locations of protected species

FY21 Status

Numerous surveys for orchids are regularly conducted on JRM AOR lands, primarily determining presence and absence of the focal species. Using known orchid locations from surveys density and population estimates from 2018 and 2019, a life history study was initiated to track the individual fate of ESA-listed orchids in FY21. The project developed a data dictionary for capturing numerous variables, with intent to measure growth, fecundity and survivorship of the orchids at the genet level. The project will help track the fate of individual genet-level populations. Over 500 orchids were documented on 300 host trees; 64 host trees were inside ungulate-protected areas and 236 host trees were outside of ungulate-protected areas on the NMS. Data was collected once during the dry season and again for all orchids in the wet season. The project will help further our understanding of the demographics of Guam's rare orchids to better pursue management, conservation, recovery of the species.

EPR: 1 S MAR NBG Endangered Species Monitoring; 61755NR142

2019 JRM INRMP Reference: THM-2; 6-39, TPS-5; 9-77

Threatened and Endangered Species Preconstruction Surveys

Location: JRM **Period of Performance:** various, multiple awards

Project Objective

Conduct preconstruction surveys prior to vegetation clearing and grubbing for construction and design related activities.

Conservation Benefit

To minimize impacts to specific listed species due to construction and design related activities.

FY21 Status

- Preconstruction fruit bat surveys ongoing for the following construction projects: J-001B, J-755, P296, and P-715.
- Preconstruction ESA-listed species surveys completed for J-001B, J-609, J- 755, P-103, P-187, P-290, P-296, P-608, P-715, P-735, North Finegayan Forest Enhancement Site fence line, and Haputo fence line.

EPR: DPRI: Marine Corps Relocation 2017/2018 amendment to 2015 BO, Conservation Measures to Contribute to the Recovery of Listed Species.

2019 JRM INRMP Reference: THM-2; 6-39, TPS-5; 9-77

Forest Restoration Plan Implementation – NBG

Location: NMS **Period of Performance:** SEP2017 – DEC2019

Project Objectives

- Restore native forest ecosystems within fenced areas where feral pigs, deer and carabao have been removed on the NMS.
- Propagate and plant and/or use direct seed techniques for reforestation following the recommendations of the Naval Base Guam (NBG) Forest Restoration Plan and the Conceptual Limestone Forest Restoration and Enhancement Plan (NAVFAC PAC 2018).
- Manage new plantings for a minimum of three years to ensure establishment.

Conservation Benefit

Increasing native forest habitats would improve native species survival, particularly threatened and endangered species enhance native habitat for listed animals, increase the biodiversity of native species, and contributes to the connectivity with surrounding communities in ways that support improved ecosystem functionality. It also contributes to the goals of the Guam NWR as an overlay unit the NMS.

FY21 Status

Work within Fence Unit #1

Fenced Unit #1 contains approximately 80 acres. Within which twenty research plots have been established in the NMS. Ten of the plots are within an ungulate exclosure area. Ten additional plots are within a control area where ungulates have access for comparison. This allows for comparison of vegetation regrowth in areas with and without ungulates. Baseline data for plant diversity was taken in 2019, to show what the forested area was like before being fenced. Another survey is planned in the future to show the changes in plant diversity and abundance. Vitex trees were removed from half the plots as shown in figure 62. The plots with the green dots are the ones where

the vitex has been removed. The plots have been planted with local plants species to ascertain whether survival rates where better inside the fence versus outside the fence. The plantings were completed in 2020. Figure 65 shows the survival of plants a year after planting, data taken in 2021. Red indicates dead plants, yellow indicates missing plants and white indicates plants that are alive. Rows 1 through 150 are within the fenced area. Rows 150 and beyond are in the control area which is outside of the fence. Those plots have exposure to ungulate predation. Most of those plants are missing (yellow).

Work within Fence Unit #2

Fence Unit #2 encompasses approximately 70 acres. The purpose of the project is to remove invasive trees and replace them with native limestone forest species. The first phase of the project was to fence the area to remove ungulates and their influence on forest regeneration. The second phase was to have a complete catalogued inventory of listed species on the site. Plots are to be set up within the fenced unit for the purpose of measuring changes in the forest understory.

The third phase is to remove vitex trees in a phased manor. Vitex removal will be done by wounding the tree and treating the wound with herbicides, then leaving the dying tree in place. Nursery grown native species will be planted in the understory of removed vitex.

A full inventory of listed species was completed at the site. All individuals were catalogued, and coordinates stored. Some results are below:

Figure 63 shows the locations of both vitex and listed species in the survey at FRU 2. A total of 743 vitex was encountered during this survey. The project goal is to remove all these trees. The first phase is to remove vitex in plots where orchids are not present. Some plots will be located where orchids are nearby and might be affected by minor

changes in light and moisture due to dying vitex. Those orchids will be monitored to determine the impacts if any of tree removal.

Survey resulting in the following:

- 41 Bulbophyllum guamense
    - 9 found on V. parviflora
    - 32 found on other host trees
- 291 Dendrobium guamense
    - 99 on V. parviflora
    - 192 on other host trees
- 2,316 Tuberlabium guamense
    - 1,438 on Vitex parviflora
    - 878 found on other host trees
- 77 Micronesian cycads Cycas micronesica

EPR:

2019 JRM INRMP Reference: THM-2; 6-39

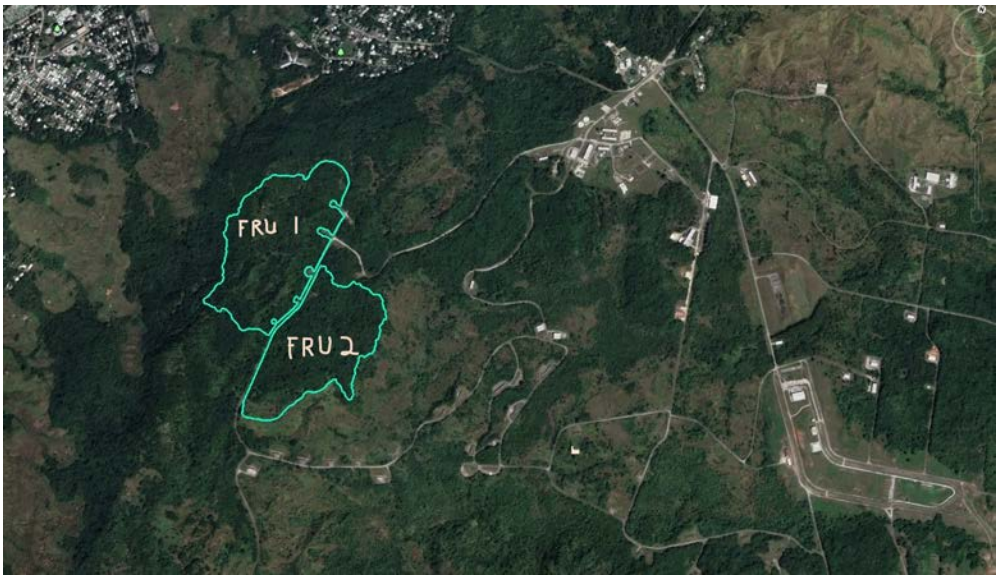


Figure 62. Both fenced units

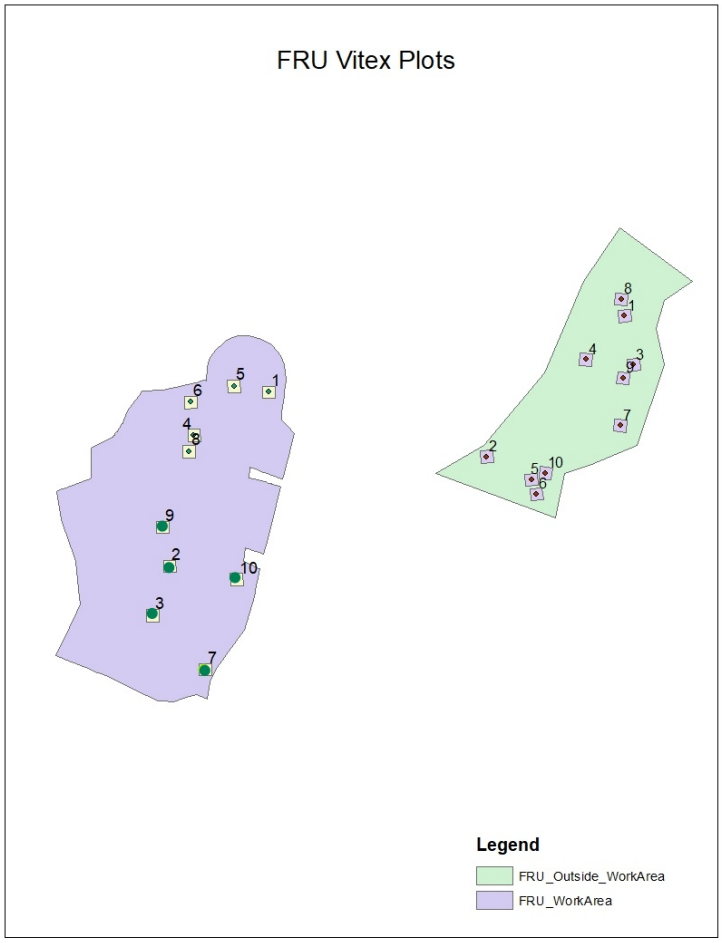


Figure 63. Vitex Plots

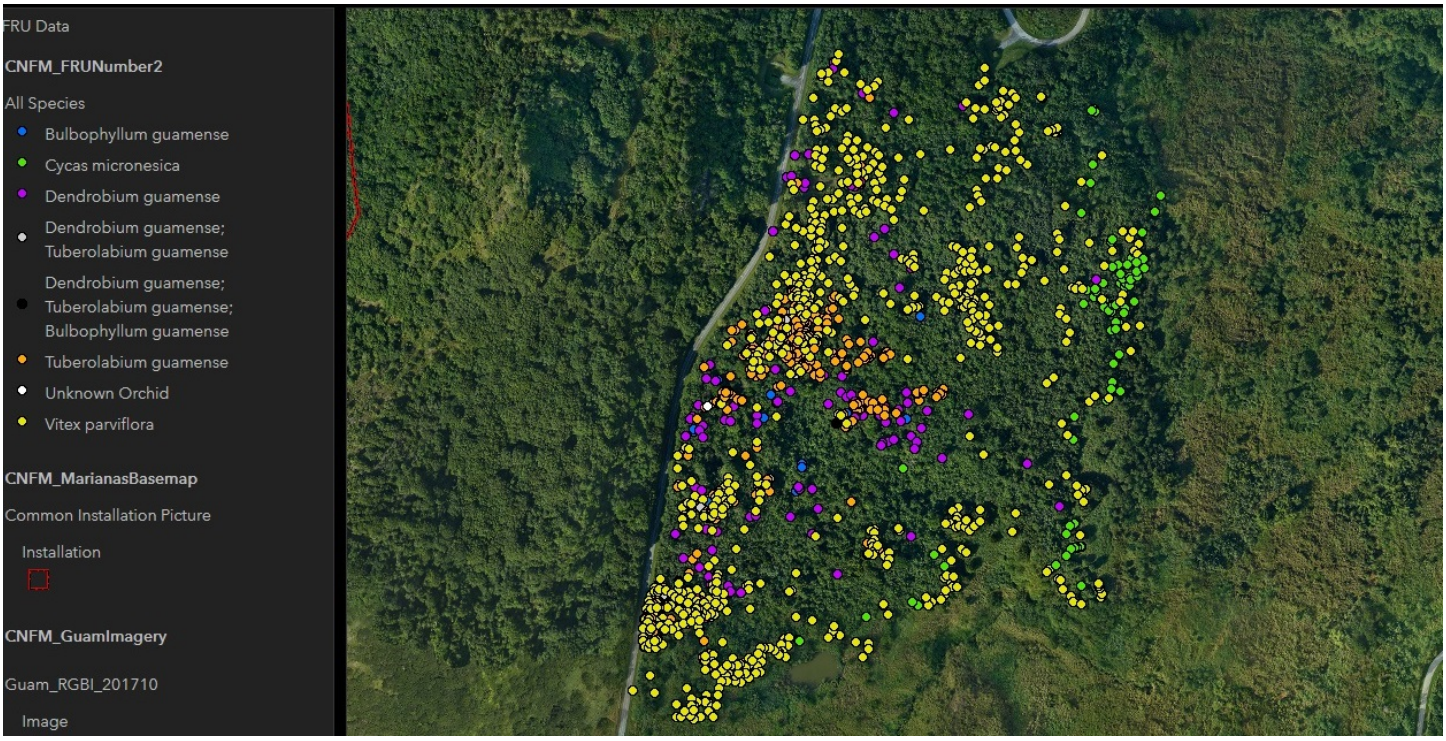


Figure 64. Species Locations

FRU Outplanting Monitoring

DEAD FROM PREVIOUS DATA
MISSING FROM PREVIOUS DATA

ID Key
Good (G), Dead (D), Missing (M), Wilting (W), Insect Damage (ID)
Ungulate Damage (UD), Uprooted (UR), Replanted (RP), No Live Growth (NLG)

Date: 7/23/2021
Personnel: AS & VF

Guma=Guamia mariannae, Memu=Melanolepis multiglandulosa, Prpe=Procris pedunculata, Ixtr=Ixora triantha, Inbi=Intsia bijuga Tags 1-150 = Inside plots; 151-288 = Outside plots

ID#	Health	Watered	Plot	Species	Notes	ID#	Health	Watered	Plot	Species	Notes	ID#	Health	Watered	Plot	Species	Notes
1			1	Guma		97			4	Memu		193	D	-	2	Guma	
2			1	Memu		98	D	-	4	Prpe		194	D		2	Guma	
3	D	-	1	Prpe		99			4	Guma		195	M	-	2	Guma	
4	D	-	1	Prpe		100			4	Guma		196	D	-	2	Prpe	
5	D	-	1	Memu		101			4	Inbi		197	M	-	2	Prpe	
6	D		1	Ixtr		102			4	Inbi		198	M		2	Memu	
7			1	Inbi		103	D	-	4	Prpe		199	M		2	Ixtr	
8	D	-	1	Prpe		104			4	Memu		200	M	-	2	Ixtr	
9	D		1	Inbi		105			4	Guma		201	M		2	Guma	
10			1	Guma		106			4	Ixtr		202	M	-	2	Inbi	
11			1	Guma		107			4	Memu		203	D	-	2	Inbi	
12			1	Ixtr		108	D	-	4	Prpe		204	D	-	2	Guma	
13	D		1	Memu		109			4	Inbi		205	NLG		2	Memu	33
14			1	Ixtr		110			4	Guma		206	M	-	2	Inbi	
15	D		1	Memu		111	D	-	4	Prpe		207	D	-	2	Ixtr	
16			1	Inbi		112			4	Ixtr		208	M	-	2	Prpe	
17	D	-	1	Inbi		113			4	Memu		209	M	-	2	Memu	
18	D		1	Guma		114	D		4	Guma		210	D	-	2	Guma	
19	D		1	Memu		115			4	Inbi		211	M		3	Memu	
20	D	-	1	Prpe		116			4	Inbi		212	M	-	3	Ixtr	
21			1	Ixtr		117			4	Guma		213	D		3	Inbi	
22			1	Ixtr		118	D	-	4	Prpe		214	M	-	3	Memu	
23	D		1	Guma		119	D		4	Memu		215	M	-	3	Prpe	
24			1	Memu		120			4	Ixtr		216	M	-	3	Prpe	
25	M		1	Inbi		121			8	Memu		217	D	-	3	Prpe	
26			1	Guma		122	D		8	Prpe		218	M	-	3	Memu	
27			1	Ixtr		123	D		8	Inbi		219	D	-	3	Ixtr	
28	D		1	Prpe		124	D	-	8	Guma		220	M	-	3	Ixtr	
29			1	Inbi		125			8	Ixtr		221	D	-	3	Guma	
30	D		1	Prpe		126	D	-	8	Prpe		222	M	-	3	Prpe	
31			6	Inbi		127			8	Ixtr		223	M	-	3	Ixtr	
32			6	Inbi		128	D		8	Prpe		224	M	-	3	Inbi	
33			6	Guma		129			8	Inbi		225	M	-	3	Ixtr	
34	D	-	6	Prpe		130	D		8	Inbi		226	M	-	3	Ixtr	
35	M		6	Guma		131			8	Ixtr		227	D	-	3	Inbi	
36			6	Memu		132			8	Memu		228	M	-	3	Guma	
37	D	-	6	Prpe		133	D		8	Inbi		229	M	-	3	Inbi	
38			6	Ixtr		134	D		8	Prpe		230	M	-	3	Guma	
39			6	Memu		135	D	-	8	Guma		231	D	-	3	Prpe	
40			6	Ixtr		136	D		8	Memu		232	M	-	3	Prpe	
41			6	Inbi		137			8	Memu		233	D		3	Inbi	
42	D		6	Prpe		138			8	Guma		234	M	-	3	Guma	
43			6	Memu		139			8	Guma		235			3	Guma	
44			6	Ixtr		140			8	Inbi		236	M		3	Memu	
45			6	Guma		141			8	Ixtr		237	M		3	Memu	
46			6	Ixtr		142	D	-	8	Prpe		238	M	-	3	Guma	
47			6	Guma		143			8	Guma		239	D	-	3	Memu	
48	D		6	Ixtr		144	D		8	Ixtr		240	M		3	Inbi	
49	D	-	6	Prpe		145			8	Memu		241	D	-	5	Prpe	
50			6	Memu		146			8	Guma		242	M	-	5	Memu	
51	D		6	Ixtr		147	D	-	8	Prpe		243	M		5	Inbi	
52	D	-	6	Prpe		148			8	Inbi		244	D	-	5	Memu	
53			6	Memu		149			8	Memu		245	D	-	5	Prpe	
54	D	-	6	Guma		150			8	Ixtr		246	M		5	Memu	
55	D		6	Guma		151	D	-	1	Prpe		247	M	-	5	Ixtr	
56	D	-	6	Prpe		152	D	-	1	Inbi		248	M	-	5	Ixtr	
57			6	Memu		153	M	-	1	Memu		249	M	-	5	Inbi	
58			6	Inbi		154	M	-	1	Memu		250	M	-	5	Prpe	
59			6	Inbi		155	M	-	1	Inbi		251	M	-	5	Inbi	
60	D		6	Inbi		156	M	-	1	Ixtr		252	D	-	5	Ixtr	
61	D		5	Memu		157	M		1	Guma		253	M	-	5	Memu	
62	D	-	5	Prpe		158	M	-	1	Guma		254	M	-	5	Ixtr	
63			5	Inbi		159	M	-	1	Ixtr		255	M	-	5	Memu	
64			5	Inbi		160	M	-	1	Prpe		256	M	-	5	Inbi	
65	D	-	5	Prpe		161	M	-	1	Ixtr		257	M	-	5	Ixtr	
66			5	Ixtr		162	G		1	Guma	15	258	D	-	5	Prpe	
67			5	Ixtr		163	M	-	1	Prpe		259	M	-	5	Inbi	
68	D		5	Memu		164	M	-	1	Guma		260	D	-	5	Prpe	
69			5	Guma		165	M	-	1	Ixtr		261	D	-	5	Prpe	
70	D		5	Memu		166	M	-	1	Memu		262	M	-	5	Ixtr	
71	D		5	Prpe		167	D	-	1	Prpe		263	M	-	5	Memu	
72	D		5	Guma		168	M	-	1	Inbi		264	M	-	5	Inbi	
73			5	Ixtr		169	D		1	Guma		265	M	-	4	Memu	
74			5	Guma		170	M	-	1	Memu		266	M	-	4	Inbi	
75	D		5	Inbi		171	M	-	1	Memu		267	M	-	4	Inbi	
76			5	Memu		172	D	-	1	Prpe		268	M	-	4	Memu	
77			5	Ixtr		173	D	-	1	Memu		269	M	-	4	Ixtr	
78			5	Guma		174	M	-	1	Inbi		270	D	-	4	Prpe	
79			5	Inbi		175	D		1	Inbi		271	D	-	4	Prpe	
80	D	-	5	Prpe		176	D	-	1	Ixtr		272	M	-	4	Ixtr	
81	D	-	5	Prpe		177	D	-	1	Ixtr		273	M	-	4	Memu	
82			5	Ixtr		178	D	-	1	Prpe		274	M	-	4	Ixtr	
83			5	Inbi		179	M	-	1	Inbi		275	D		4	Prpe	
84			5	Inbi		180	M	-	1	Guma		276	D	-	4	Inbi	
85	M		5	Memu		181	D	-	2	Prpe		277	D	-	4	Prpe	
86	D	-	5	Prpe		182	D	-	2	Memu		278	D		4	Prpe	
87			5	Guma		183	M		2	Memu		279	M	-	4	Prpe	
88			5	Memu		184	D	-	2	Prpe		280	M	-	4	Memu	
89	D		5	Ixtr		185	D	-	2	Prpe		281	M	-	4	Ixtr	
90			5	Guma		186	M	-	2	Inbi		282	D	-	4	Inbi	
91		-	4	Inbi		187	M	-	2	Ixtr		283	M	-	4	Ixtr	
92			4	Ixtr		188	D	-	2	Memu		284	M	-	4	Inbi	
93			4	Memu		189	M	-	2	Ixtr		285	M	-	4	Ixtr	
94	D	-	4	Prpe		190	M	-	2	Inbi		286	M	-	4	Memu	
95			4	Ixtr		191	D	-	2	Inbi		287	D	-	4	Inbi	
96			4	Ixtr		192	M	-	2	Ixtr		288	D		4	Memu	

Figure 65. Survival of plants a year after planting; data taken in 2021.

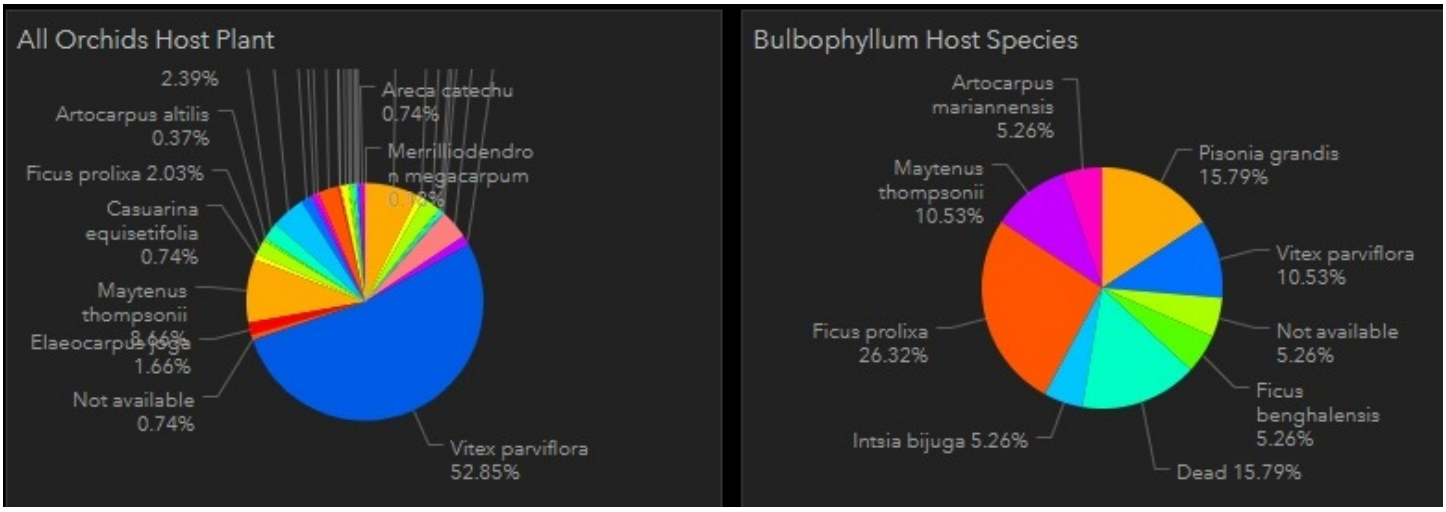
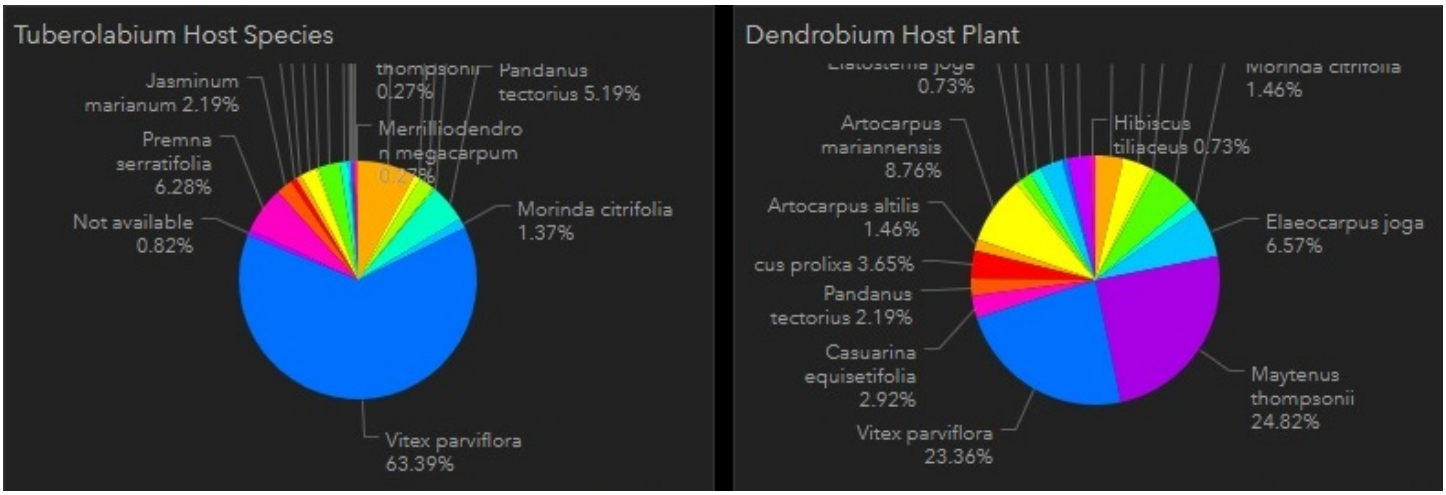


Figure 66 - 67 Host Plant Species for orchids



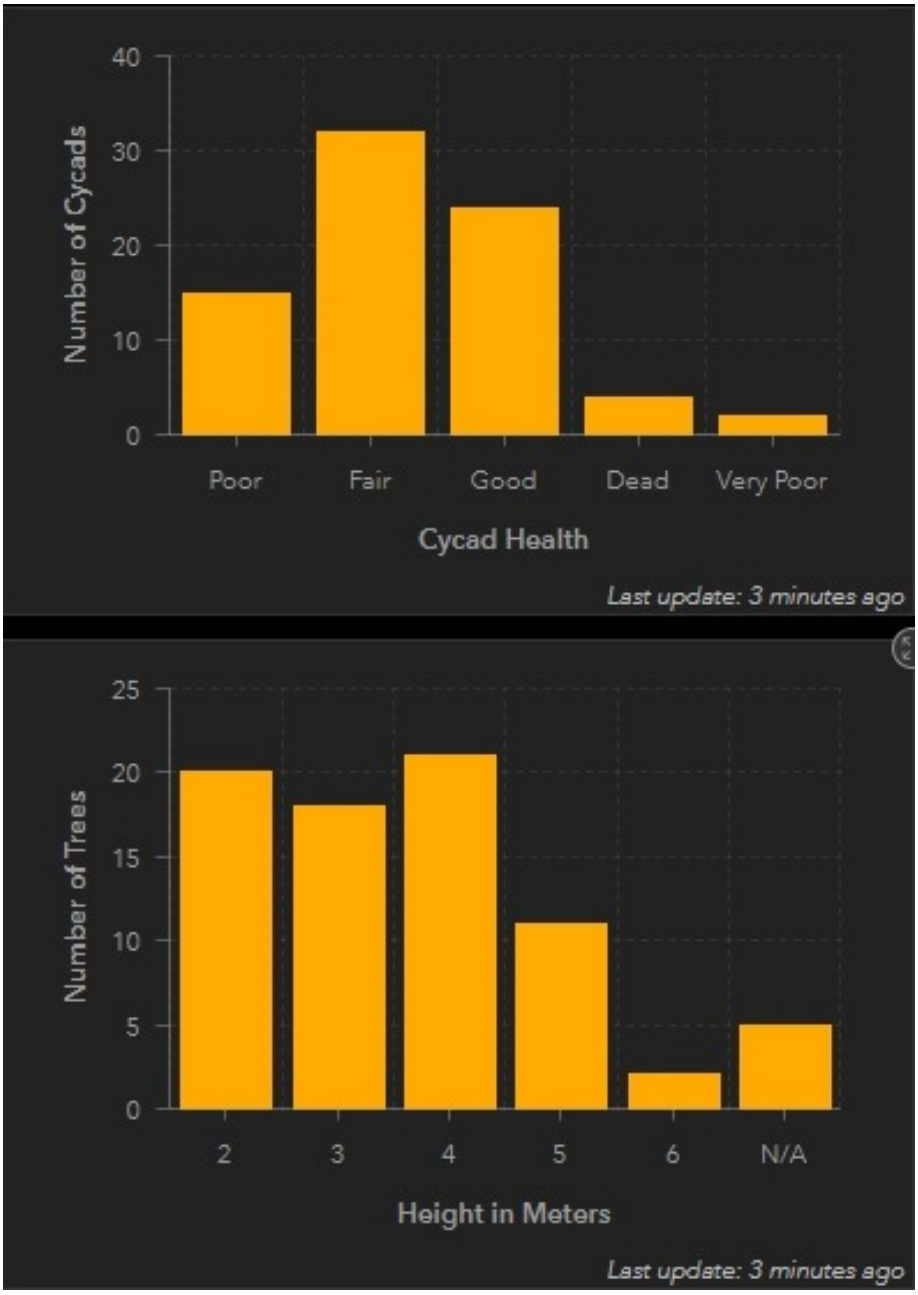


Figure 68. Cycads and their health status

Cetti Bay Watershed Terrestrial Monitoring

Location: Cetti Bay Watershed **Period of Performance**: SEP2017 - MAR2021

Project Objective

To gage the efficacy of the acacia plantings in reducing the effects of fires in Cetti Bay and reducing the amount of soil runoff that settles into Cetti Bay. The measures involved in addressing the project objective include measuring the survival and growth rates of the planted acacia trees, tree survival rates after a fire, and the amount of sediment reaching the bay from the two rivers that drain the Cetti watershed into the Bay.

Conservation Benefit

The project will establish how effective the acacia tree plantings are in improving Cetti Bay aquatic resources, given the environment and site history of annual fires.

FY 2021 Status

- New contract to measure success at Cetti is in the works and will be awarded mid-September.
- The ecological conditions of the reef were to be studied in 2020, but due to covid the contractor was not able to complete them. An inventory of coral communities was taken (figure 70).

EPR: USACE Permit, NBG Reforestation Site, Cetti Bay; 61755NR896

2019 JRM INRMP Reference: THM-2; 6-39, TPS-5; 9-77

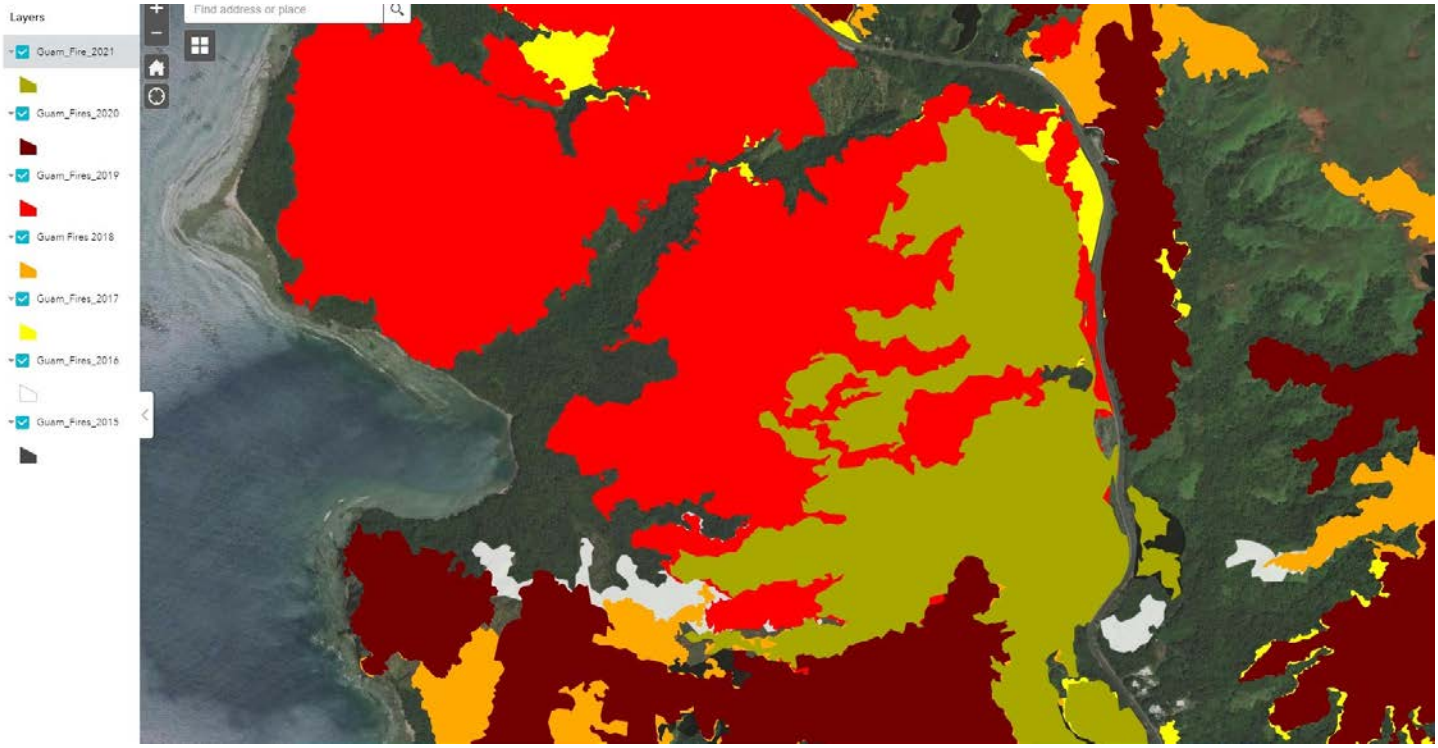


Figure 69. Map of Cetti Bay

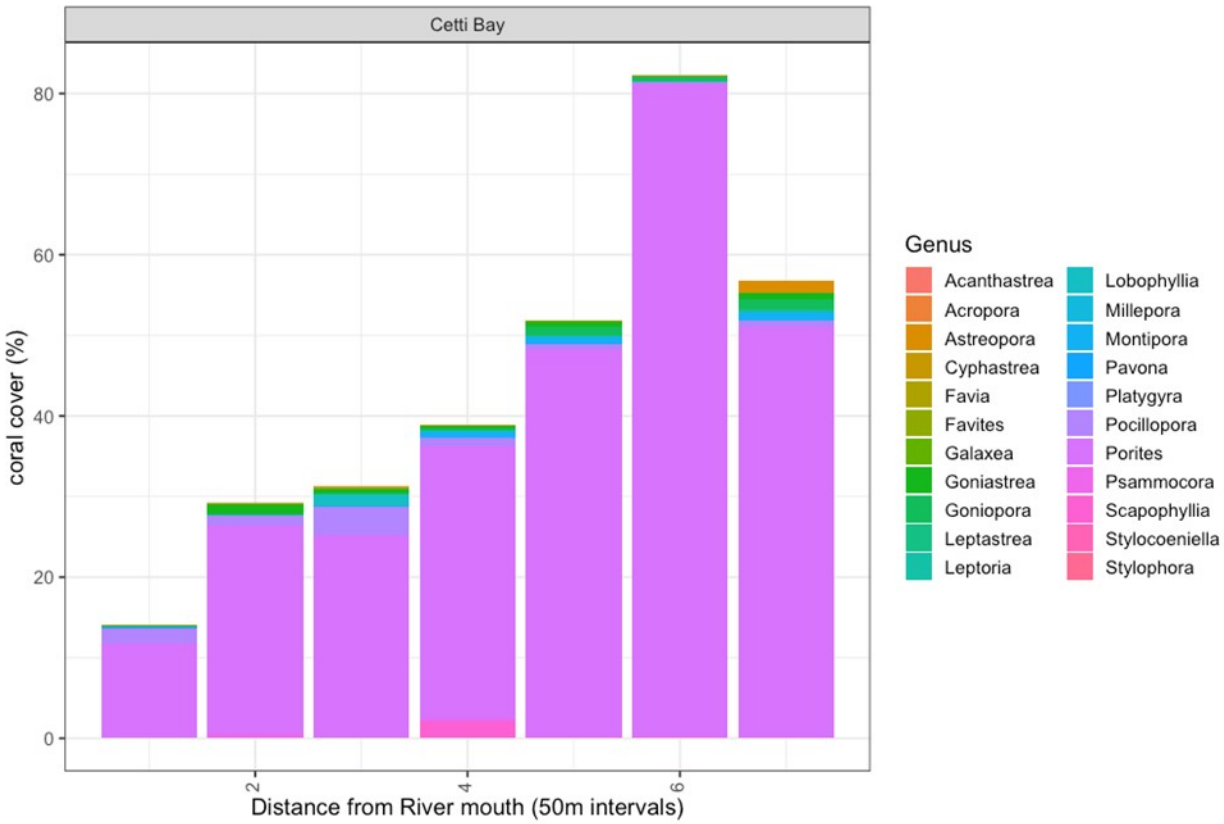


Figure 70. Inventory of coral communities in Cetti Bay in terms of distance from river mouth

Firebreak Management Plan Implementation – NBG

Location: NMS **Period of Performance**: SEP 2021 – SEP2022

Project Objective

- To implement the NBG Wildland Fire Management Plan.
- Specifically, to treat problem fuels (e.g., swordgrass (Miscanthus floridulus)) in strategic locations to disrupt the spread of wildland fires in savannah/ grasslands on NBG land.
- The long-term goal is to have less flammable vegetation to allow uninterrupted land use that meets the military mission requirements. These projects implement specific management actions for Fire Management by planting and/or direct seeding of trees to create shaded fuel breaks and annual management of forested fuel breaks by mowing and chemical treatments of high-fuel load grasses.

FY21 Status

- Nothing to report from 2020-2021 fiscal year
- A new contract is set to be awarded September 2021

This contract will represent the first phase of creating a firebreak. The intent of breaking the process of planting firebreaks into phases it to ensure better survival of planted trees. The first phase of the project will include several rounds of sword grass suppression to initially reduce the biomass of sword grass. Follow up suppression will reduce a portion of the sword grass seed bank. Erosion control measures will be added to the site, such as straw wattles to catch loose soils. Wattles will be treated with local seeds to encourage soil stabilization and native plants.

EPR:

2019 JRM INRMP Reference: THM-2; 6-39

Marianas Basemap

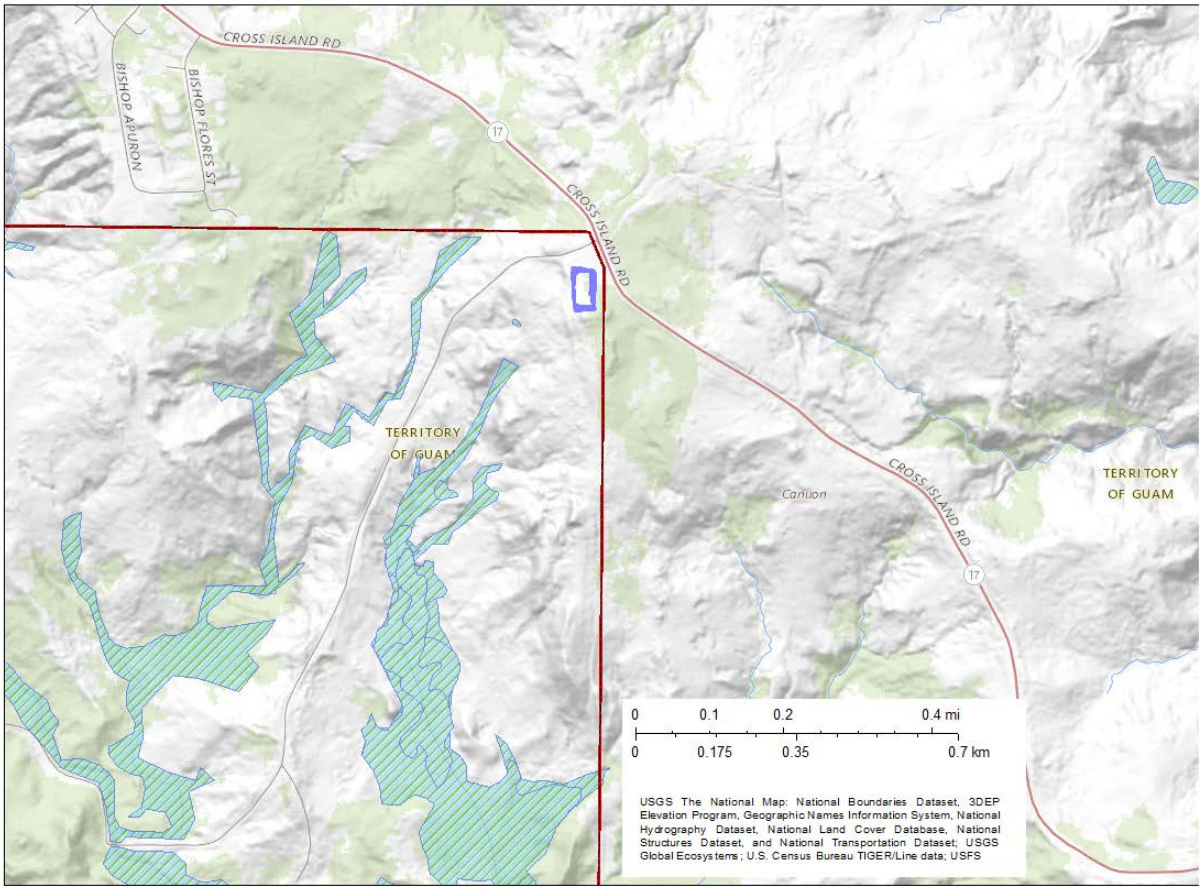


Figure 71 – Base Map of Firebreak Area and close up of planned treatment area





Figure 72 – Example of Fire Break Wattle

Erosion Control – NBG

Location: NMS **Period of Performance**: AUG 2020 – SEP2023

Project Objective

The objective of this procurement is to obtain services for planting native grasses and savanna shrubs to in areas prone to erosion. The goal of this project is to stabilize soils in erosion prone areas that wash into waterways. The secondary goal is to protect Guam's coral reefs by reducing the sediment loads in the coastal drainage system that deposit the sediments into coastal waters, and to increase the amount of native plant communities on Guam.

FY21 Status

Project is in the planning stage, but outplanting will start September 2021. The work will be performed on the erosion scars in an area south of Fena Reservoir (figure 73). These areas contribute most of the erosion into Imong River, the scars themselves are a difficult environment to establish plants (figure 75). Due to the difficult nature of these areas to plant, soil stabilization will be accomplished by a combination of plantings located strategically around the erosion scar and straw wattles that can catch the soil and hold it in place. The straw wattles will additionally be experimentally seeded with plants to further hold the soil while establishing plants.

EPR: CHS JRM NBG Soil and Water Conservation: stabilization of eroding streambanks and cliff/ravine; 61755NR832

2019 JRM INRMP Reference: THM-1: Watershed Management

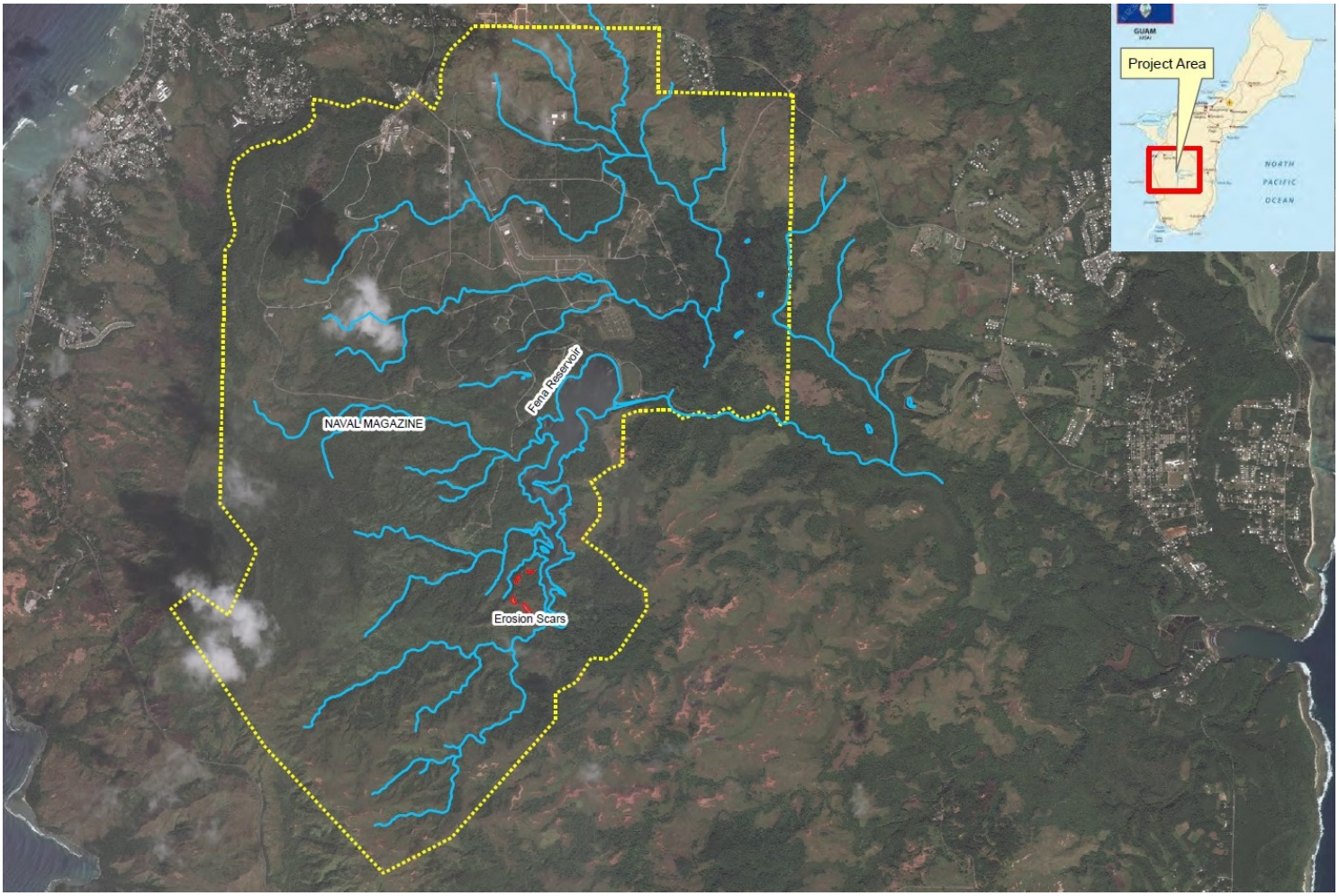


Figure 73. Fena Reservoir project location

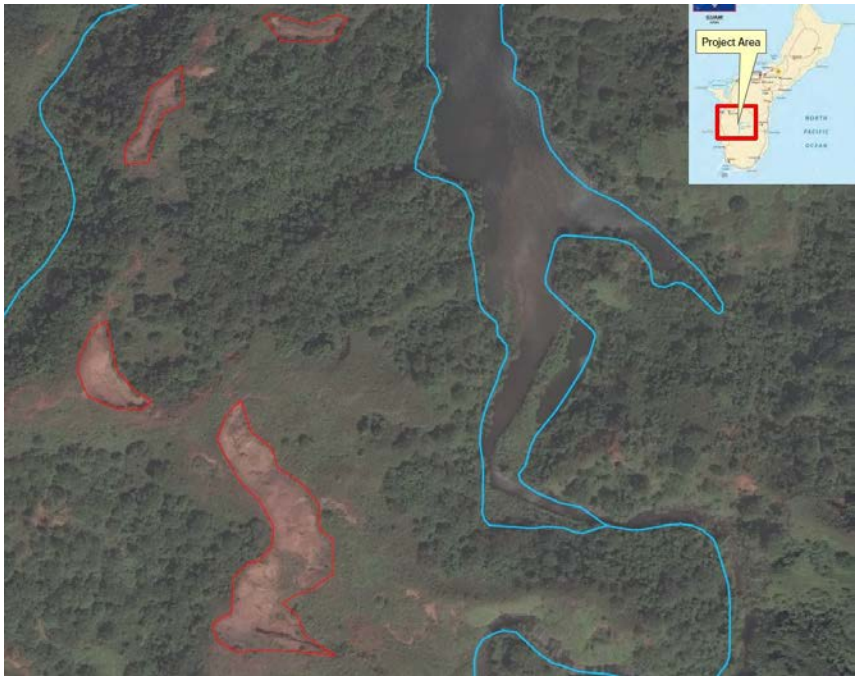


Figure 74. Close up of project location

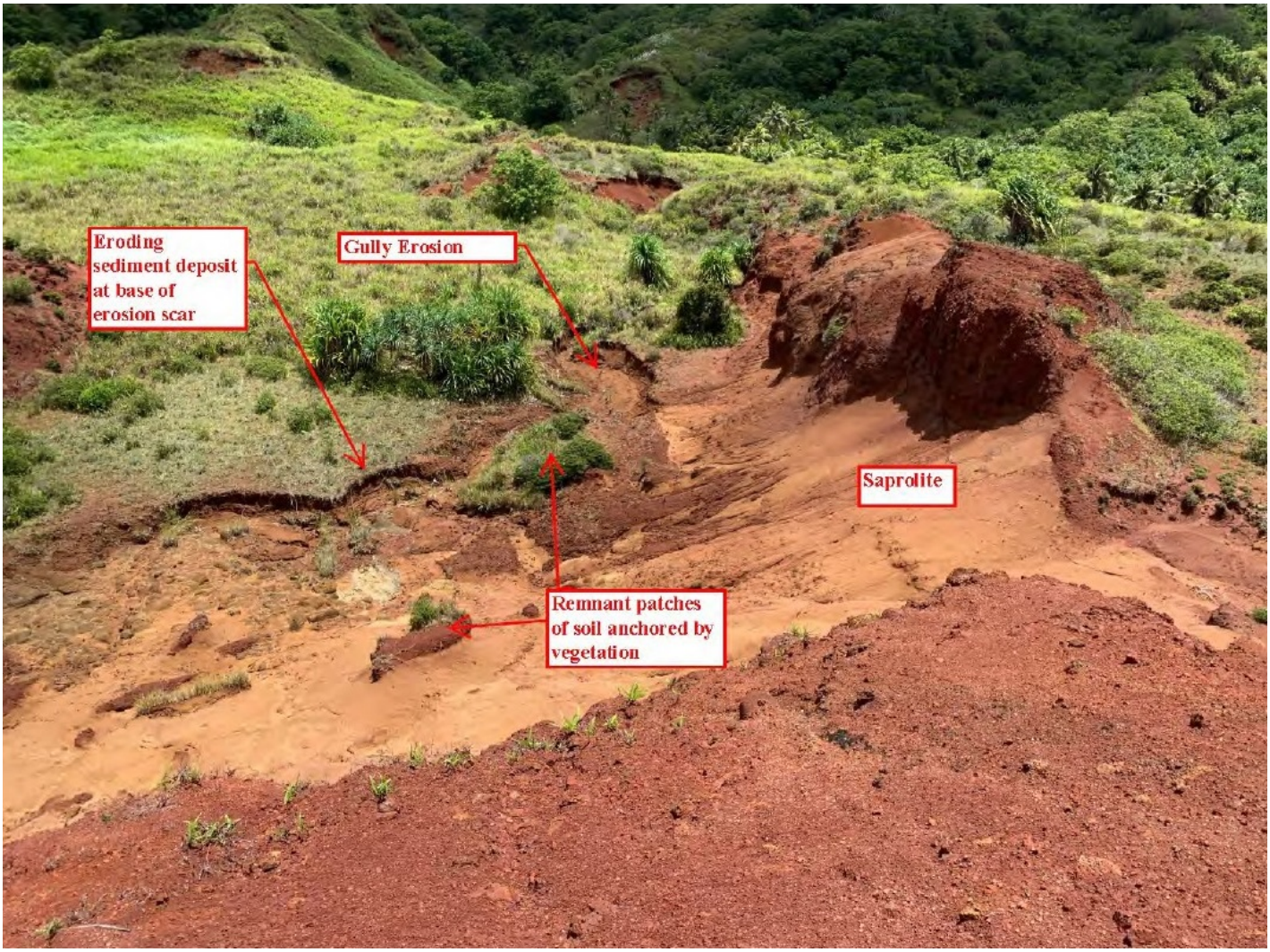


Figure 75. Erosion scarring

Ungulate Fencing on NBG NMS

Location: NBG **Period of performance:** Recurring Annually

Project Objectives

- The primary objective is to construct a fence barrier to exclude ungulates (Philippine deer, pigs and carabao) on NMS to facilitate conservation efforts

Conservation benefit

The installation effort facilitates the revitalization of native habitats that support viable populations of native and ESA-listed species, increases biodiversity, and promotes ecosystem health. Ungulate fence construction is the first step of the applied ecosystem approach to resource management, as defined in the INRMP.

FY21 Status

Ungulates introduced to Guam include feral pig (*Sus scrofa*), Philippine deer (*Cervus mariannus*) and Asiatic water buffalo or carabao (*Bubalus bubalis*). These ungulates currently cause significant impacts to native habitats (i.e. wetlands, native limestone forest) on the NMS. Construction of ungulate fences and eradication of ungulates works to reverse degradation of habitats and increase populations of native species, particularly ESA-listed species.

In FY21, ungulate fence #4 (Parsons Road Conservation Fence #4) was contracted (Table 5). The fence focuses on protection and enhancement of approximately 60 acres of habitat in central NMS. The area was selected due to its unique wetland habitat, periodically supporting Mariana common moorhen, as well as providing a canvas for forestry projects and conservation of ravine forests. The location provides logistical efficiencies for a variety of conservation projects in an area heavily impacted by feral pigs, Philippine deer and carabao. Once constructed, the north side of the fence will connect to ungulate fence #5.

EPR: 1 RP MAR NBG Ungulate Fencing; 61755NR894

2019 JRM INRMP Reference: THM-2; 6-39

Table 5. Ungulate Fencing Unit Construction Overview – NMS.

FY	NMS Region	Name	Hectares/ Acres	Status
FY17	Alifan Ridge	Alifan Conservation Fence #1	32/80	Constructed and ungulate free
FY18	East of High Road	NMS Conservation Fence #2	29/71	Constructed, and ungulate free November 2021
FY19	Alifan Ridge South	Alifan South Conservation Fence #3	30/73	Construction starting Fall 2021
FY21	Central NMS	Parsons Road Conservation Fence #4	28/70	Contracted FY21
FY22	Central NMS	Parsons Road North Conservation Fence #5	62/155	TBD
FY23-24	Eastern NMS	TBD/ Maemong River Fence	TBD	TBD

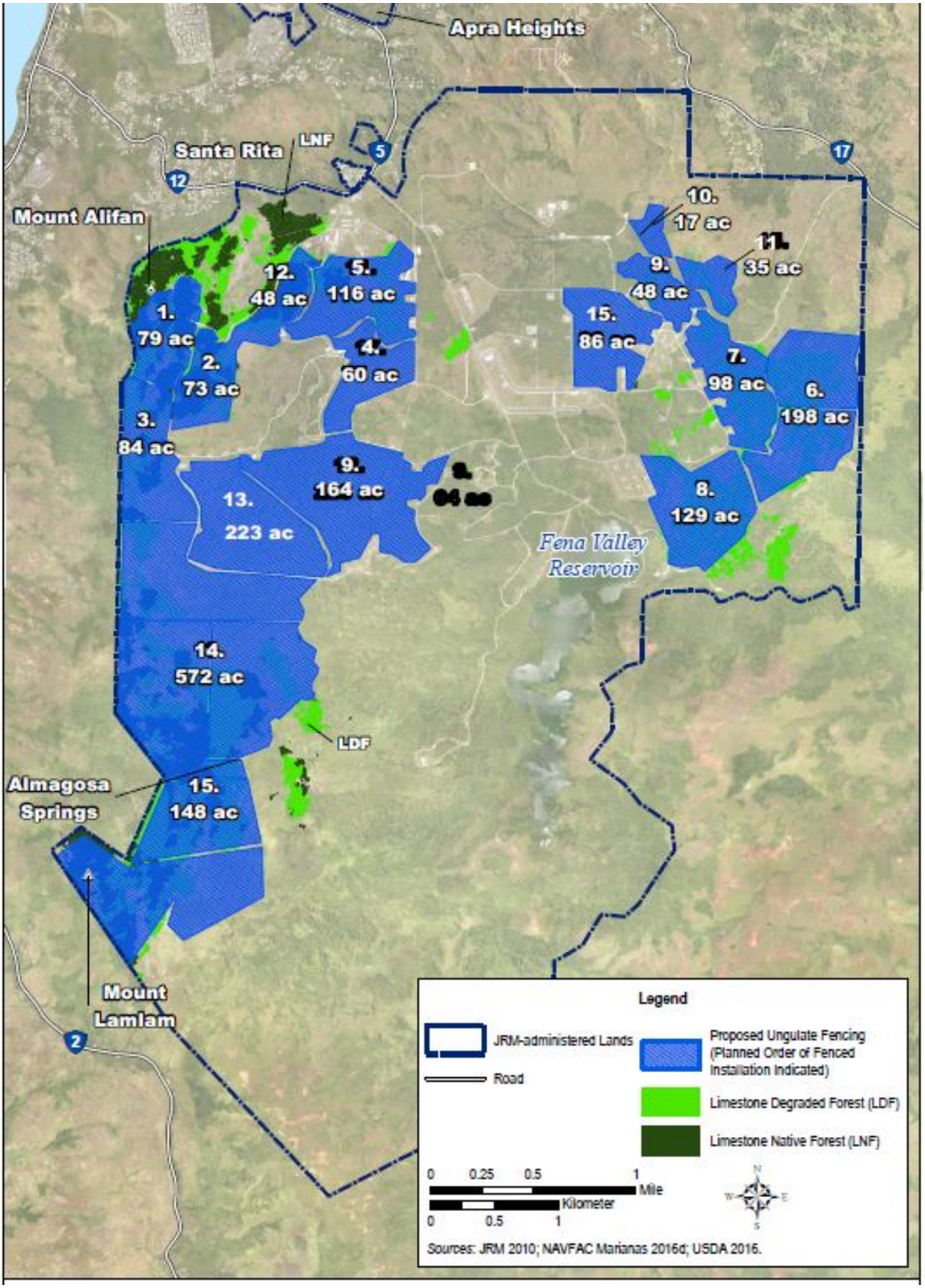


Figure 76. Proposed Ungulate Fencing Units NMS

Range Fire Management Plan for Marine Corps Ranges on Guam

Location: AAFB and Andy South **Period of Performance**: SEP2017 – SEP2021

Project Objective

Create a range fire management plan to reduce range/wildfire potential, protect and enhance natural and cultural resources, integrate applicable permit and reporting requirements and implement ecosystem management goals, sustainable training, and objectives already supported on existing Marine Corps installations.

Conservation Benefit

Management plan goal is to reduce the effects of fires by limiting their frequency, size, and severity while still allowing the USMC to maintain a high level of combat readiness. The fire management plan is being developed in accordance with a conservation measure in the Biological Opinion for the Marine Corps relocation program.

FY21 Status

- CESU awarded to Colorado State in Sept 2017.
- Final Plan expected in September of 2021.

EPR: DPRI: Marine Corps Relocation 2017/2018 amendment to 2015 BO, Conservation Measures to Minimize the Effects of Fire

2019 JRM INRMP Reference: THM-1; 9-68

Seed Collection from *Heritiera longipetiolata* and *Tabernaemontana rotensis*

Location: AAFB **Period of Performance**: OCT2018 - 2021

Project Objective

To collect seeds from federally endangered *Heritiera longipetiolata* and threatened *Tabernaemontana rotensis* identified within project footprints associated with the Guam Relocation.

Conservation Benefit

To minimize impacts of military construction activities to native ecosystems by collecting the seeds from as many mature individuals as possible and preserving the genetic diversity of the species.

FY21 Status

- 54 seeds have been collected from 3 of 5 mature *Heritiera longipetiolata* located within AAFB project footprints.
- 15 *Heritiera longipetiolata* seeds have germinated.
- 1,396 seeds have been collected from 19 of 136 mature *Tabernaemontana rotensis* located within AAFB project footprints.
- 945 *Tabernaemontana rotensis* seeds have germinated.

EPR: DPRI: Marine Corps Relocation 2017/2018 amendment to 2015 BO, Conservation Measures to Contribute to the Recovery of Listed Species.

2019 JRM INRMP Reference: THM-3; 8-49

Forest Restoration at Achae Point

Location: AAFB **Period of Performance:** JUL2021 – JUL2022

Project Objective

Restore native vegetation component to limestone forest rehabilitation site.

Conservation Benefit

Enhance and restore habitats, reduce habitat fragmentation, increase populations of native species, and buffer protected areas.

FY21 Status

- The Cooperative Agreement specifically for the site ended in Sept 2019 and in Oct 2019 the maintenance work was added to the *Serianthes* management Cooperative Agreement.
- As of July 2021, there are a total of 1,026 multi-species native plants within the site and we are utilizing Treeplotter GIS software for managing data (Figure 77).
- Outplanting of *Serianthes nelsonii* seedlings began, and we installed new cages and insect barriers that provide shading and protection to the young trees (Figure 78).
- An irrigation system has been installed on-site for efficient watering of plants.

Original EPR: 1 CR MAR AFB Native Forest Habitat Restoration; M5240NR067
EPR (under Serianthes Management): 2 LC MAR AAFB *Serianthes nelsonii* Monitoring and Management; M5240CN039

2019 JRM INRMP Reference: THM-1; 9-68



Figure 77. Treeplotter GIS software used for managing Route 3A plot.



Figure 78. Serianthes nelsonii seedlings outplanted at Achae Restoration Site on Route 3A.

Vegetation Restoration for the Habitat Management Unit (HMU)

Location: AAFB **Period of Performance:** JUL2021 – JUL2022

Project Objective

- Implement vegetation restoration within the Habitat Management Unit (HMU) utilizing the 2017 HMU Vegetation Restoration Plan.

Conservation Benefit

Enhance and restore habitat and maintain or increase populations of threatened and endangered species, including those extirpated from Guam and potentially reintroduced within the HMU.

FY21 Status

- Five (5) experimental, 30-meter x 30-meter interior plots and 9, 20-meter by 10-meter edge plots.
- Herbicide treatments (hack and squirt method) completed on *Vitex parviflora, Spathodea campanulata* and *Averrhoa bilimbi* on interior and edge plots.
- Outplantings on interior plots, used the following species: *Pandanus tectorius, Ixora triantha, Premna obtusifolia, Procris pedunculata*, and *Ochrosia mariannensis*.
- Outplantings on edge plots used: *Aglaia mariannensis, Glochidion marianum, Hibiscus tiliaceus, Melanolepis multiglandulosa, Ochrosia mariannensis, Pandanus dubius, Pandanus tectorius, Procris pedunculata, Timonius nitidus, Wikstroemia elliptica.*
- Edge plot outplantings planted in a “tiered” plan, with shorter species in the front.
- In FY22 a 1-acre plot will be cleared of *Vitex*, *Spathodea* and *Averrhoa*, and outplanted with native trees, species to be determined but want to include *Artocarpus mariannensis* and *Ficus prolixa* as both are preferred by bats.
- Hope to experiment with outplanting *Ficus prolixa* directly on *Vitex*.

EPR: 1 CR MAR AAFB Native Forest Habitat Restoration; M5240NR067

2019 JRM INRMP Reference: THM-1; 9-68

Table 6. Mortality rates for treated trees.

Species	Hack and Squirt mortality rate on experimental trees	Number removed from 30mx30m plots	Number removed from edge plots
Vitex parviflora	0.73	215	363
Averrhoa bilimbi	0.93		1
Spathodea campanulata	0.75		13

Table 7. Survivorship on interior plot outplanted species

Species	Survivorship rate
Ixora triantha	0.83
Ochrosia mariannensis	0.52
Pandanus tectorius	1.00
Premna serratifolia	0.97
Procris pedunculata	0.13

Table 8. Table of edge plot outplanting survival rates. Survival rates of edge plot outplantings by plot based on the latest monitoring data (01August2021)

Species / Plot	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6	Plot 7	Plot 8	Plot 9	Grand Total
Aglaia mariannensis	N/A	N/A	N/A	N/A	N/A	N/A	0.86	1.00	0.88	0.91
Glochidion marianum	N/A	N/A	N/A	1.00	1.00	0.40	N/A	N/A	N/A	0.81
Hibiscus tiliaceus	N/A	N/A	N/A	N/A	N/A	N/A	1.00	1.00	1.00	1.00
Melanolepis multiglandulosa	1.00	1.00	0.80	N/A	N/A	N/A	N/A	N/A	N/A	0.93
Ochrosia mariannensis	0.88	1.00	0.75	N/A	N/A	N/A	N/A	N/A	N/A	0.88
Ochrosia oppositifolia	N/A	N/A	N/A	N/A	N/A	N/A	1.00	1.00	1.00	1.00
Pandanus dubius	N/A	N/A	N/A	1.00	1.00	1.00	N/A	N/A	N/A	1.00
Pandanus tectorius	1.00	1.00	1.00	N/A	N/A	N/A	1.00	1.00	1.00	1.00
Procris pedunculata	N/A	N/A	N/A	0.07	0.64	0.29	N/A	N/A	N/A	0.33
Timonius nitidus	N/A	N/A	N/A	0.75	0.80	0.80	N/A	N/A	N/A	0.79
Wikstroemia elliptica	1.00	1.00	1.00	N/A	N/A	N/A	0.82	0.60	0.90	0.92
Grand Total	0.98	1.00	0.93	0.63	0.84	0.63	0.92	0.89	0.95	0.87

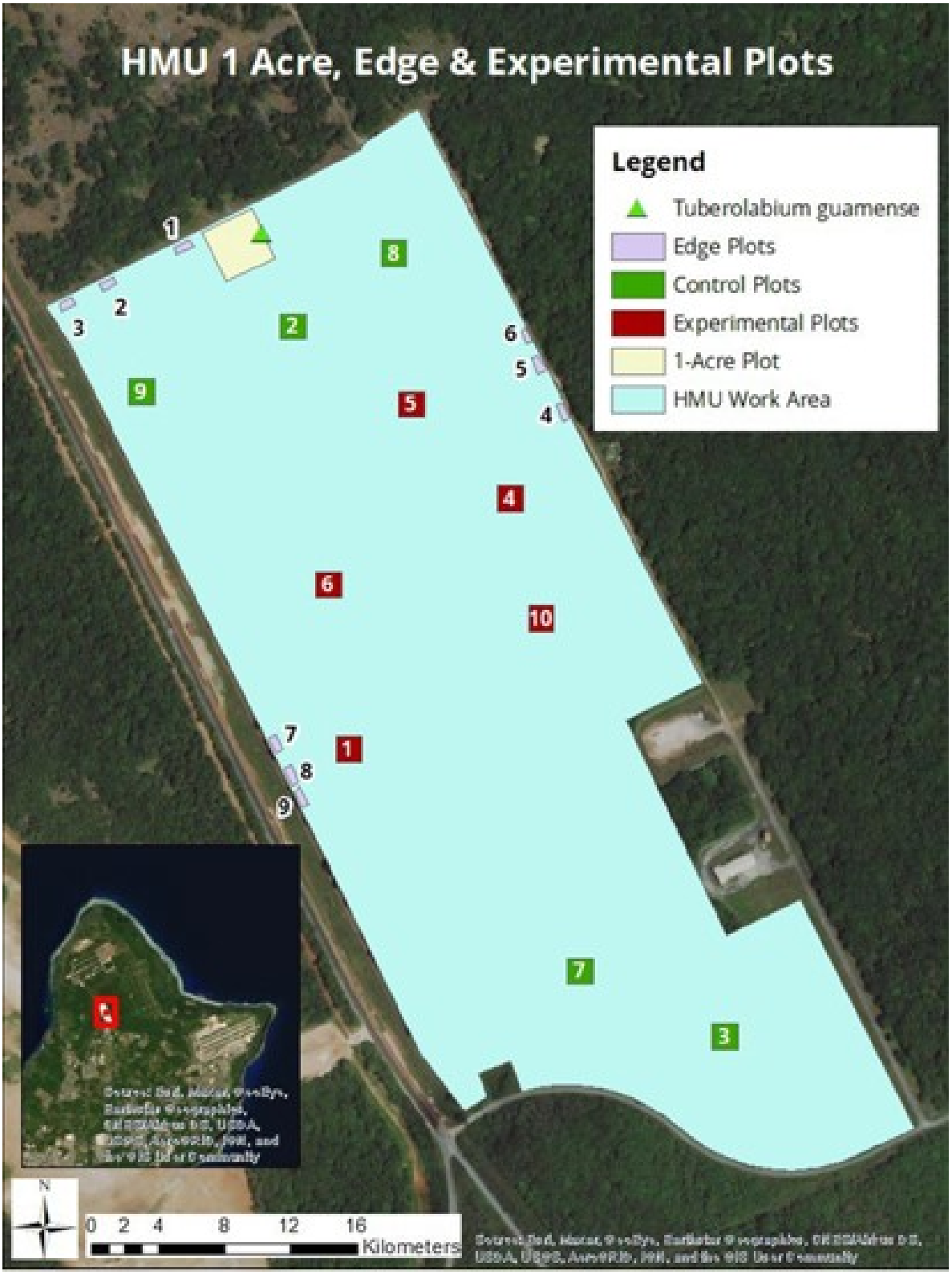


Figure 79. Proposed locations of experimental plots in the HMU.



Figure 80. UOG Center for Island Sustainability Biologist outplanting in the HMU.

Ungulate Fencing

Location: AAFB **Period of Performance:** SEP2019 – AUG2020

Project Objective

- Construct ungulate fencing on AAFB to facilitate eradication of feral pigs and Philippine deer as well as prevent immigration of ungulates within fenced areas.

Conservation Benefit

Supports ungulate eradication goals within fenced areas of AAFB (Figure 81). Ungulate eradication facilitates the revitalization of native habitat that supports viable populations of native species, increases the biodiversity of native species, and contributes to the connectivity with surrounding communities in ways that support improved ecosystem functionality. Contributes to the goals of the Guam NWR as an overlay unit on AAFB.

FY21 Status

- Tarague Triangle fence completed in August 2020. Post ungulate eradication completed in August 2021, with 15 deer and 56 pigs removed. The area is presently being monitored with trail cameras in case ungulates were missed during eradication. This area will provide for approximately 80 acres (32 hecatars) of conservation area for INRMP project implementation and sites for mitigation associated with military construction projects.
- Ungulate fencing 10-year plan, funding has been programmed.
- FY22 funds for constructing second Tarague Triangle Fence.

EPR: 1 RP MAR AAFB Ungulate Fencing; M5240NR043

2019 JRM INRMP Reference: THM-1; 9-68

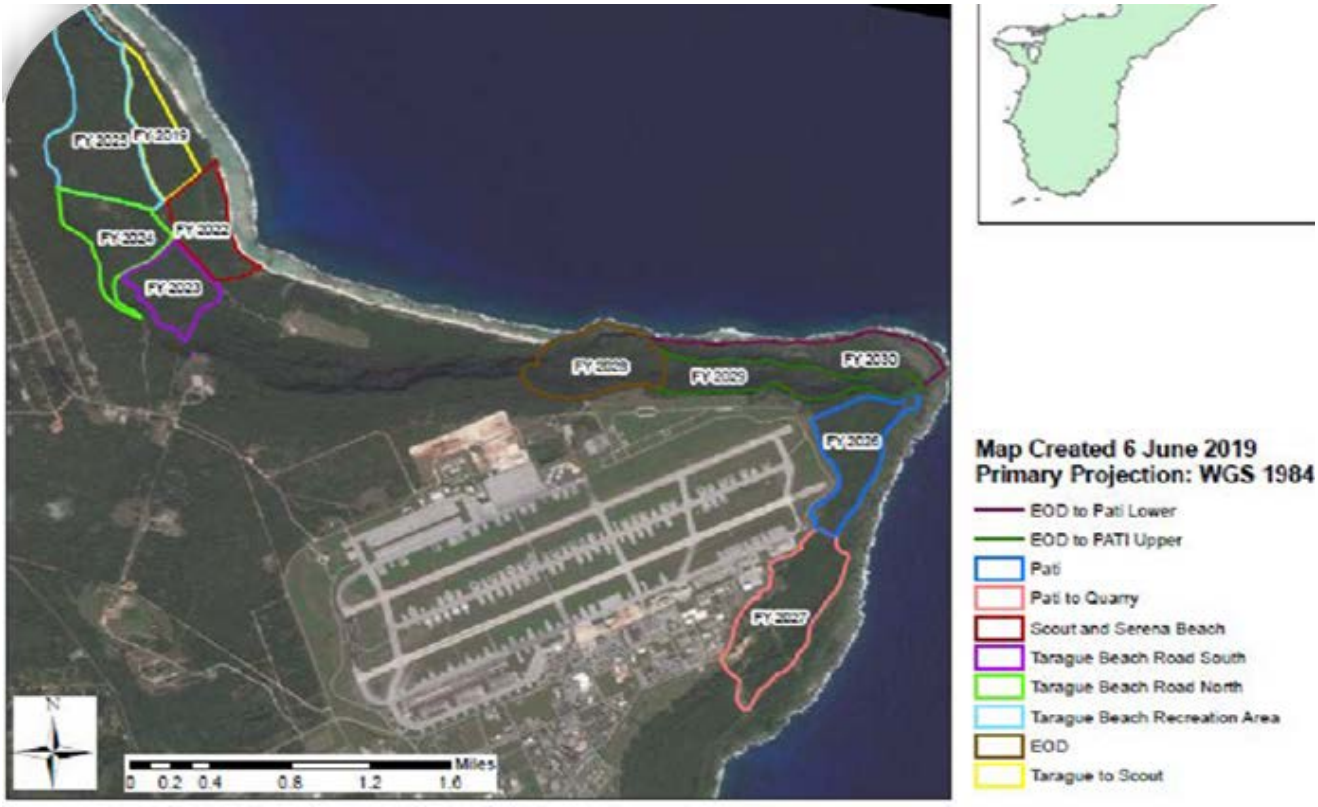


Figure 81. Map depicting areas of programmed ungulate fencing at AAFB.

Ungulate Eradication and Control

Location: AAFB **Period of Performance:** AUG2019 – DEC2021

Project Objective

- Removal of feral pigs and Philippine deer from AAFB to protect and enhance native species and associated habitat.

Conservation Benefit

Enhance and restore habitats to increase populations of native species, particularly threatened and endangered species, as well as promote biodiversity of native plants. Reduce ground disturbance from ungulates to improve soil stabilization and reduce suitability of invasive plant species.

FY21 Status

- Although driven by human health and safety, the AAFB Volunteer Conservation Officer Program (VCOs) conducted depredation hunts to increase roadway safety and remove animals from recreation areas.
- Ecosystems will benefit from the removal of 417 deer and 191 pigs from AAFB as of May 2021 (Figure 82).
- Pig trapping by USDA Wildlife Services throughout the base removed 132 pigs as of June 2021
- Plans in FY22 includes (1) Expanding depredation hunts through a cooperative agreement with White Buffalo, Inc. to remove deer and pigs from the Northwest Field area of AAFB; and (2) Recreational hunting in non-fenced areas will begin soon.

EPR: 1 CP MAR AAFB Ungulate Eradication and Control; M5240NR069

2019 JRM INRMP Reference: THM-1; 9-68

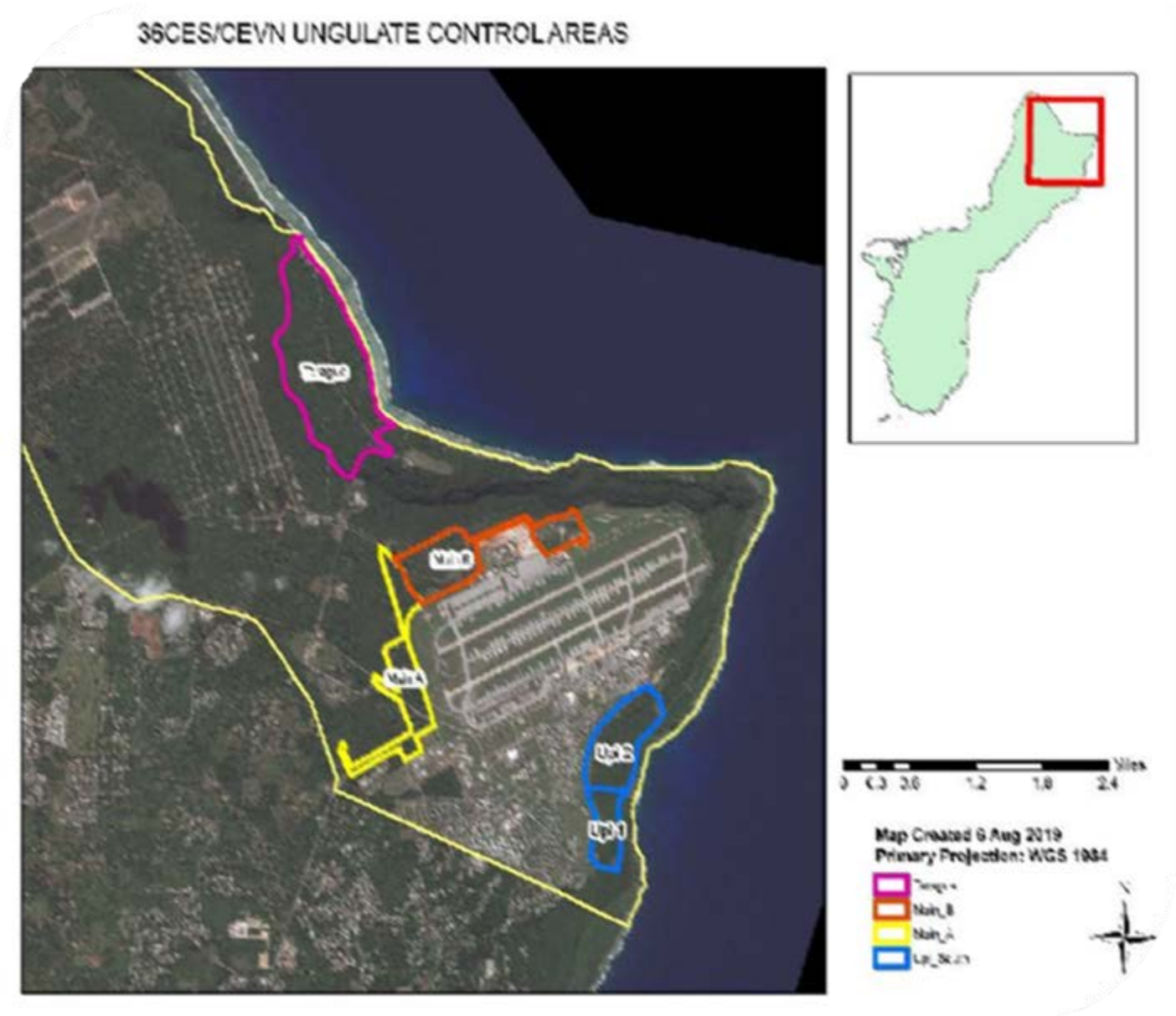


Figure 82. Current AAFB Depredation Areas.

Maintenance of Ungulate Exclosures

Location: AAFB **Period of Performance:** OCT2019 - DEC2021

Project Objective

Annual fence line maintenance and repairs to maintain the efficacy of AAFB ungulate-free exclosures. This project includes 1) weekly inspections, which involves walking or driving the fence-line encompassing multiple ungulate exclosures and conducting any repairs and 2) cutting and trimming the vegetation within 3 feet of each side of the fence monthly to reduce any damage to the fence.

Conservation Benefit

The routine maintenance and repair of ungulate exclosures will enhance the longevity of the ungulate barrier. Regular fence monitoring and repair also has the benefit of early detection to any possible immigration of ungulates into fenced eradicated areas. Monitoring, maintenance and repair all support the purpose of facilitating ungulate-free areas to enhance native forest ecosystem regeneration.

FY21 Status

- Cooperative agreement for weekly HMU inspections awarded September 2020 with added inspections for Tarague fence to be awarded Sept 2021.
- Repairs and replacement of HMU fence section awarded July 2021.

EPR: 2 BO MAR AAFB Maintenance of Ungulate Exclosure; M5240NR045
EPR: 1 CR MAR AAFB BTS Barrier Maintenance in HMU; M52401000

2019 JRM INRMP Reference: THM-1; 9-68

Northwest Field Ungulate Control Area Fencing and Eradication - AAFB

Location: AAFB **Period of Performance:** JUL2020-FEB2022

Project Objective

The project will install ungulate-proof fencing around the limestone plateau in the vicinity of the Live Fire Training Range Complex and subsequently eradicate pigs and deer from the exclosure.

Conservation Benefit

Feral pigs and deer are among the most significant threats to sensitive limestone forests; ungulate removal will promote growth of native species and increased survival of threatened and endangered species.

FY21 Status

Fencing contract awarded and target completion is September 2021.
USDA began population estimates in March 2021 and began removals in August 2021.

EPR: DPRI: Marine Corps Relocation 2017/2018 amendment to 2015 BO, Conservation Measures to Minimize the Effects of Invasive Species.

INRMP FY2019 Reference: THM-1; 9-68

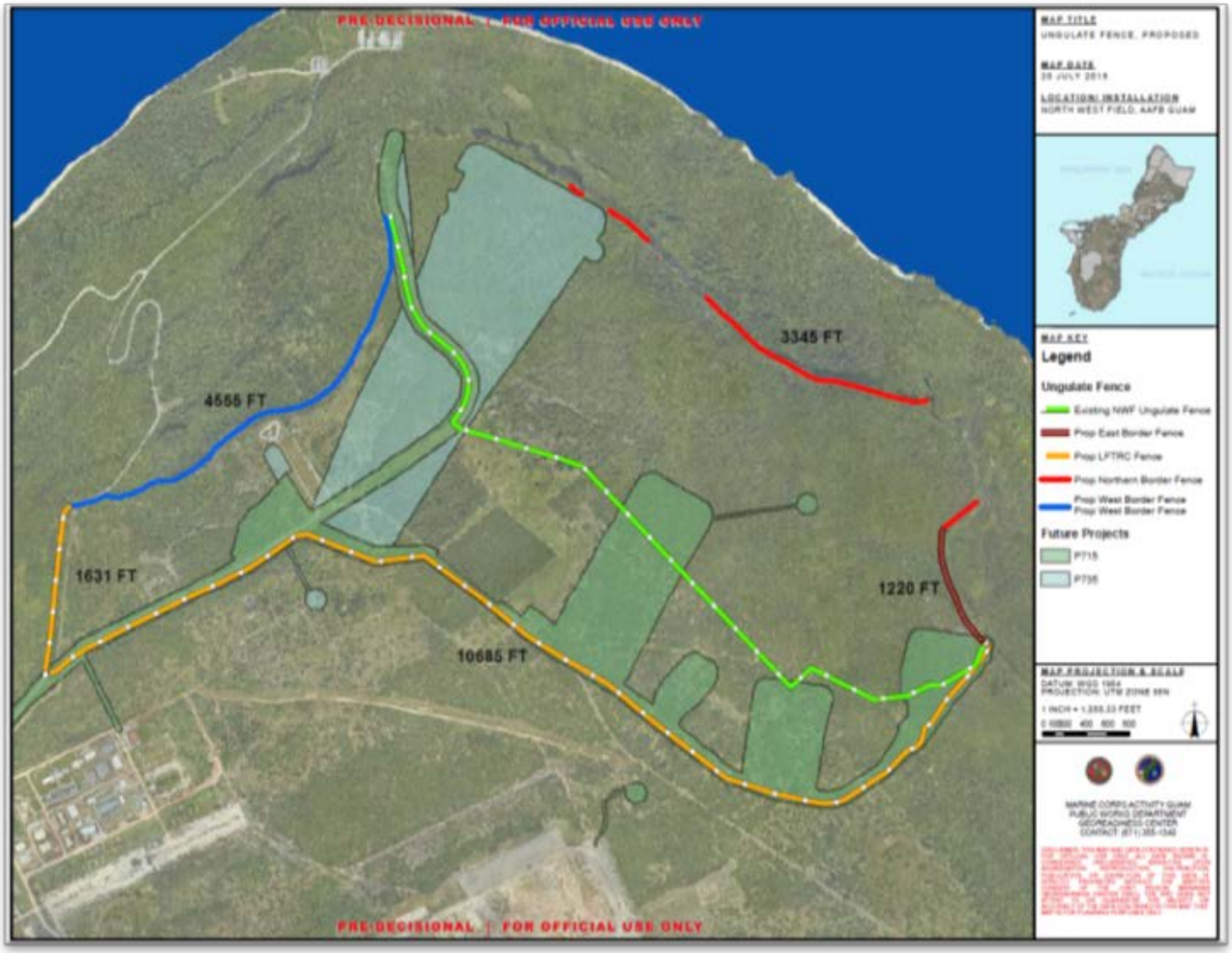


Figure 83. Location of Ungulate Exclusion Fence (Yellow/Blue/Red) Targeted for ungulate eradication at future USMC LFTRC at NWF, AAFB (Gaps are Sheer Cliff Areas)

Salvage and Transplantation of ESA-listed Orchids – NBG TS and AAFB

Location: NBG TS; AAFB **Period of Performance:** 2017 - 2022

Project Objective

To salvage and transplant federally threatened *Bulbophyllum guamense, Dendrobium guamense,* and *Tuberolabium guamense* identified within construction footprints associated with the Guam Relocation.

Conservation Benefit

To minimize impacts of military construction activities to native ecosystems by salvaging as many healthy individuals as possible and preserving the genetic diversity of each species.

FY21 Status

Bulbophyllum guamense

- One individual salvaged on March 2021 and transplanted to the FES is undergoing 12 months of monitoring.
- All of the 71 individuals that were identified, salvaged, and transplanted to the Forest Enhancement Site (FES) from project footprints on Finegayan survived at least 1 year after transplantation.
- One individual in the Government nursery undergoing maintenance & monitoring, plans to outplant to FES sometime in 2021.

Dendrobium guamense

- Five (5) individuals salvaged on March 2021 and transplanted to the FES is undergoing 12 months of monitoring.
- Sixteen (16) individuals salvaged on August 2021 and transplanted to the FES is undergoing 12 months of monitoring.

- Eighteen (18) of the 21 individuals that were identified, salvaged, and transplanted to the Forest Enhancement Area from project footprints on Finegayan and Andersen South since 2017 survived at least 1 year after transplantation.

Tuberolabium guamense

- 173 individuals salvaged on March 2021 and transplanted to the FES is undergoing 12 months of monitoring.
- 170 individuals salvaged on August 2021 and transplanted to the FES is undergoing 12 months of monitoring.
- 76 individuals salvaged on August 2021 and transplanted to the FES is undergoing 12 months of monitoring.
- 15,385 individuals have been identified in NBG Telecommunications Site and throughout AAFB since 2017.
- 4,826 of the 6,357 individuals that were salvaged and transplanted to the Forest Enhancement Area survived at least 1 year after transplantation.

EPR: DPRI: Marine Corps Relocation 2017/2018 amendment to 2015 BO, Conservation Measures to Contribute to the Recovery of Listed Species.

INRMP FY2019 Reference: THM-3; 8-49

Salvage and Transplantation of *Cycas micronesica* – NBG TS and AAFB

Location: NBG TS; AAFB **Period of Performance:** various, multiple awards

Project Objective

To salvage and transplant federally threatened *Cycas micronesica* identified within construction footprints associated with the Guam Relocation.

Conservation Benefit

To minimize impacts of military construction activities to native ecosystems by salvaging as many healthy individuals as possible and preserving the genetic diversity of the species.

FY21 Status

NBG Telecommunications Site

- Four of the six adult cycads salvaged and transplanted to an area of the Forest Enhancement Site survived pass the 1-year maintenance and monitoring period.
- Quarterly monitoring on-going via cooperative agreement through the CESU network to Island Eco Services

Northwest Field, AAFB

- Pup salvage was completed in December 2019. Of the 1,503 pups salvaged, 22 survived pass the 1-year maintenance and monitoring period and were transferred to the Government nursery for continued maintenance until outplanting to the FES.
- 22 of the 27 direct salvage and outplanting trees survived pass the 1-year maintenance and monitoring period. Quarterly monitoring on-going via cooperative agreement through the CESU network to Island Eco Services.
- 1,690 cycad seeds were collected. To date, 900 seeds are being maintained and monitored in the Government or Government-approved nursery. 325 seeds have

leaf emergence. 129 of these seedlings have survived pass the 1-year maintenance and monitoring period and were transferred to the Government nursery for continued maintenance until outplanting to the FES (Figure 84).

Munitions Storage Area (MSA), AAFB

- Seven of the nine pups and/or stem cuttings salvaged from five cycads and transplanted to pots within a government-approved nursery survived pass the 1 year maintenance and monitoring period. These cycads are being maintained in the Government nursery until outplanting to the FES.
- In March 2021, three pups and/or stem cuttings were salvaged from two cycads and transplanted to pots within a government-approved nursery and are undergoing 1 year of maintenance and monitoring.

Andersen South, AAFB

- Four of the eight pups and stem cuttings salvaged from six cycads and transplanted to pots within a government-approved nursery survived pass the 1-year maintenance and monitoring period. These cycads are being maintained in the Government nursery until outplanting to the FES (Figure 85).
- In August 2021, 10 pups and/or stem cuttings were salvaged from four cycads and transplanted to pots within a government-approved nursery and are undergoing 1 year of maintenance and monitoring.

EPR: DPRI: Marine Corps Relocation 2017/2018 amendment to 2015 BO, Conservation Measures to Contribute to the Recovery of Listed Species.

2019 JRM INRMP Reference: THM-3; 8-49



Figure 84. Cycad seedlings in Government-approved nursery.



Figure 85. Cycad heads in Government nursery.

Salvage and Transplantation of *Cycas micronesica* – MSA-1 Igloo Project (P-3105, Phase 3)

Location: MSA-1, AAFB **Period of Performance:** DEC2020 - TBD

Project Objective

Objective is to meet the special conditions and success criteria stated in the USFWS Biological Opinion Ref: 01EPIF00-2019-F-0012. To salvage, propagate, and out plant the federally threatened *Cycas micronesica* and *Tabernaemontanae rotensis* identified within the construction footprint of the Munitions Storage Area (MSA-1) Igloo Project, P-3105 Phase 3 (Figure 86).

Conservation Benefit

To minimize impacts of military construction activities to native ecosystems by salvaging as many individuals of *C. micronesica* and *T. rotensis* as possible and preserving the genetic diversity of the species.

FY21 Status

- Salvaging of Cycas micronesica and Tabernaemontana rotensis
- Total of 556 cycad plant materials were salvaged from Blocks 1 through 5 and completed on 19 April 2021 (Table 9) as part of P-3105.
- 54 seeds were collected from *T. rotensis* trees located on Block 5.
- Contractor's Plant Nursery
- As of July 2021, a total of 147 cycad plant parts have initiated root growth.
- As of July 2021, (18) seeds of *T. rotensis* have germinated.
- Contractors will continue to maintain the salvaged cycads until they are ready for outplanting in the AAFB fenced plots.

EPR: Biological Opinion for MSA-1 Igloo, P-3105 Phase 3 (Ref # 01EPIF00-2019-F-0012)

2019 JRM INRMP Reference: No reference (new project post INRMP).

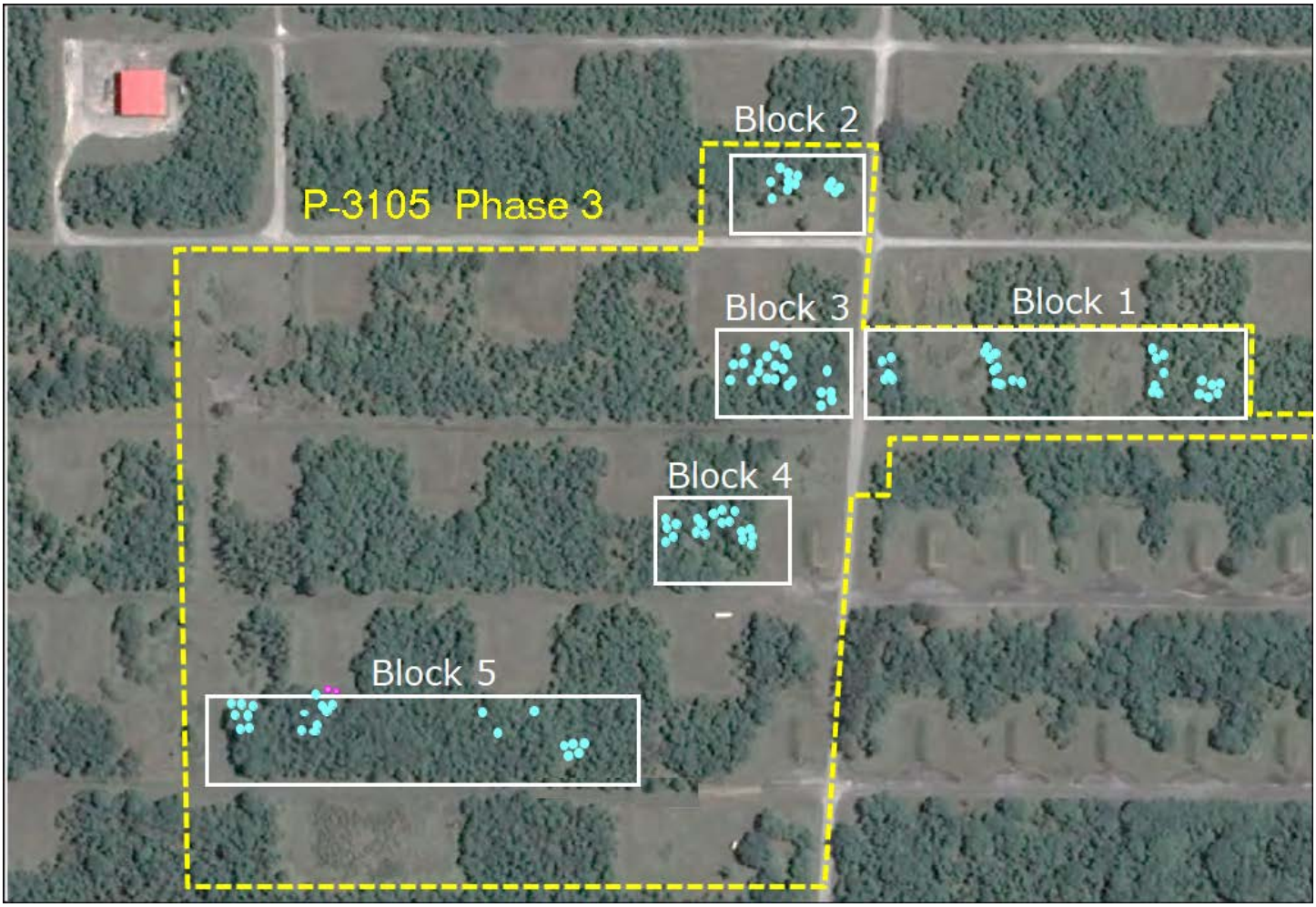


Figure 86. Blocks 1 to 5 in MSA-1 Igloo Project Site (P-3105 Phase 3), NWF Anderson AFB, Guam

Table 9. Summary of Cycad salvaging for MSA-1 Igloo Project.

SUMMARY OF CYCAD SALVAGING WORK

Dates	Block	Distinct Cycad Trees	Heads	Pups	Seeds
8 April 2021 – 13 April 2021	1	35	81	87	18
14 April 2021	2	13	34	6	18
15 April 2021	3	26	38	66	9
16 April 2021	4	28	24	30	44
19 April 2021	5	22	19	50	32
TOTALS		**124**	**196**	**239**	**121**

556 total plant parts



Figure 87. Contractor salvaging *Cycas micronesica* from MSA-1 project site.



Figure 88. Contractor's Plant Nursery containing plant material salvaged from MSA-1 Project site.



Figure 89. Germinated cycad seeds at Contractor's plant nursery.

Invasive Plant Control – NBG TS and AAFB

Location: NBG TS; AAFB **Period of Performance:** SEP2020 – MAR2022

Project Objective

This project intends to eradicate limited infestations of *Antigonon leptopus* and *Mimosa diplotricha* in the North Finegayan and Finegayan Forest Enhancement Sites, as well as conduct trials to determine options for control of *Mikania micrantha*.

Conservation Benefit

Invasive plants can outcompete native vegetation and interfere with restoration efforts for threatened and endangered species. Removal of invasive plants, particularly in new or smaller infestations where it may be possible to eradicate the invasive species from sensitive areas, will improve survivorship and growth of native plant species during future restoration efforts.

FY21 Status

- *M. diplotricha* site re-burned by poachers, with additional buffer areas burned during a controlled burn exercise by Guam Dept. of Agriculture.
- *A. leptopus* cut at the base before herbicide application.
- Targeted herbicide applications monthly at both sites.
- *M. micrantha* plots established and various herbicide/mechanical control combinations are being tested (Figure 90).

EPR: DPRI: Marine Corps Relocation 2017/2018 amendment to 2015 BO, Conservation Measures to Minimize the Effects of Invasive Species.

2019 JRM INRMP Reference: THM-3; 8-49, TIS-1; 8-52, THM-1; 9-68



Figure 90. *Mimosa diplotricha* following herbicide treatment.

North Finegayan Forest Enhancement Site Ungulate Fencing and Eradication

Location: NBG TS; AAFB **Period of Performance:** SEP2020 – SEP2022

Project Objective

The project will eradicate feral pigs and Philippine deer in both phases of the North Finegayan Forest Enhancement Site.

Conservation Benefit

Feral pigs and deer are among the most significant threats to sensitive limestone forests; ungulate removal will promote growth of native species and increased survival of threatened and endangered species.

FY21 Status

- The North Finegayan FES Phase 1 exclosure (Figure 91) was completed in March 2020 with eradication completed in October 2020. 323 deer and 85 pigs were removed.
- The Phase 2 fence was completed in August 2021, with eradication beginning immediately after closure.
- Phase 2 eradication is targeted for completion in October 2021.

EPR: DPRI: Marine Corps Relocation 2017/2018 amendment to 2015 BO, Conservation Measures to Minimize the Effects of Invasive Species.

2019 JRM INRMP Reference: THM-33; 8-49

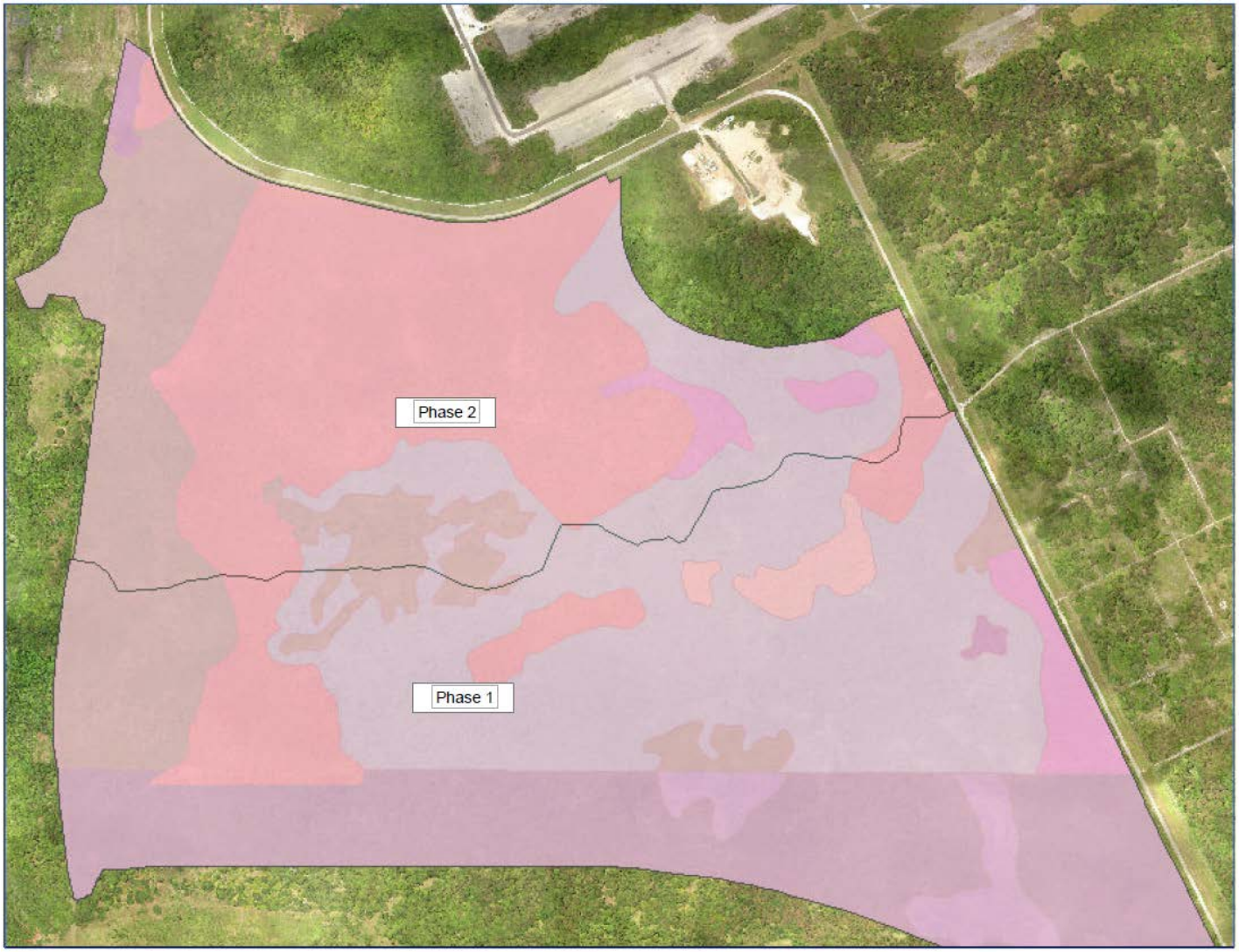


Figure 91. Ungulate fence

Haputo Ecological Reserve Area Ungulate Fencing

Location: NBG TS **Period of Performance:** AUG2019 – Mar2022

Project Objective

Haputo Ecological Reserve Area will be fenced to exclude feral ungulates. The northern section will encompass 168 acres while the southern section encloses approximately 116 acres.

Conservation Benefit

The ungulate fence (Figure 92) will exclude deer and pigs that destroy native vegetation and contribute to erosion that harms nearshore reefs. Ungulate removal will promote growth of native species and increase survival of threatened and endangered species.

FY21 Status

- N. Haputo ERA fence installation is ongoing. Target completion is March 2022.
- S. Haputo ERA fence installation is expected to be complete in October 2021.
- Eradication for the southern fence will begin in FY22.

EPR: DPRI: 2015 Navy-USFWS Guam Micronesia Kingfisher MOA.

2019 JRM INRMP Reference: THM-2; 8-48



Figure 92. Haputo Ecological Reserve Area ungulate fence alignment.

Implementation Plan for the North Finegayan Forest Enhancement Site

Location: NBG TS; AAFB **Period of Performance:** JUL2019 – JAN2022

Project Objective

The project will develop a site-specific plan for Phase 1 of the North Finegayan Forest Enhancement Site (Figure 93) to address regulatory compliance, infrastructure needs, invasive plant removal options, and sequencing for native species outplanting. An irrigation study and implementation plan for Phase 2 will also be developed.

Conservation Benefit

Forest enhancement efforts will improve habitat for native species, including threatened and endangered plants and animals.

FY21 Status

- Draft final implementation plan under review.
- Currently working on invasive tree control trials
- Irrigation study and Phase 2 plan development began in August 2021.

EPR: DPRI: Marine Corps Relocation 2017/2018 amendment to 2015 BO, Conservation Measures to Contribute to the Recovery of Listed Species.

2019 JRM INRMP Reference: THM-1; 9-68

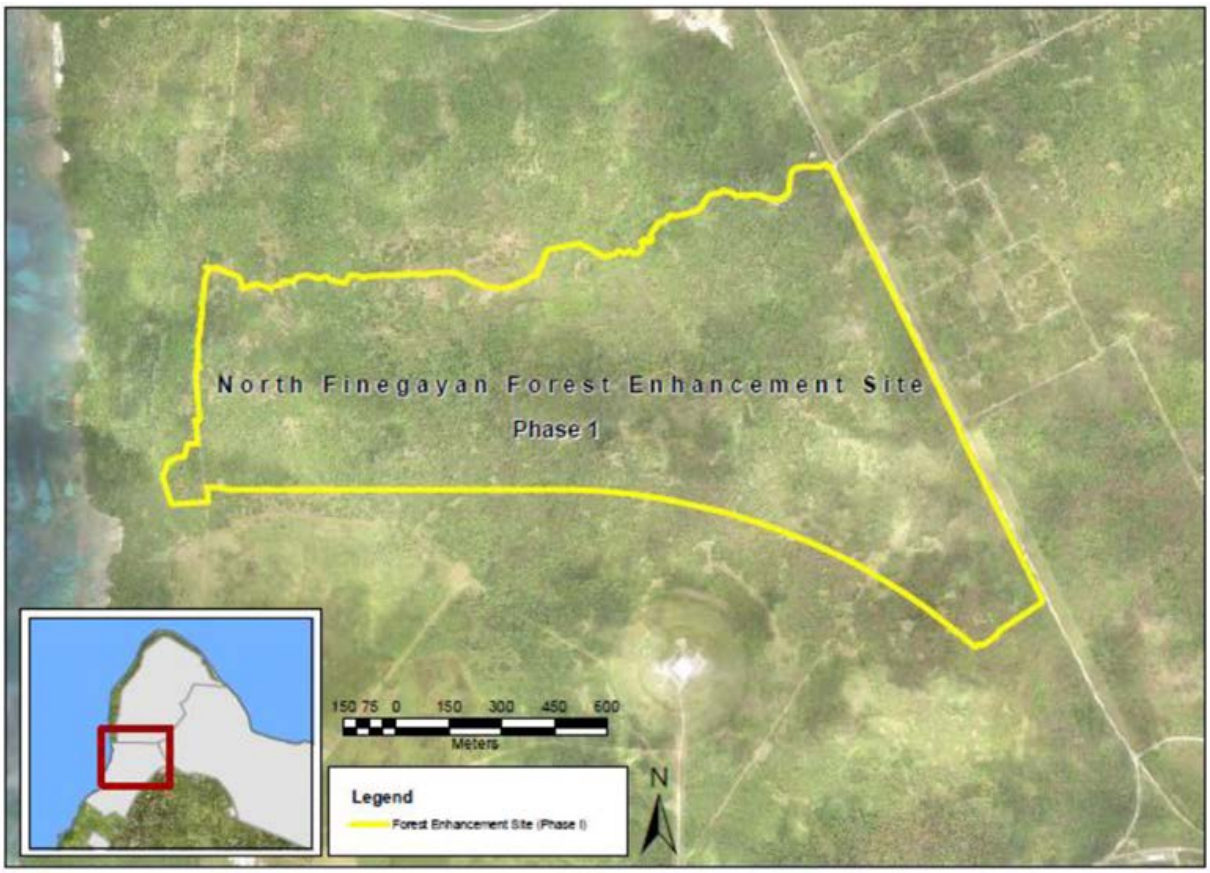


Figure 93. Map depicting North Finegayan Forest Enhancement Site Phase 1.

TERRESTRIAL PROTECTED SPECIES MANAGEMENT

Biomonitor Support for Natural Resource Management at Joint Region Marianas Area of Responsibility

Location: JRM AOR **Period of Performance:** JUL2019 – JUL2022

Project Objective

Provide biomonitor support to assist the Department of the Navy in natural resource management across lands under JRM AOR.

Conservation Benefit

Biomonitors will conduct surveys for threatened and endangered species, culturally valuable plant species, rare plants, and non-native/invasive species (Figure 94). Activities support the GMK MOA (2015) and the Biological Opinion for the Department of the Navy's Relocation of the U.S. Marine Corps from Okinawa to Guam and Associated Activities on Guam (USFWS, 2015, 2017, 2018).

FY21 Status

- Awarded as cooperative agreement through the CESU network to UOG-CIS on 29 July 2019.

EPR: DPRI: Marine Corps Relocation 2017/2018 amendment to 2015 BO, Conservation Measures to Contribute to the Recovery of Listed Species.

2019 JRM INRMP Reference: TPS-1; 7-55



Figure 94. Biomonitor conducting survey for T&E species.

Monitoring Salvaged and Translocated ESA-listed Plants and Invertebrates on JRM Lands on Guam

Location: JRM **Period of Performance:** SEP 2020-2021

Project Objective

Monitor and maintain salvaged and translocated plants and invertebrate species listed under the ESA (16 USC 1531 et seq.) located at the Forest Enhancement Area and the Haputo Ecological Reserve Area at Naval Base Guam Telecommunication Site (NBGTS) and the Northwest Field Ungulate Control Area at AAFB.

Conservation Benefit

Monitoring to allow for management actions to enhance and restore habitat, reduce habitat fragmentation, buffer protected areas, and implement new conservation strategies.

FY21 Status

- Monitoring and maintenance began Sept 2020 and is ongoing.
- Monitoring and maintenance of *Cycas micronesica*:
    - 29 of 33 *C. micronesica* alive through July 2021. All plants free of pests except for one. Most in good condition and a few plants have put out reproductive structures.





Figure 95 - 96. Translocated *Cycas micronesica* being monitored and maintained.

- Monitoring of ESA-listed orchids:
    - Monitoring of orchids is ongoing. Flowering and fruiting was documented throughout the translocated populations for both *Bulbophyllum guamense* and *Tuberolabium guamense*. New *T. guamense* seedlings have been noted.



Figure 97. Translocated *Tuberolabium guamense* with open seed pod.

- Monitoring of butterfly host plants:
    - Most recent monitoring found 12 eggs and a chrysalis on the host plants. Previous monitoring noted 69 eggs, 1 larva, 4 chrysallids, and 2 adults.









Figures 98 – 101. Various life stages of *Hypolimnas octocula mariannensis* found on translocated butterfly host plants being monitored.

- Monitoring of *Partula radiolata*:
    - Full comprehensive count coming in September 2021. Multiple monitoring events found many empty *P. radiolata* shells on the ground under debris and rocks. *P. radiolata* and *P. gibba* are found at the site closer to the ocean and only *P. radiolata* found at the other site.



Figure 102. Translocated *Partula radiolata* being monitored at Haputo

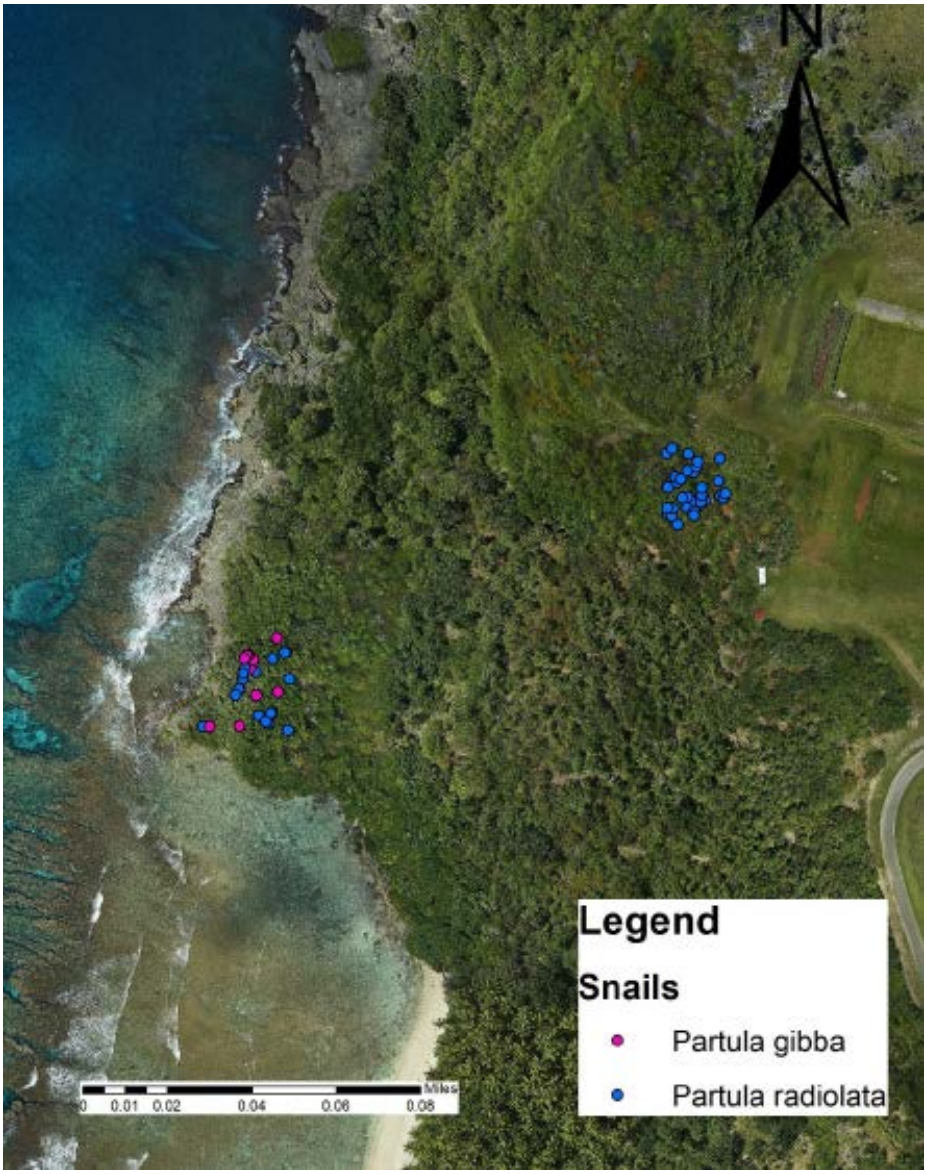


Figure 103. Locations of ESA-listed snail species being monitored at translocation sites near Haputo.

EPR: Listed plant surveys, Propagation, planting, and Establishment in the Wild; 61128NR209

2019 JRM INRMP Reference: THM-2; 6-39, TPS-5; 9-77

Salvage and Transplantation of *Partula radiolata* – NBG TS and AAFB

Location: Andersen South, Haputo ERA

Period of Performance: JAN2019 – FEB2021

Project Objective

To salvage and translocate federally endangered *Partula radiolata* identified within the construction footprint on Andersen South associated with the Guam Relocation.

Conservation Benefit

To minimize impacts of military construction activities to native ecosystems by salvaging as many healthy individuals as possible and preserving the genetic diversity of the species.

FY21 Status

- Snail surveys took place from January 2019 to March 2020.
- *P. radiolata* were located in two main areas of the project footprint.
- 3,850 *P. radiolata* were salvaged from the project footprint and translocated to the Haputo Ecological Reserve Area.
- Bi-weekly snail monitoring completed Haputo Ecological Reserve Area to count the number of marked (i.e., translocated) and unmarked snails.
- Quarterly monitoring on-going via cooperative agreement through the CESU network to Island Eco Services.

EPR: DPRI: Marine Corps Relocation 2017/2018 amendment to 2015 BO, Conservation Measures to Contribute to the Recovery of Listed Species.

2019 JRM INRMP Reference: TPS-1; 7-55

Native Plant Seed Collection, Salvage, Storage, and Nursery Propagation for Forest Enhancement

Location: NBG TS **Period of Performance**: OCT2017 – OCT2022

Project Objective

Collect salvaged native plant species and their seeds to propagate for use in limestone forest enhancement projects in Northern Guam. Design, install and operate a native plant nursery to maintain and provide healthy plant materials.

Conservation Benefit

To maintain a stock of healthy native plants ready to be used in forest enhancement planting. Native plant species from within DoD construction areas will be salvaged and propagated at the native plant nursery to maintain genetic diversity.

FY21 Status

- Native plant nursery installed at Finegayan Dec 2018 – March 2019.
- Irrigation installed July 2019, water filtration system pending installation.
- 30 species of rare, high value, native, threatened and endangered plant species.
- Over 500 *T. rotensis* plants in propagation.
- Developed species-specific protocols for plant propagation and care
- Biosecurity program to manage pests, diseases and pathogens.
- FWS removed the requirement for Contractor to possess a 10(a)(1)(A) permit for collection of threatened and endangered species in June 2020.

2019 JRM INRMP Reference: TPS-1; 7-5



Figure 104. *Tabernaemontana rotensis* seedlings in the nursery.



Figure 105. *Tabernaemontana rotensis* seed being prepared for water treatment before sowing.

Monitoring of Butterfly Host Plant Sites and Tarague Snail Colony

Location: AAFB **Period of Performance:** AUG2020 – AUG2022

Project Objective

Collect baseline data on listed butterfly and snail populations.

Conservation Benefit

Monitoring will allow for management actions to enhance and restore habitat and increase efforts to recover listed butterfly and snail populations in Guam.

FY21 Status

- 4 plots in Tarague snail colony have been sampled by mark recapture during the dry season (data is pending analyses) and rainy season sampling upcoming.
- The snail colony has been delineated and covers an approximate area of 3 hectares. Surveys are ongoing with the southeast corner of the colony's location to be covered soon.
- Butterfly host plants at 3 sites are monitored twice a month for eggs, larvae or adult presence. There is also one alternate site identified.
- Butterfly host plant sites are monitored with trail cameras to document ungulate browsing.
- Project was delayed due to COVID, SOW modifications and staffing issues. Data collection began in March for snails and June for butterflies.
- Preliminary data is showing high levels of butterfly egg parasitism, possibly ~70%. The Exact numbers are hampered by not knowing how long the eggs (hatched or parasitized) and chrysalids last in one spot. Double counting is a possibility.
- Deer herbivory on host plants has yet to be documented.

EPR: Monitoring and Surveys for Listed Tree Snails, Butterflies, and Plants; M5240CN048

2019 JRM INRMP Reference: TPS-1; 7-5

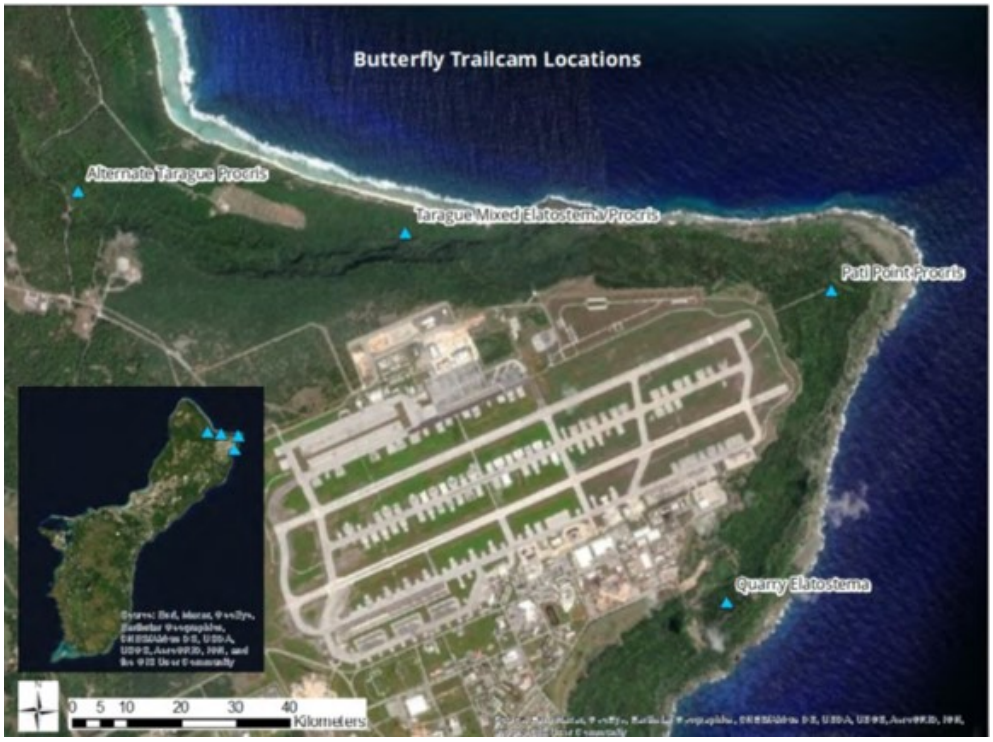


Figure 106. Butterfly Host plant sites

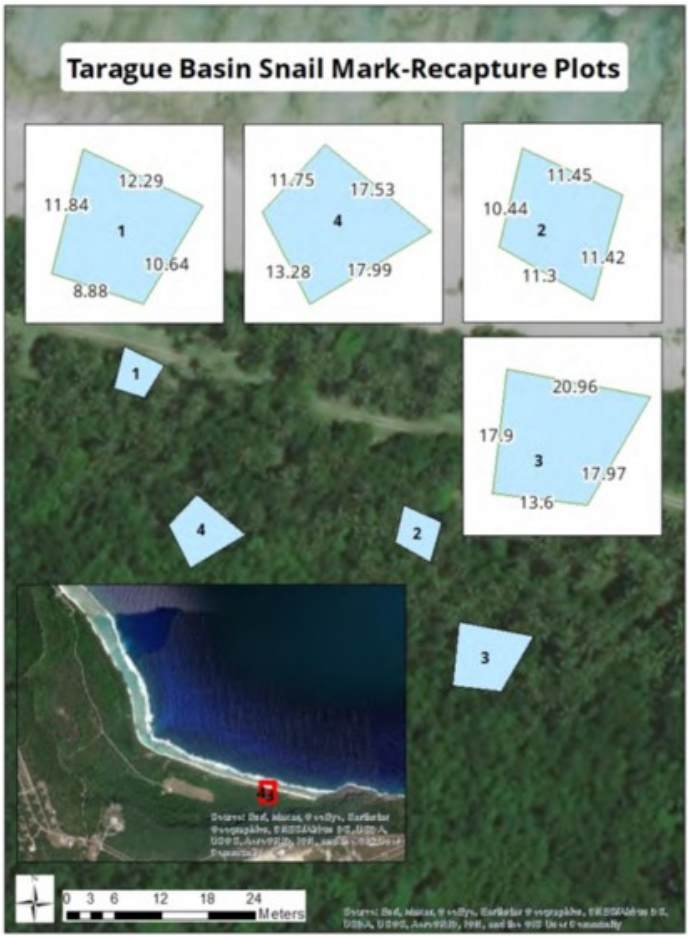


Figure 107. Snail colony and mark recapture plot locations



Figure 108. Snail colony delineation

JRM *Serianthes nelsonii* Propagation, Outplanting, and Maintenance

Location: JRM **Period of Performance**: JUL2021-2022

Project Objective

This project is to propagate, outplant, and maintain subpopulations of the federally endangered *Serianthes nelsonii* (tree) on Joint Region Marianas (JRM) managed lands.

Conservation Benefit

Increasing the number of *Serianthes* trees would improve species survival, enhance native habitat, increase the biodiversity of native species, and contributes to the connectivity with surrounding communities in ways that support improved ecosystem functionality.

FY21 Status

- Cooperative agreement with University of Guam awarded late July 2021. Propagation of seeds and outplanting planning meetings ongoing.

EPR: 1 RP MAR JRM *Serianthes nelsonii* Propagation, Outplanting, and Maintenance; 61128NRSNI

2019 JRM INRMP Reference: TPS-5; 9-76

Serianthes nelsonii Monitoring, Outplanting and Management - AAFB

Location: AAFB **Period of Performance:** New CESU July 2021 – July 2022

Project Objective

Maintenance and monitoring of mature *Serianthes nelsonii* tree in Northwest Field at Ritidian point, including in situ seedlings and fence maintenance, monitoring and maintenance of outplanted seedlings, and nursery propagation and maintenance of seedlings.

Conservation Benefit

Implementation of recovery actions such as increasing populations, insuring against catastrophic events, and testing and implementing new conservation strategies.

FY21 Status

- The mature tree at Ritidian remains stable and is visited on a weekly basis. As of July 2021, there were 66 seedlings within the fence enclosure, and a total of 2,609 seeds collected from January 2020 to July 2021 (Table 10).
- Use of insect barriers, floating row covers on seedlings and an insect screened shade house have resulted in the production of a very healthy set of seedlings for outplanting after just one year in the nursery (Figure 109).
- Up to 50 new *Serianthes* saplings are planned for 2021 and will be placed at the Route 3A Reforestation site and Golf Course plot. As of July 2021, there were 64 seedlings in the rare plant nursery.
- The use of air root pruning in rootbuilder pots are producing excellent fibrous root systems, which should result in improved establishment at the outplanting sites.

EPR: 2 LC MAR AAFB *Serianthes nelsonii* Monitoring and Management; M5240CN039

2019 JRM INRMP Reference: TPS-5; 9-76

Table 10. Serianthes nelsonii seed collection and status from January 2020 to July 2021.

	Seeds Collected	Seeds Planted	No. of explants initiated *in vitro* culture	Seeds in Storage
January 2020	191	0	0	1,954
February 2020	23	0	0	1,977
March 2020	4	0	8	1,973
April 2020	4	0	0	1,977
May 2020	4	0	0	1,981
June 2020	5	140	2	1,844
July 2020	2	0	1	1,845
August 2020	182	30	14	1,983
September 2020	19	0	0	2,002
October 2020	0	0	0	2,002
November 2020	98	0	0	2,100
December 2020	25	0	0	2,125
January 2021	16	0	3	2,138
February 2021	6	0	2	2,142
March 2021	16	0	5	2,153
April 2021	12	0	0	2,165
May 2021	24	0	2	2,188
June 2021	30	0	10	2,208
July 2021	410	0	8	2,609



Figure 109. *Serianthes* sapling at GPEPP plant nursery ready for out planting.

Serianthes nelsonii Propagation, Outplanting, and Maintenance

Location: NBGTS **Period of Performance:** Pending Contract Award

Project Objective

Propagate, Outplant, and Maintain *Serianthes nelsonii* in the Forest Enhancement Area at NBGTS.

Conservation Benefit

It is a requirement under Conservation Measures for the 2017/2018 amendment to 2015 Biological Opinion of the Marine Corps Relocation.

FY 21 Status

- Pending contract award

EPR: DPRI: Marine Corps Relocation 2017/2018 amendment to 2015 BO, Conservation Measures to Contribute to the Recovery of Listed Species

2020 JRM INRMP Reference: TPS-5; 9-76

Cycas micronesica Conservation

Location: AAFB **Period of Performance:** MAY2021 - MAY2022

Project Objective

Maintenance and monitoring of six, 1-acre, permanent fenced cycad (*Cycas micronesica*) plots (Achae Point, Ritidian, Tarague Basin, Golf Course, Tarague North, and Tarague South) (Figure 110).

Conservation Benefit

Research and monitoring on management actions that directly benefit *Cycas micronesica*. The intent is to identify which management actions most benefit the plant and if possible, implement on a broader scale.

FY21 Status

- Recent June 2020 study indicates cycad pollen can remain viable under refrigeration for at least 2 years. May be a new method to preserve genetic diversity (Figure 111) through manual pollination efforts.
- Two new cycad plots (Tarague Triangle North and South) were established inside the Tarague Triangle ungulate exclosure.
- Installed skirt fencing reinforcing the existing perimeter fences of three cycad plots (Achae, Golf Course, Tarague Basin) to fortify from ungulates. (Figure 112)
- A systemic pesticide treatment (Merit®) continues to be applied on a quarterly basis (every 3 months) to increase the trees' resilience to invasive insect pests, while seedlings are treated with direct applications of Distance® to target scale infestations. Treatment continues to show that cycad health is preserved in the managed plots versus the control plots.
- 298 cycad seedlings are monitored and maintained in situ and ex situ. No new seedlings have survived in the areas outside of the managed plots.

EPR: 3 SAR JRM, AAFB – *Cycas micronesica* Management for Conservation; M5240NR061

2019 JRM INRMP Reference: TPS-5; 9-77

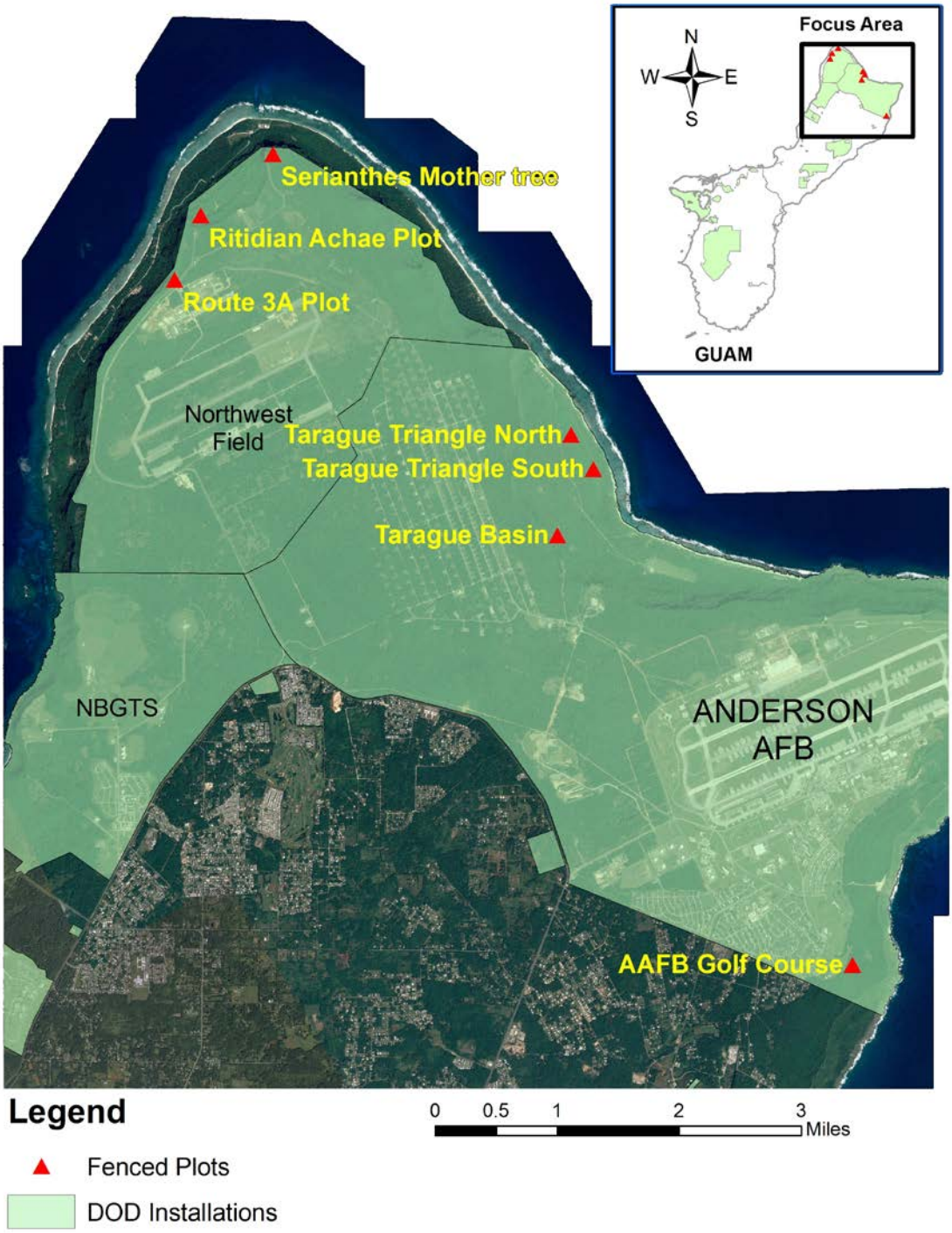


Figure 110. Map of AAFB Fenced Monitoring Plots.

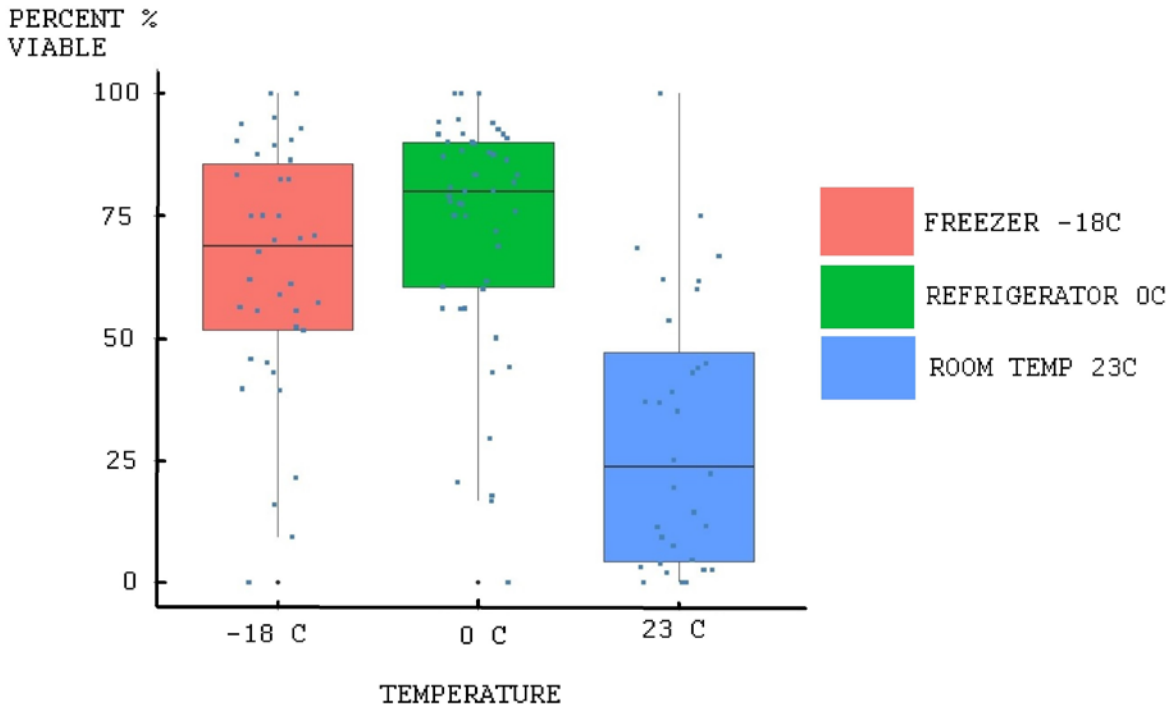


Figure 111. Mean germination rate (%) of pollen stored in freezer, refrigerator, and at room temperature.



Figure 112. UOG installing additional fence skirting material to prevent ungulate intrusion.

Green and Hawksbill Sea Turtle Nesting Habitat – Invasive Plant and Predator Control

Location: NBG **Period of performance:** SEP2020 – SEP2021

Project Objectives

- Conduct sea turtle surveys on NBG beaches
- Monitor sea turtle nesting areas
- Conduct predator control

FY21 Status

The goal of this annually recurring project is to protect and enhance the sea turtle nesting population on NBG beaches. Between October 2020 and July 2021, the following beaches were monitored: Spanish Steps, Gab Gab, San Luis, Tipalao, Dadi, Reserve Craft, Polaris Point, Family and Haputo. Monitoring methods included visual surveys along beach transects and installation of trail cameras near nests. Turtle nesting activities were observed solely at Spanish Steps. On various days, monitor lizards and ghost crabs were observed at nesting locations. Over the ten-month period, the excavation of nearly 40 nests determined mean clutch size (n=66), mean hatch success (66%), mean emergence success (65%), and clutch size (range: 3 to 117). The wide range in clutch size, relatively low mean hatch success and emergence success, and the depredation of monitor lizards and ghost crabs demonstrate the recurring need to monitor NBG beaches and conduct predator control.

EPR: 1 CP MAR NBG Benthic Habitat and Coral Mapping and Management (CHS); 61755NR818

2019 JRM INRMP Reference: MHM-1 (5-98); MHM-2 (5-99); MHM-6 (5-101); MEDU-2 (5-105)

Sea Turtle Monitoring, Protection, and Educational Outreach - AAFB

Location: AAFB **Period of Performance:** JUL2018 – DEC2021

Project Objective

To implement management techniques and methodologies to monitor nesting sea turtles on AAFB. These methodologies include but are not limited to: collection of consistent data to determine population demographics, reduce mortality and increase natural survivorship, increase sea turtle awareness of AAFB units and beach stakeholders, and create/maintain a robust database for long-term monitoring data that can support future research and detect trends. Ensure active nests are protected until hatchlings emerge. Conduct two beach clean-ups and other educational outreach activities for public awareness regarding sea turtles.

Conservation Benefit

Implement recovery actions by conducting long-term monitoring to determine population estimates and abundance; provide protection of sea turtles and their nesting habitats; and conducting outreach and education to the public on sea turtles and their habitats.

FY21 Status

- Nesting activity monitoring awarded as a cooperative agreement through the CESU network to UOG and SeaGrant.
- During 2019, all nests were observed on Explosive Ordnance Disposal (EOD) and Pati Beaches only. Since 2020, nests have been recorded on all AAFB Beaches including Tarague, Scout, Sirena, Pati, and EOD. There has been a total of 225 emergences from August 2020 to present, with 172 nests and 53 false crawls (Figure 113) with an 88.9% emergence success. This is the highest recorded number of emergences ever recorded on AAFB.

- Since August 2020, seven nesting turtles were Passive Transponder (PIT) tagged and none were satellite tagged. Figure 114 provides a map of the most recently satellite tagged turtle and her movements.
- Clutch data was collected on previously marked nests located successfully either after the emergence of hatchlings or after 70 days incubation. Data from these nest inventories estimated hatching and emergence success.
- In July 2020, a nest inventory revealed a record of 135 live hatchlings within a nest which appeared to be in the process of hatching. All hatchlings were observed safely entering the ocean (Figure 115).
- Outreach events included the February 2021 EOD Beach clean-up in preparation for nesting season, presentations to Notre Dame High School, Inarajan Middle School, Oceanview Middle School, WAVE Club, and in-brief with key stakeholders such as EOD personnel, Outdoor Recreation, Security Forces, and the Marine Patrol Conservation Volunteer Program.
- Other outreach activities included public service announcements (PSA) via the AAFB Facebook Page and the development and installation of new full color “Sea Turtle Nesting Beach” signs throughout the AAFB Beaches.
- Project Final Report due December 2021.

EPR: 1 LC MAR AAFB Sea Turtle Monitoring; M5240CN037

2019 JRM INRMP Reference: TPS-1; 9-75

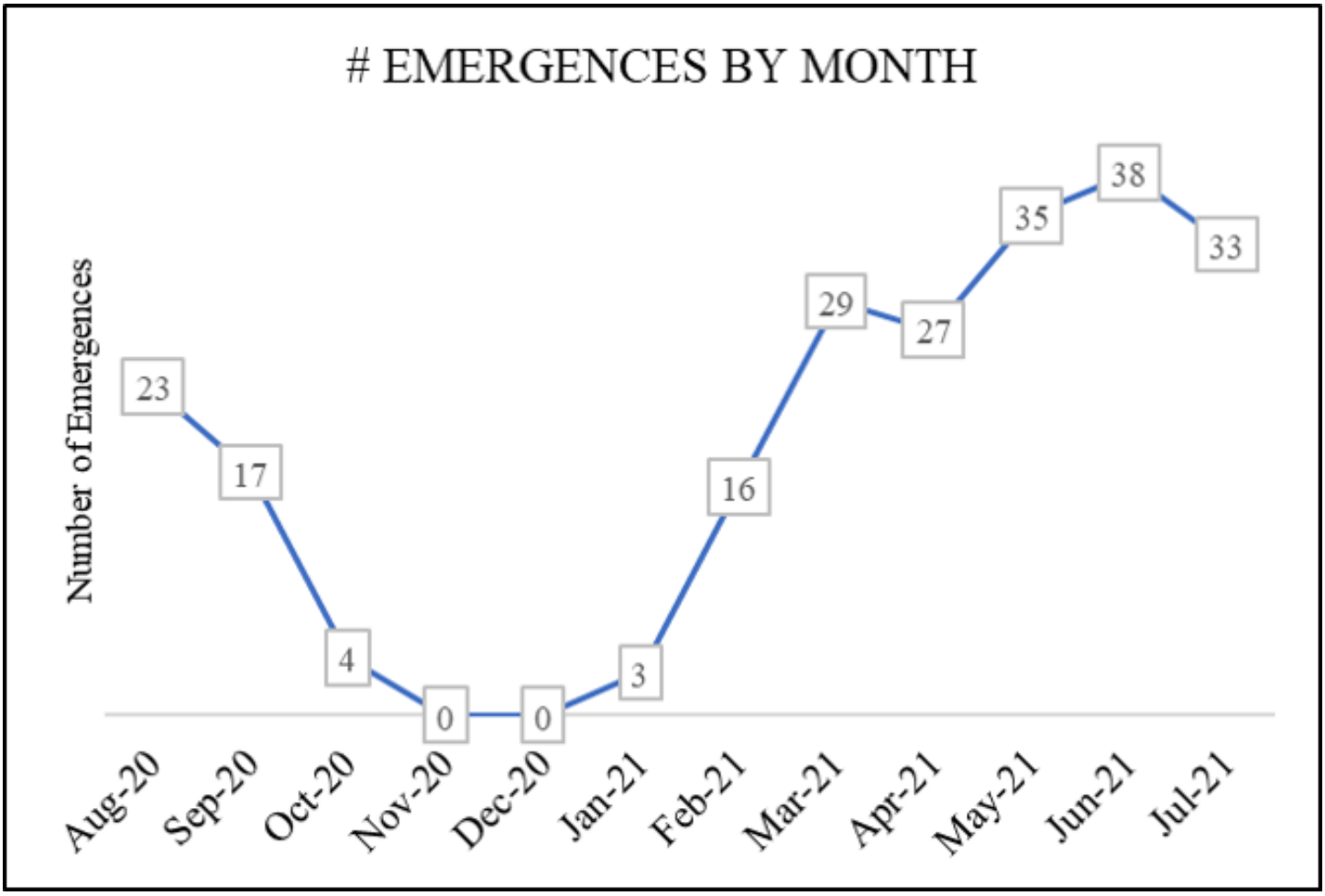


Figure 113. Total number of emergences by month from August 2020–July 2021, with peak activity depicted from May to July.

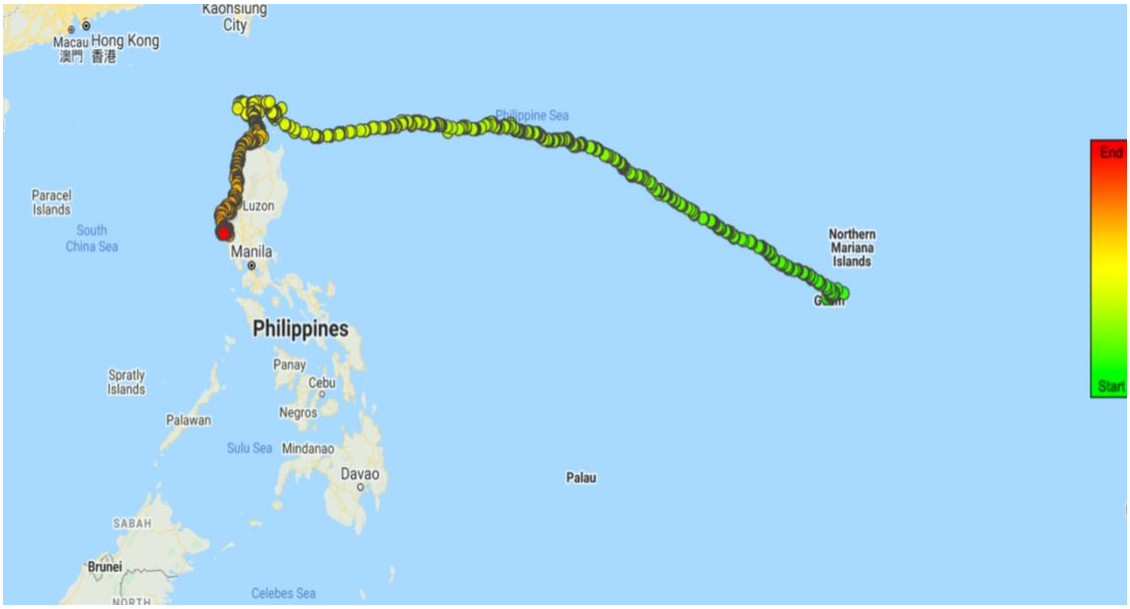


Figure 114. Movement of satellite tagged sea turtle from July 2020.



Figure 115. Live hatchlings from July 2020 making their way to the ocean.



Figure 116. Photograph of new signage posted throughout AAFB recreational areas

Population Surveys and Restoration/Enhancement of Mariana Moorhen Habitat

Location: NBG **Period of performance:** Recurring Annually

Project Objectives

Conduct periodic monitoring of Mariana Common Moorhen (*Gallinula chloropus guami*) To install and monitor nesting platforms in ponds/wetlands where Mariana Common Moorhen habitat is suitable for occupancy.

Conservation benefit

Improve nesting habitat, quantify predators, and work toward goal of increasing the moorhen population in Guam. Techniques utilize goals of applied conservation and understanding of stressors and habitat use within important primary and secondary wetlands on DoD property.

FY21 Status

Monitoring has shown the presence (visual or auditory) of moorhen on all focal wetlands. Activity has been recorded through direct observation and protocol species surveys in coordination with DAWR. Many platforms installed in FY19 are experiencing various levels of deterioration but are still periodically being utilized by moorhen in most areas. During the dry season in FY21, additional wetlands were monitored for moorhen presence and as potential locations for applied conservation efforts (Table 11). Secondary wetlands, located in the remote regions of the NMS, recorded abundant presence of moorhen during FY21.

EPR: 1 RP MAR Restoration of Mariana Moorhen at Fena Reservoir; 61744NR895

2019 JRM INRMP Reference: TPS-3; 5-89

Table 11. Moorhen presence recorded at NBG locations during 2021.

Installation	Wetland Inventory	Name	Visual	Auditory	Number Confirmed
NBG MB	WL-10	San Luis	X	X	1
NBG MB	WL-H	Front Wetland		X	1
NMS	WL-87-1	Shelf Pond	X		1
NMS	WL-87-2	Mahlac	X		1
NMS	WL-87-3	Mahlac-S	X		6
NMS	WL-90	Santa Rita Fence	X	X	5
NMS	WL-56	Parsons Road	X	X	1
NMS	High Road Pond	High Road Pond			0

Monitoring of Mariana Swiftlets

Location: NMS **Period of Performance:** Recurring annually

Project Objective

Monitor population trends of Mariana swiftlets (*Aerodramus bartschi*) at three caves on NMS.

Conservation Benefit

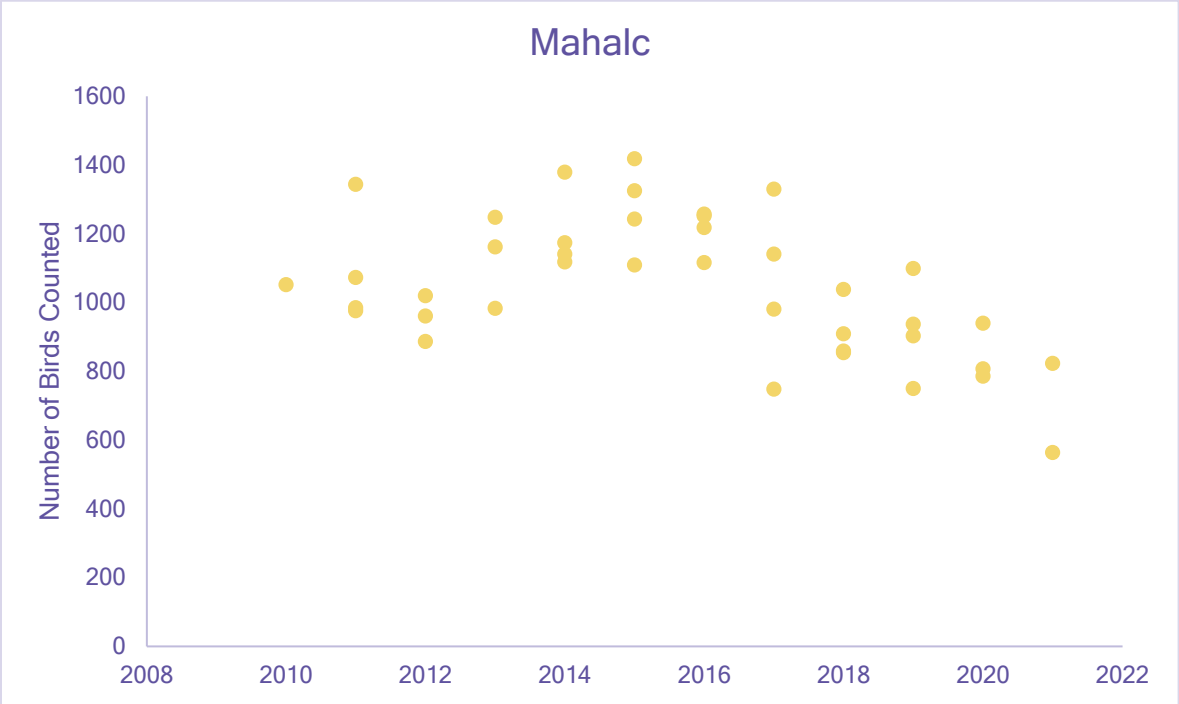
Monitoring to allow for management actions to enhance and restore habitat, reduce habitat fragmentation, buffer protected areas, and implement new conservation strategies.

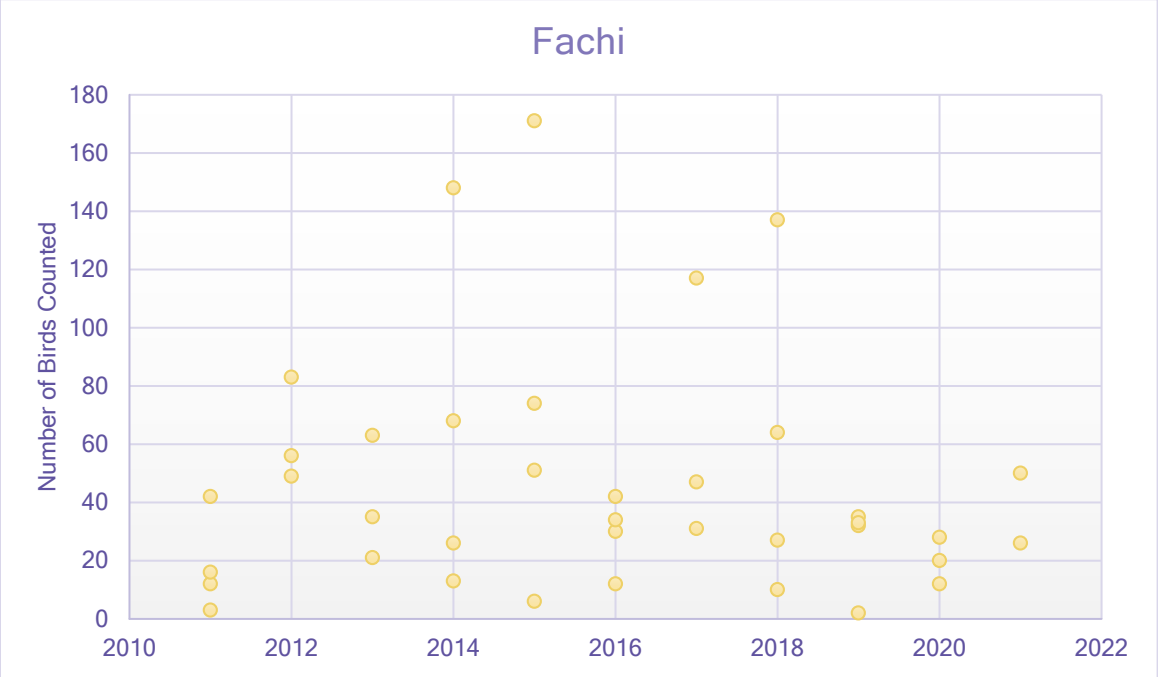
FY 21 Status

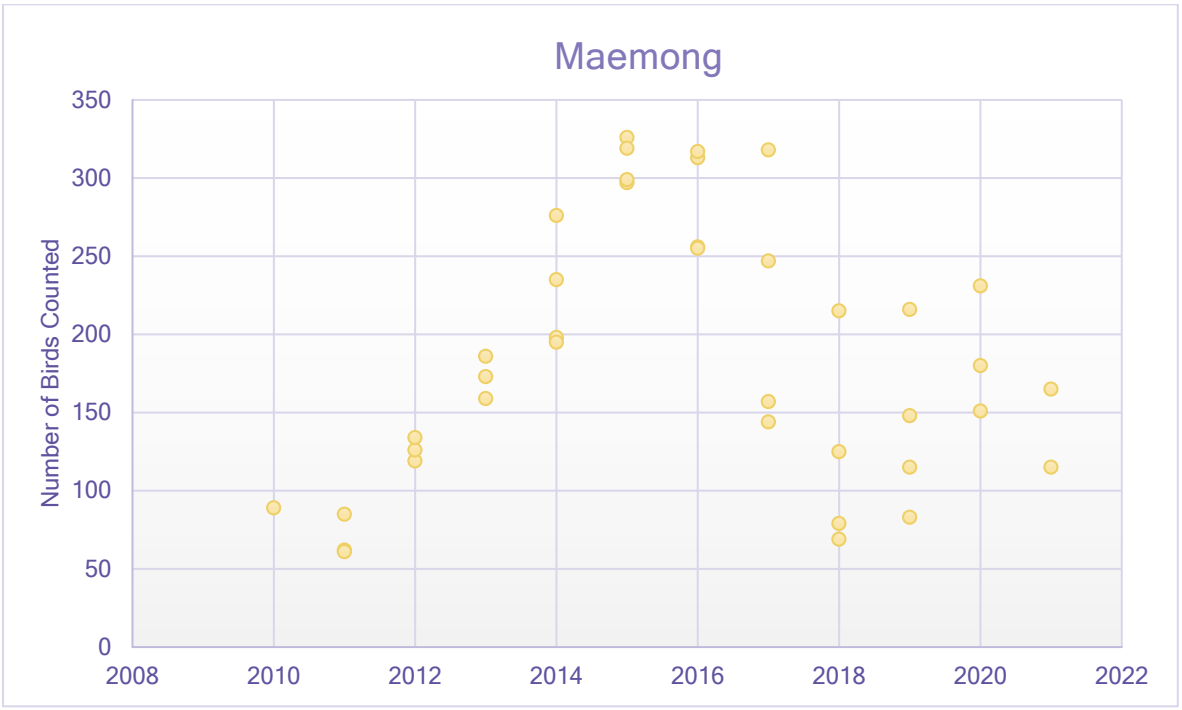
- Conducted swiftlet surveys at the three swiftlet caves on NMS Maemong, at Mahlac, and Fachi. A total of three (3) surveys occurred at each cave.
- Estimated population size of swiftlets on NMS in 2021 was 931 (Figures 117 - 120). Numbers of birds counted are down from the previous year (1031).

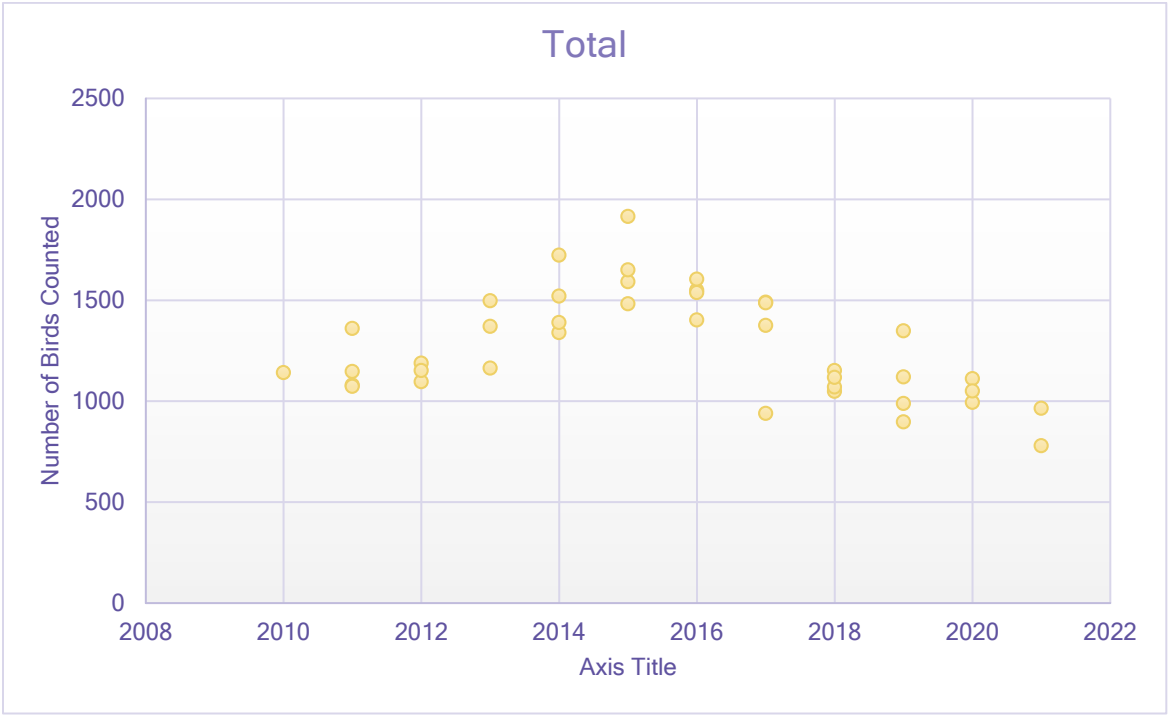
EPR: 1 S MAR NBG Endangered Species Monitoring; 61755NR142

2021 JRM INRMP Reference: TPS-4; 6-47


Mahalc
Number of Birds Counted
1600
1400
1200
1000
800
600
400
200
0
2008
2010
2012
2014
2016
2018
2020
2022


Fachi
Number of Birds Counted
180
160
140
120
100
80
60
40
20
0
2010
2012
2014
2016
2018
2020
2022





Figures 117 - 120. Estimated Population Size of Swiftlets on NMS from individual caves and totaled together.

Mariana Swiftlet Recovery and Habitat Use

Location: NMS **Period of Performance:** ASAP – SEP2022

Project Objective

To provide an understanding of Mariana swiftlet (*Aerodramus bartschi*) habitat use, movement, reproductive success, and breeding site selection to inform management actions and meet specific objectives identified in the USFWS Recovery Plan for the Mariana Swiftlet.

FY21 Status

- COVID Delays
- 1 of 2 MIPRs issued to begin work ASAP
- Establish thermal camera system to visualize, map, and monitor roosting and nesting locations in occupied caves.
- Monitor nesting activity and success
- Estimate roosting population size.
- Banding and radio tracking movement of adult swiftlets at caves and surrounding landscape
- Develop low-cost audio detectors to detect swiftlets prospecting of unoccupied caves.

EPR: 1 RP MAR NBG Mariana Swiftlet Habitat Use; 61755NR303

2019 INRMP References: TPS-4; 6-47

Monitoring Survival and Demography of Micronesian Starlings

Location: AAFB **Period of Performance:** JUL2019 – JAN2021

Project Objective

To monitor and analyze for Micronesian starling (*Aplonis opaca*, Sali) nest success and fledgling survival using telemetry, nest monitoring, and survey methods in relation to BTS control efforts. Through monitoring fledging survival and population recruitment efficacy of BTS control techniques are assessed based on population responses. This project is one of four projects that, collectively, will further develop information on BTS behaviors related to predation and movement in the presence of abundant avian species

Conservation Benefit

The Micronesian Starling is a useful proxy for understanding Guam forest bird ecology in the presence in of BTS. Behavior, survivorship, and population demographics could be useful for supporting future avian restoration projects and controlling BTS in low density with competing food sources in the presence of control regimes.

FY21 Status

- Agreement via the CESU network with Iowa State University (ISU)
- 292 Sali banded 2019-21
- Cats and BTS remain primary causes of mortality
- Indications suppression of BTS reduces number of fledglings killed by BTS
- Population still skewed to adults
- Period of performance renewed through February 2022

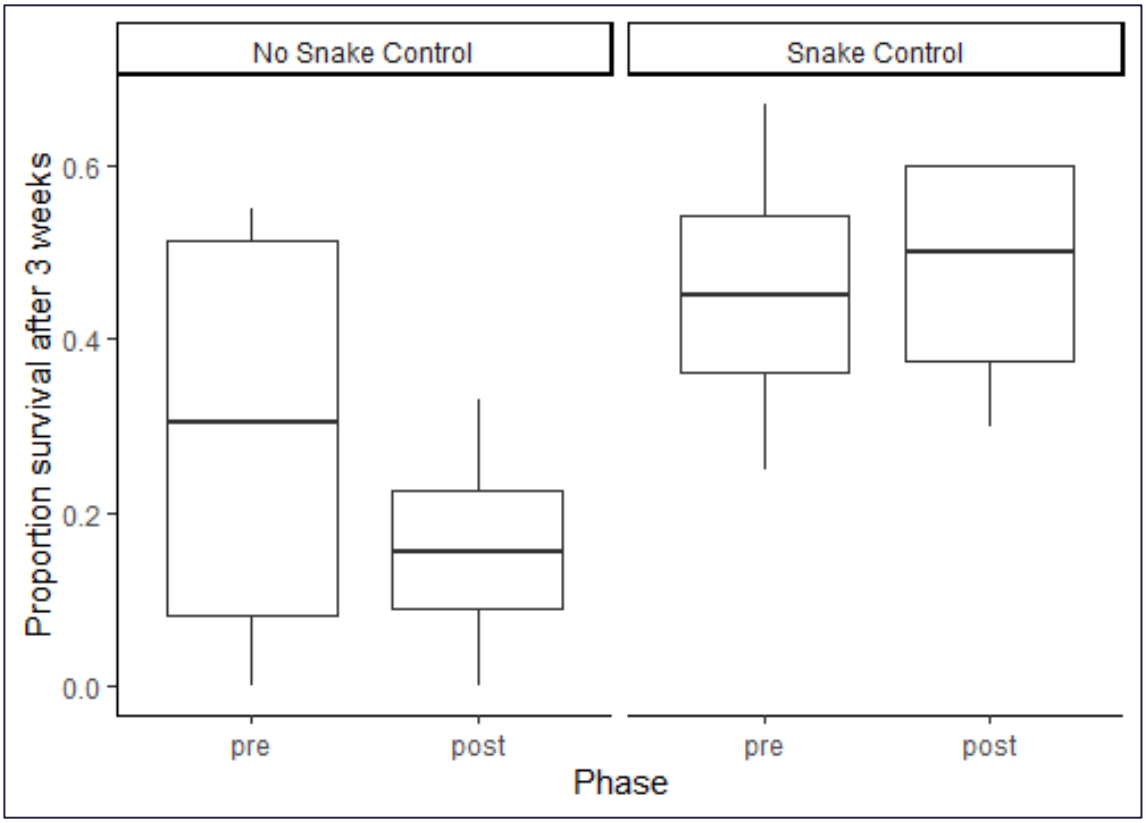
EPR: 1 RP JRM Brown Tree Snake Eradication and Control to Support Recovery of ESA-Listed Species; 61128NR202

2019 JRM INRMP Reference: TIS-2, TIS-3; 5-85, 6-43; 7-52, 8-50-51, 9-71



Figure 121. (a) Sali fledgling with radio tracker and leg bands on AAFB;

Figure 122. (b) box ploys comparing proportion Sali survivorship before and after BTS bait treatment. Photo. A. Titus.



Mariana Fruit Bat Monitoring - AAFB

Location: AAFB **Period of Performance:** JAN2021 – DEC2021

Project Objective

Conduct surveys for Mariana fruit bats (*Pteropus mariannus mariannus*) at AAFB as part of long-term population monitoring and to provide analysis on the effects of aircraft overflights and behavior of Mariana fruit bats at Pati Point.

Conservation Benefit

Monitoring will allow for management actions to enhance and restore habitat and increase efforts to recover Mariana fruit bat populations in Guam.

FY21 Status

- Addresses three of the recovery criteria in the 2009 U.S. Fish and Wildlife Service (USFWS) Draft Revised Recovery Plan for the Mariana Fruit Bat or Fanihi by supporting the implementation of seven of the Recovery Actions outlined in the Draft Plan.
- The 7th Annual Base-wide Count occurred on August 7, 2020. Participants totaled 64 with 33 sightings on AAFB. Data suggests that the population appears to be increasing.
- A roost site believed to be located above the cliff line just south of the CATM range. The site was identified on 11 May 2020 with an estimated 30-40 bats, but population counts have not been conducted.
- Performing habitat quality surveys and bat sign/scat surveys to identify foraging areas.

EPR: 2 BO MAR AAFB Fruit Bat Monitoring; M5240CN041

2019 JRM INRMP Reference: TPS-2; 9-75

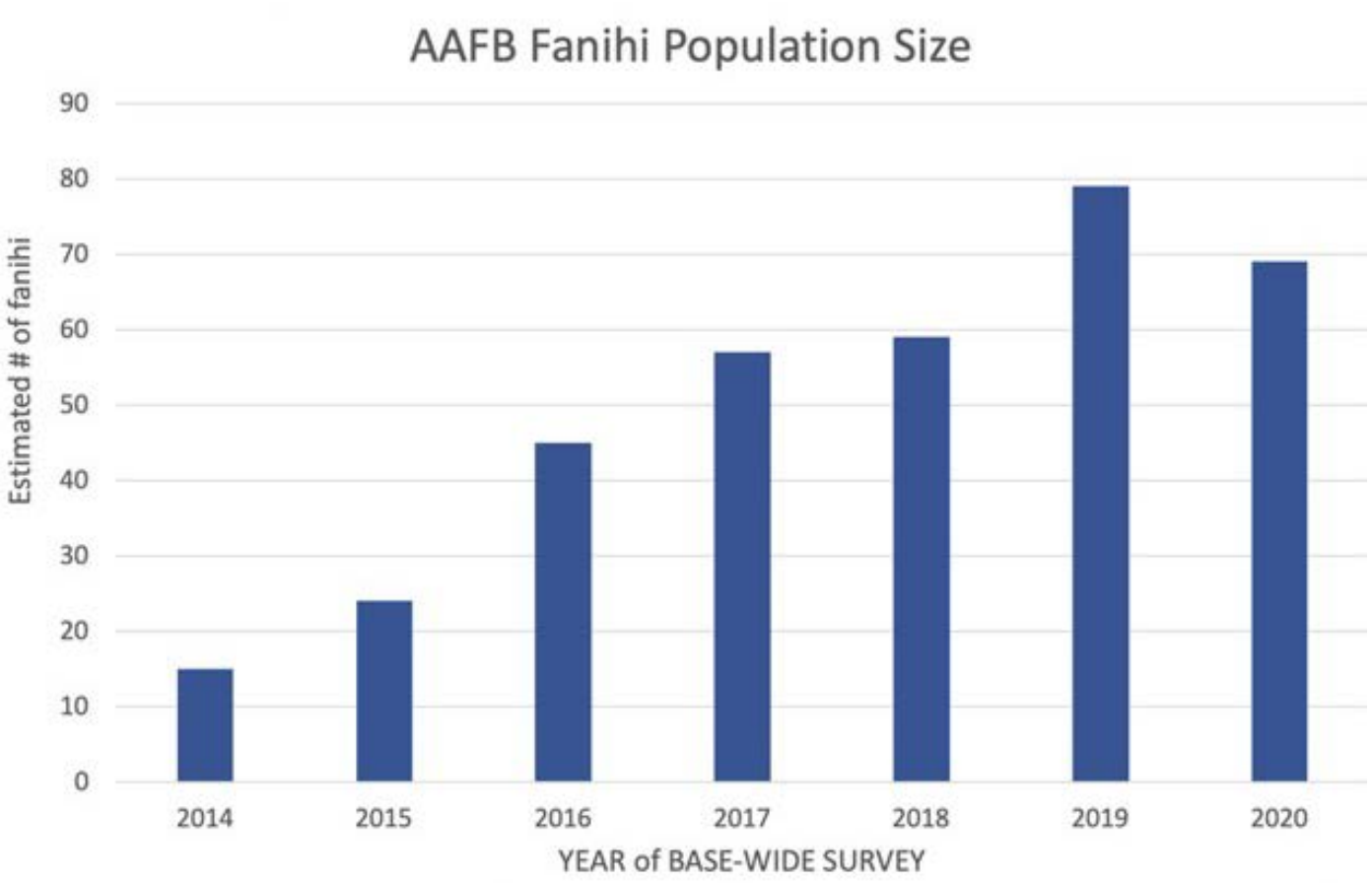


Figure 123. Estimations of AAFB Fruit Bat population size by year.

NMS Mariana Fruit Bat Monitoring – Naval Munitions Site (NMS) NBG and Tinian Military Leased Areas (MLA)

Location: NMS and MLA **Period of Performance:** JAN 2021 - AUG 2021

Project Objective

Conduct annual surveys for Mariana fruit Bats (*Pteropus mariannus marianuus*) on NMS and Tinian MLA. Search for fruit bat aggregating locations. If aggregations or new colony locations are detected, roost counts will commence in accordance with established survey protocols. If changes in roost locations, colony size, or movement are detected, investigate potential threats or stressors that may be causing disturbance.

Conservation Benefit

Management strategies and actions of the INRMP to protect and conserve Mariana fruit bats include protection and enhancement of their forested habitats, control and suppression of BTS, continued monitoring of bat populations, and control of wildland fires and ungulates. Monitoring allows for management actions to enhance and restore habitat, reduce habitat fragmentation, buffer protected areas, implement new conservation strategies, and avoid and minimize impacts to fruit bats.

FY21 Status

- NMS Surveys conducted on March 18, 2021 with ten (10) fruit bats observed; March 26, 2021 with zero (0) bats observed; and Aug 6, 2021 with fifteen (15) fruit bats observed.
- The last known counts on NMS was during the island wide bat count in 2019.
- No Tinian MLA surveys conducted FY21 due to COVID-19 travel restrictions.

EPR: 1 RP MAR JRM Mariana Fruit Bat Monitoring: 61128NRFBM

2019 JRM INRMP Reference: TPS-7; 6-48



Tinian Monarch
Photo by: Jill Liske-Clark

Joint Region Marianas Integrated Natural Resources Management Plan Summary of 2021 Projects

CNMI REPORT

NAVFAC
Naval Facilities Engineering Systems Command
NAVFAC Marianas

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ACRONYMS AND ABBREVIATIONS

ACRONYM	DESCRIPTION
AAFB	Andersen Air Force Base
ADS	Automated Delivery System
AOR	Area of Responsibility
BO	Biological Opinion
BTS	Brown Treesnake
CESU	Cooperative Ecosystem Studies Units Network
CEMML	Center for Environmental Management of Military Land
CIS	Center for Island Sustainability
CNMI	Commonwealth of the Northern Mariana IslandS
COMPACFLT	Commander, U.S. Pacific Fleet
CP	Closed Population
CRB	Coconut Rhinoceros Beetle
CRU	Cooperative Research Unit
CSU	Colorado State University
DNM	Dead Neonatal Mice
DoD	Department of Defense
EOD	Explosive Ordnance Disposal
ERA	Ecological Reserve Area
ESA	Endangered Species Act
FDM	Farallon de Medinilla
Ft	foot/feet
FY	Fiscal Year
GIS	Geographic Information System
GMK	Guam Micronesian Kingfisher
GNWR	Guam National Wildlife Refuge
GPEPP	Guam Plant Extinction and Prevention Program
GDOAg	Guam Department of Agriculture
ha	hectare(s)

HACCP	Hazard Analysis and Critical Control Points
HMU	Habitat Management Unit
ISU	Iowa State University
INRMP	Integrated Natural Resources Management Plan
IRP	Installation Restoration Program
JRM	Joint Region Marianas
LFA	Little fire ant
LFTRC	Live Fire Training Range Complex
M	meter(s)
MCAG	Marine Corps Activity Guam
MCB	Marine Corps Base
MIRC	Mariana Islands Range Complex
MITT	Mariana Islands Training and Testing
MLA	Military Lease Area
MOA	Memorandum of Agreement
MSA	Munitions Storage Area
NAVFAC	Naval Facilities Engineering Systems Command
NBG	Naval Base Guam
NBGTS	Naval Base Telecommunications Site
NMS	Naval Base Guam Naval Munitions Site
NNE	Non-Nesting Emergence
NWF	Northwest Field
NWRC	National Wildlife Research Center
PACOM	Pacific Command
PIERC	Pacific Island Ecosystems Research Center
QA/QC	Quality Assurance/Quality Control
RFMP	Range Fire Management Plan
RBP	Regional Biosecurity Plan for Micronesia and Hawaii
UOG	University of Guam
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
USDA-WS	United States Department of Agriculture- Wildlife Services

MARINE PROTECTED SPECIES MANAGEMENT

Sea Turtle Aerial Surveys in FDM Nearshore Waters

Location: FDM

Period of Performance: SEP2018 - SEP2020; AUG2020 – FEB2022

Project Objective

- Design aerial transect surveys to determine sea turtle and marine mammal abundances and distributions in the nearshore waters surrounding FDM.
- Conduct aerial surveys for sea turtle and marine mammal identifications, abundances, and distributions in the nearshore waters surrounding FDM.
- Analyze sea turtle and marine mammal identifications, abundances, and distributions in the nearshore waters surrounding FDM.

Conservation Benefit

- Increase habitat for ESA-listed species (e.g., sea turtles and marine mammals).
- Support habitat areas of particular concern, which align with Magnuson-Stevens Fishery Conservation Act for Essential Fish Habitat and the Marianas Fishery Ecosystem Plan.

FY21 Status

- Final report available (2018-2020 data)
- FY21 CESU awarded to UOG Sea Grant

EPR: CNMI Ecosystem and Protected Species Monitoring and Management: Sea Turtle Distribution and Habitat Use in FDM Nearshore Waters (emergent); 61128NR851

2019 JRM INRMP Reference: MPS-1 (12-41)

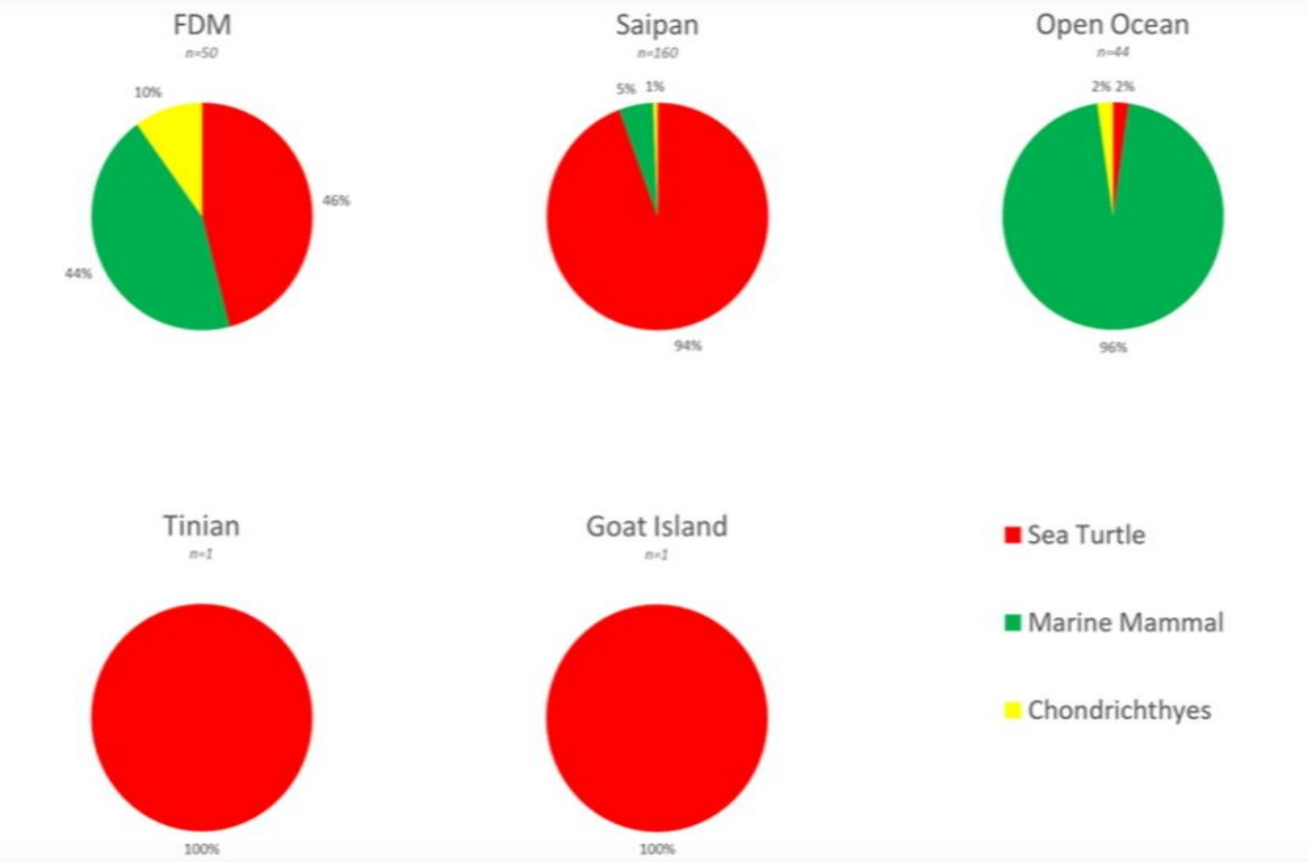
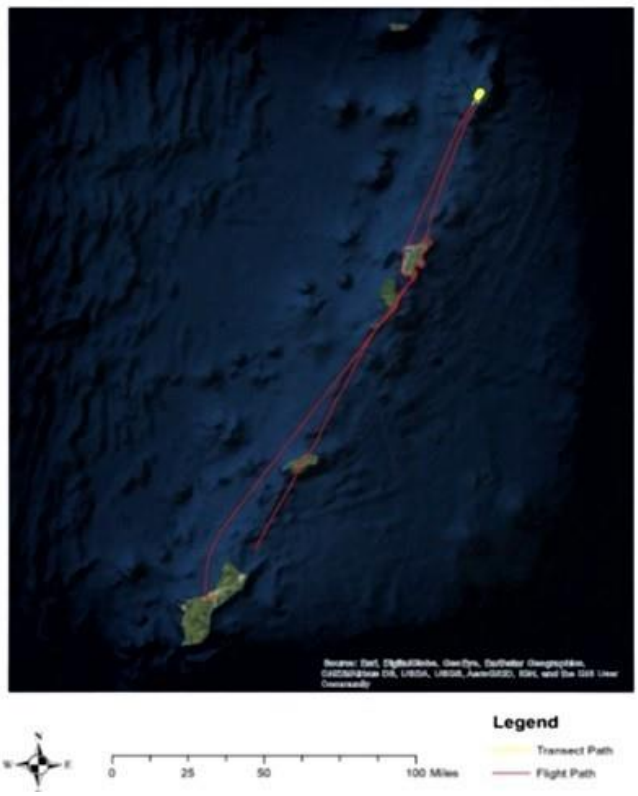


Figure 1. Number of individuals identified in surveys

Figure 2. (below) General flight path of surveys



TERRESTRIAL EXOTIC AND INVASIVE SPECIES MANAGEMENT

Implementation of the Regional Biosecurity Plan of Micronesia and Hawaii

Location: JRM **Period of Performance:** AUG2020-JUL2021

Project Objective

Update Attachment M (DoD Biosecurity Recommendations) of the Regional Biosecurity Plan for Micronesia and Hawaii (hereafter: RBP), and implement various actions identified within the RBP aimed at: preventing the spread of invasive species into/out of Joint Region Marianas (JRM) Area of Responsibility (AOR); controlling, managing, and eradicating invasive and nuisance species on DoD lands within the JRM AOR; providing outreach and awareness to military personnel, contractors, and their respective dependents; and increasing coordination and collaboration with regional partners and DoD stakeholders regarding biosecurity and invasive species management.

Conservation Benefit

Protect native species, particularly those that are threatened and endangered from the threat of invasive species within the JRM AOR.

FY21 Status

- Implementation of biosecurity arrival and pre-departure biosecurity inspections of non-training military equipment and cargo movements into/out of JRM AOR and movements to Tinian for Seabee public works projects. Twenty (20) non-training biosecurity inspection events took place during this reporting period with seven pre-departure biosecurity events for items going to Tinian.
- Continued interagency coordination and consultation regarding invasive species management and biosecurity concerns within the region (CRB Working Group, LFA Working Group, GISC, GISAC, RISC, CNMI DLNR, Guam Biosecurity Division).

EPR: CHS NISA MAR JRM Implementation of the Regional Biosecurity Plan; 61128NR860

2019 JRM INRMP Reference: TIS-4; 5-85, TIS-5; 6-44, TIS-5; 7-53, TIS-4; 8-51, TIS-6; 9-73, TIS-1; 11-62, TIS-1; 12-32, MIS-1; 5-102, MIS-1; 8-64, MIS-1; 9-87, MIS-1; 11-74, MIS-2; 11-74

Invasive Species Management within the Joint Region Marianas Area of Responsibility

Location: JRM **Period of Performance:** AUG2020 – JUL2021

Project Objective

In support of Mariana Islands Training & Testing (MITT) activities, 1) conduct Early Detection Surveys (EDS) non-native species at training and cargo staging locations within the JRM AOR (Guam and CNMI (Tinian Ports, Military Leased Area, Rota Ports); 2) develop and implement standard operating procedures for the control and removal of high-risk invasive species; 3) develop and implement invasive species rapid response protocols; 4) develop and implement bio-sanitation standards along with quality assurance/quality control standards; and 5) development of a programmatic pathway risk analysis for the movement of equipment and personnel within the JRM AOR; and 6) targeting high risk invasive arthropod species for control and eradication.

Conservation Benefit

Prevent the movement and establishment of invasive species into and out of Guam and the CNMI during training exercises.

FY21 Status

Ongoing cooperative agreement Colorado State University (CSU), Center for Environmental Management of Military Lands (CEMML).

Early Detection Surveys Conducted

- Tinian MLA – 1 of 3 All-Taxa sites and Weed Surveys conducted at North Field (runways, taxiways, Dankulo beach)
- All-Taxa Surveys – AAFB: 12 of 29 sites; NBG; 9 of 27 sites
- Weed surveys – AAFB: 11 of 28 sites; NBG: 27 of 47 sites

Invasive Species Rapid Response

- No rapid response deployment events occurred during FY21

Development of SOPs for the Control/Eradication of High-Risk Species

- Little Fire Ant (LFA; Wasmannia auropuncta) revised
- Yellow-jacket (*Vespula penyslvanica & V. germanica*)

Bio-sanitation QA/QC Biosecurity Inspections during Military Training Events

- Four major training events (>100 cargo items; Valiant Shield 20, Cope North 21, Forager 21, Freedom Banner 21)
- Eight minor training events (25 – 100 cargo items)
- Six unit level training events (<25 cargo items)
- >3,000 items inspected during arrival and pre-departure biosecurity inspections to meet AFPMB TG-31 cleanliness standards
- Bio-material interceptions (plant material, seeds, soil/gravel, insects, spiders/webs/eggs, wasp nests, dead frog, etc.)(Figure 3).

Development of a Programmatic Pathway Risk Analysis for Movements into the Mariana Islands and between Islands

- Ongoing data collection to support the risk analysis

FY20 Cooperative Agreement with CSU CEMML ongoing (Jul2020 – Dec2021)

EPR: 2 BO MAR Mariana Islands Training and Testing (MITT) Implementation; 61128NR218
CHS NISA MAR JRM Implementation of the Regional Biosecurity Plan; 61128NR860
USMC HQ MITT Biological Opinion Conservation Measures Implement (FY21 Non-EPR)

2019 JRM INRMP Reference: TIS-6; 5-86, TIS-7; 6-44, TIS-6; 7-53, TIS-5; 8-51, TIS-7; 9-73, TIS-2; 11-62, TIS-1; 12-32; TIS-2; 12-33



Figure 3. Examples of biomaterial interceptions:
During Guam Martime Prepositioning Force (MPF) cargo/equipment biosecurity arrival inspections on Guam (GU). Items identified during arrival inspections included live scale insects, spider egg cases, bird nest, and a desiccated frog.

Marianas Islands Training & Testing Biological Opinion Terms & Conditions

1.1 Compliance – CNMI

Location: CNMI **Period of Performance:** AUG2018 – SEP2022

Project Objective

To comply with the Mariana Islands Training & Testing (MITT) Biological Opinion (BO) Incidental Take Statement Terms and Conditions 1.1 (as amended 28 FEB 2016) to provide funding to the U.S. Fish & Wildlife Service for invasive vertebrate pest control to minimize the effect of take on the Micronesian megapode (*Megapodius laperouse*). DoD is not responsible for project implementation or the results thereof, per the MITT Biological Opinion (BO) amended Terms and Conditions 1.1.

Conservation Benefit

To ensure compliance with the Incidental Take Statement of the 2015 MITT BO to minimize the effect of take on the Micronesian megapode.

FY21 Status

- Interagency Agreement between Joint Region Marianas and the U.S. Fish & Wildlife Service established and funding issued in August 2018.
- U.S Fish & Wildlife Service project currently in implementation phase for Micronesian megapode habitat restoration on Aguiguan.

EPR: 2 BO MAR Mariana Islands Training and Testing (MITT) Implementation; 61128NR218

2019 JRM INRMP Reference: TPS-1; 12-34

Coconut Rhinoceros Beetle (CRB; *Oryctes rhinoceros*) Surveys, Interdiction, and Monitoring - CNMI

Location: CNMI **Period of Performance:** AUG2020 – JUL2021

Project Objective

To implement CRB best management practices:

- Conduct CRB Early Detection Surveys in military training areas,
- Implement interdiction trapping during military exercises with cargo movements from Guam,
- Implement CRB awareness military personnel, and
- Implement CRB interdiction measures on Guam; and coordinate and collaborate with resources partners in the CNMI to prevent the movement of CRB to the CNMI via military cargo and transport while maintaining military readiness.

Conservation Benefit

Prevent the movement and establishment of CRB into the CNMI during military activities.

FY21 Status

- Conducted CRB Early Detection Surveys along roadways in the Military Leased Area on Tinian for CRB damaged coconut trees (Jul/Aug 2021)
    - No CRB damage detected
- Conducted surveys for dead coconut trees within the Tinian MLA
- Deployed and monitored CRB panels traps at North Field during Forager 2021 exercise (Jul/Aug 2020)
- Assisted CNMI DLNR CRB Interdiction Program in providing CRB tekken netting trap supplies and pheromone packets to supplement CRB trapping efforts around the Tinian International Airport during military training events (Jul/Aug 2021)
- Provide military personnel with CRB awareness information and CRB sighting protocols during military training exercises conducted in the CNMI (Jul/Aug 2021)
- Pre-departure biosecurity inspections were conducted on all cargo and equipment prior to transport from Guam to CNMI during military exercises to ensure all items were devoid of bio-material (including CRB)
- Coordinated CRB interdiction measures during FY21 exercises on Tinian with CNMI natural resources partners

EPR: 2 BO MAR Mariana Islands Training and Testing (MITT) Implementation; 61128NR218
CHS NISA MAR JRM Implementation of the Regional Biosecurity Plan; 61128NR860
USMC HQ MITT Biological Opinion Conservation Measures Implement (FY21 Non-EPR)

2019 JRM INRMP Reference: TIS-5; 5-86, TIS-6; 5-87, TIS-6; 6-44, TIS-7; 6-45, TIS-4; 7-53, TIS-6; 7-53/54, TIS-5; 8-52, TIS-6; 8-52, TIS-5; 9-72, TIS-7; 9-73/74, TIS-1; 11-62, TIS-2; 11-63, TIS-1; 12-32, TIS-2; 12-33



Figure 4. CRB Trap

TERRESTRIAL PROTECTED SPECIES MANAGEMENT

Cycad Conservation – Tinian

Location: Tinian, CNMI **Period of Performance:** APR2020 – APR2021

Project Objective

To conserve representative plants of *Cycas micronesica* populations from Guam (ongoing project from 2007).

Conservation Benefit

Increase populations, ensure resiliency to catastrophic events, and test and implement new conservation strategies.

FY21 Status

- The project continues to be implemented by UOG Plant Extinction Prevention Program.
- The April 2021 health assessment recorded a slight increase in survival rate from 2019 to 2021 (85%) compared to 2017-2019 (81%). ~850 live cycads remain over the 24 plots.
- While the cycad scale infestation has spread to half of the plots and contributed to mortality, the highest mortality occurred in savannah plots where there was little scale infestation.
- No management was conducted April-December 2020 due to Covid-related travel issues. Management resumed with a CNMI-based contractor conducting vegetation clearing starting in January 2021 and application of a systemic pesticide (Merit) in March 2021.
- The current cooperative agreement was awarded to UOG in May 2021. An entomologist was added to the UOG project team to consult on pest management options. UOG is seeking a new CNMI-based partner to implement the fieldwork.
- Established protocols prevent transfer of scale or other invasive species between Guam and Tinian, and between Tinian plots.

EPR: 1 CP MAR Conservation Management of Tinian Cycads; 61128NR162

2019 JRM INRMP Reference: TPS-1; 11-63

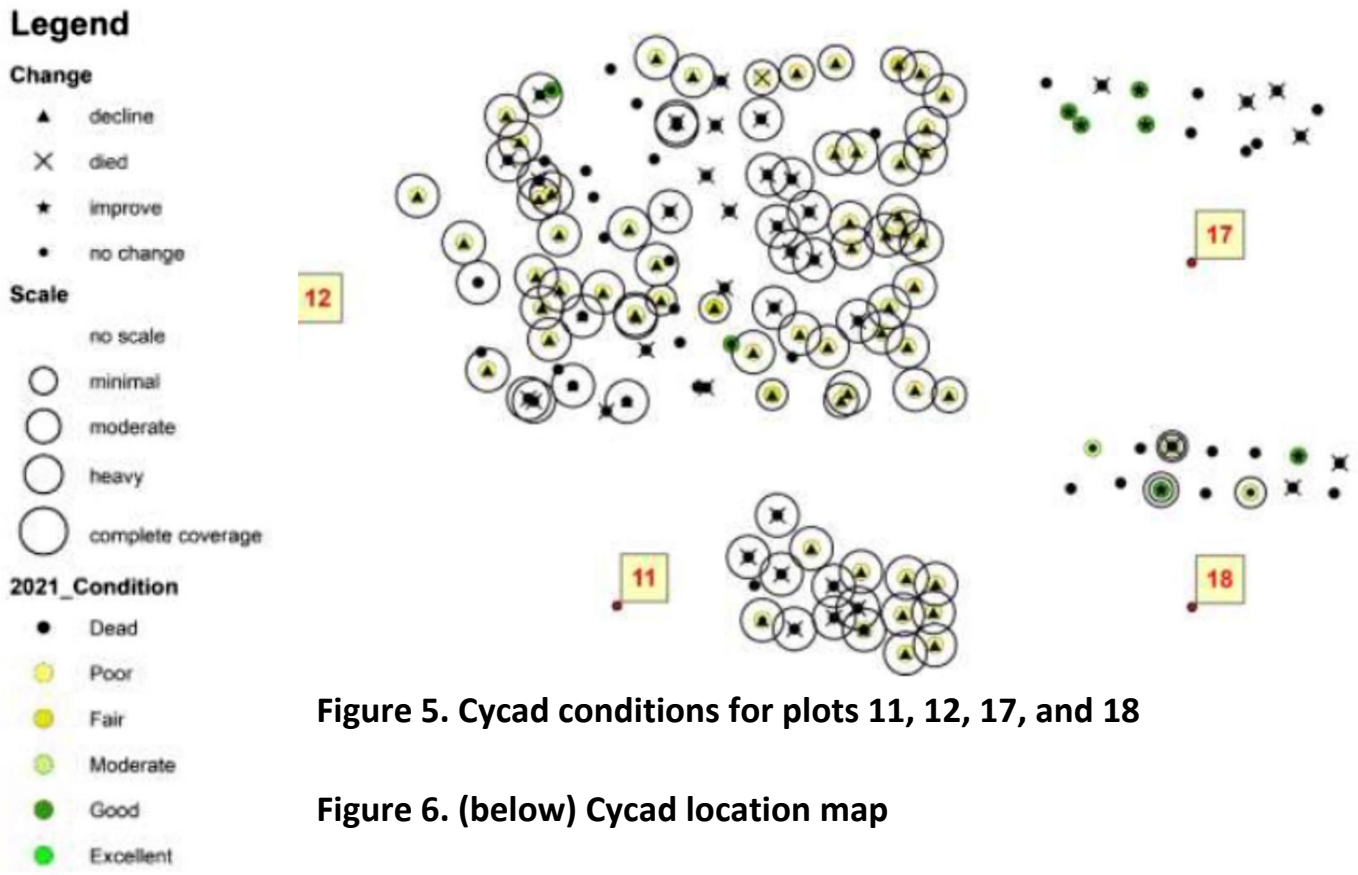
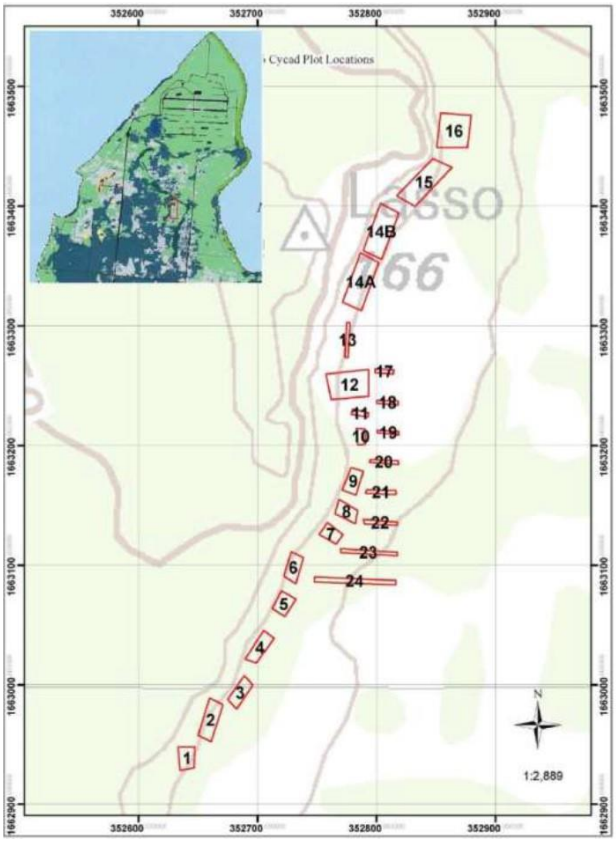


Figure 5. Cycad conditions for plots 11, 12, 17, and 18

Figure 6. (below) Cycad location map



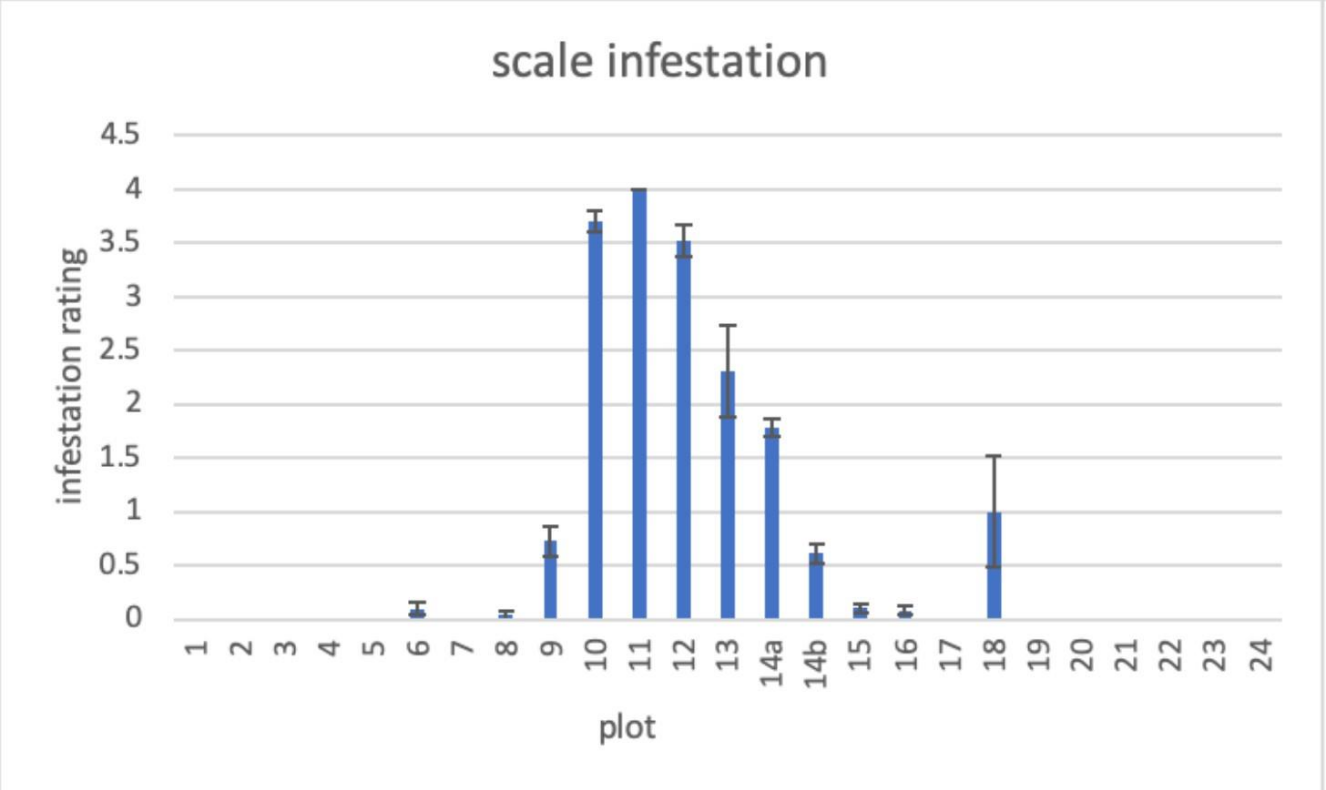


Figure 7. Scale infestation by plot

Sea Turtle Nesting Surveys – Tinian

Location: Tinian, CNMI **Period of Performance**: JUN2020 - JUN2021

Project Objective

Ongoing monitoring of sea turtle nesting on Tinian MLA beaches.

Conservation Benefit

Long-term sea turtle nesting trends inform our understanding of the success and urgency of management efforts.

FY21 Status

- Biweekly surveys resumed July 3, 2020.
- Tinian MLA beaches supported an estimated 3 nesting Green Sea Turtles (GST) during the 2020 nesting season, and 3 GST during the 2021 nesting season thus far. (Figure 9)
- A total of 33 nests and eight non-nesting emergences (all GST) were recorded during the performance period. From 2009-2019, an average of 26 total nesting activities were recorded across Tinian MLA beaches annually. (Figure 10)
- Nests were recorded at all beaches except Chiget. Tidal inundation was the primary threat impacting hatching success of 26% of nests.

EPR: 1 S RP MAR CNMI ESA and MBTA Species Management; 61128NR211

2019 JRM INRMP Reference: TPS-2; 11-64

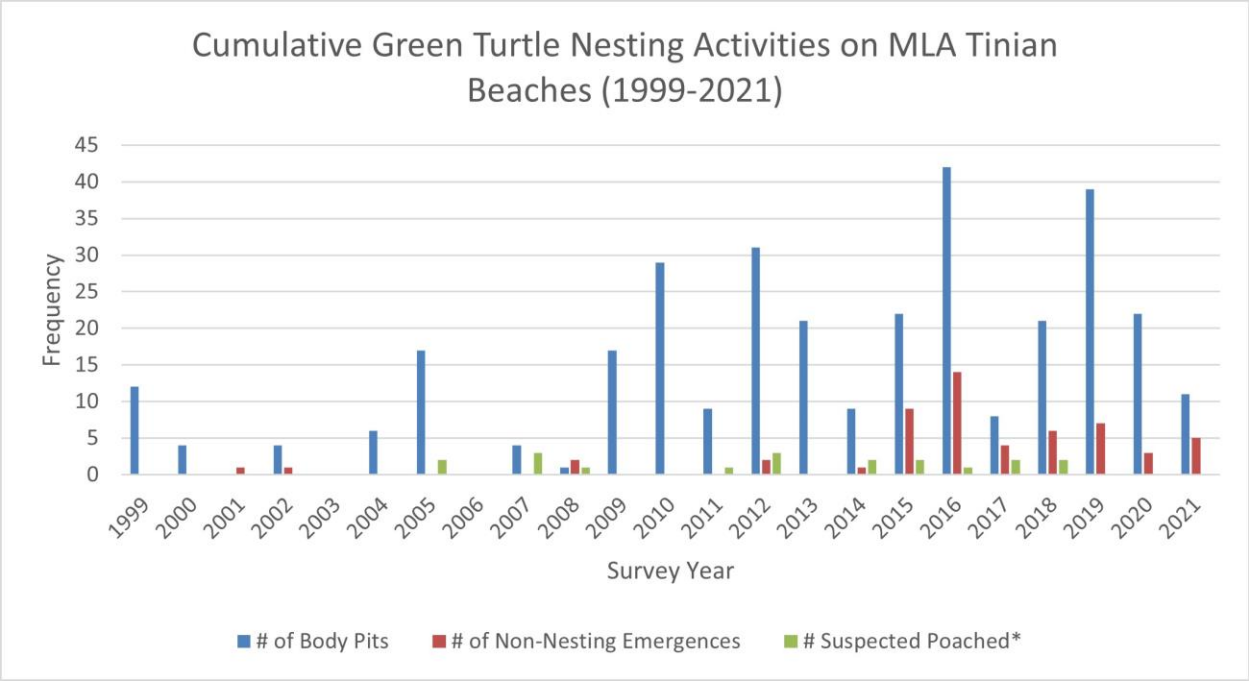


Figure 8. GST Nesting Activities on MLA Tinian Beaches (1999-2021)

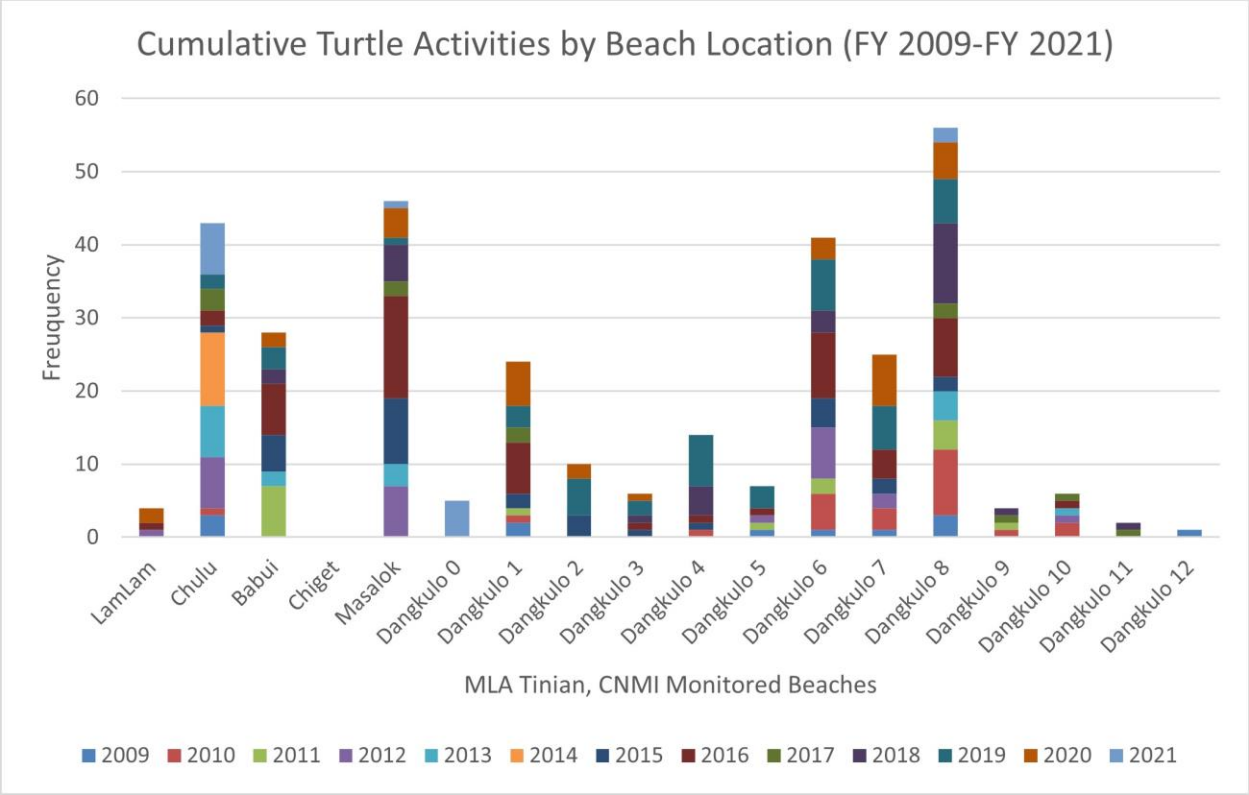


Figure 9. Turtle Activities by Beach Locations (2009-2021)

Beach Cleanups on the Tinian MLA

Location: Tinian, CNMI **Period of Performance:** JUN2020 – JUN2021

Project Objective

Removal of marine debris from all sea turtle nesting beaches in the Military Lease Area (MLA). Cleanup is conducted at least annually.

Conservation Benefit

The removal of marine debris benefits sea turtles by preventing entanglements and allowing successful nest excavation and egg deposition, and reduces the potential for ingestion of debris by seabirds.

FY21 Status

- A total of 5,789 lbs of debris were removed from 18 MLA beaches during five cleanup events.
- The top four materials collected by weight were plastic (67.3%), fishing gear (22.0%), footwear (4.9%), and glass (4.0%).
- All bags were transported from Tinian to the Lower Base Refuse Transfer Station located on Saipan, CNMI for final disposal.

EPR: 1 RP MAR CNMI ESA and MBTA Species Management; 61128NR211

2019 JRM INRMP Reference: TPS-2; 11-64

Beach Name	Distance (km)	# of Bags	Weight (lbs)	Plastic Density (%)
Babui (1 & 2)	0.14	2	10	70.0
LamLam	0.01	2	14	78.6
Chulu	0.18	5	68	57.4
Dangkulo (0-7)	0.75	65	1956	72.2
Dangkulo (8)	0.07	73	2440	60.9
Dangkulo (9-12)	0.2	14	256	37.9
Chiget	0.04	9	132	76.5
Masalok (1-3)	0.16	40	913	81.3
TOTAL	**1.23**	**210**	**5789**	**66.9 (mean)**

Table 1. Table of Cleanup Activities



Figure 10. Dangkulo Cleanup Removal of Trash

Concrete barrier - Sea Turtle Conservation – CNMI

Location: Tinian, CNMI **Period of Performance:** ONGOING

Project Objective

The intent of this contract is to fabricate, paint, transport and place, eighty (80), six foot concrete barriers to North Field, Military Leased Area, Tinian. Barriers will be placed on MLA beach access roads with input from CNMI resource partners on placement.

Conservation Benefit

Poaching and predation of sea turtle nests and recreational use of sea turtle nesting beaches have resulted in disturbance of habitat and illegal intentional take of these endangered species. Concrete barriers will prevent vehicles from disturbing nesting female turtles, their nests and nesting habitats.

FY21 Status

- Barriers moved in OCT 2019. They are currently stored at NW field.
- Indo-PACOM Liaison officer last communicated with Tinian Mayor's office in June 2021. Awaiting Mayor's review.

EPR: 1 RP MAR CNMI ESA and MBTA Species Management Tinian; 61128NR211

2019 JRM INRMP Reference: TPS-2; 11-64

Surveys for Micronesian Megapodes and Mariana Fruit Bats

Location: FDM **Period of Performance:** OCT2020 – SEP2021

Project Objective

- To conduct Micronesian megapode (*Megapodius laperouse*) surveys along established trails and paths to use as an index of megapode population change over time;
- Record Mariana fruit bats (*Pteropus mariannus mariannus*) observed during surveys, and
- Conduct habitat ground surveys to monitor habitat change over time per the 2015 Mariana Islands Training and Testing (MITT) BO terms and conditions.

Conservation Benefit

To ensure compliance with the Incidental Take Statement of the 2015 MITT BO.

FY21 Status

- Survey conducted on April 25, 2021 at nine stations previously established and two new stations established during this survey (Figure 5).
- A total of nine (9) Micronesian megapodes were detected during the playback survey effort on 11 survey stations.
- No Mariana fruit bats observed while conducting megapode surveys.
- Vegetation photo points collected at 7 of 11 survey stations.
- Final survey reports expected in December 2021.

EPR: BO MAR Mariana Islands Training and Testing (MITT) Implementation; 61128NR218

2019 JRM INRMP Reference: TPS-1; 12-34

Table 2. Comparison of Micronesian megapode detections at playback survey stations on Farallon de Medinilla between 2013 and 2021.

YEAR	Stn1	Stn2	Stn 3	Stn 4	Stn 5	Stn 6	Stn 7	Stn 7A	Stn 8	Stn 9	Stn 10	Stn 11	Total
2013	1	1	0	0	1	2	4	N/A	2	N/A	N/A	N/A	11
2019	1	2	0	0	3	3	2	N/A	3	0	4	N/A	18
2021	2	2	0	0	0	0	N/A	1	0	0	0	0	9

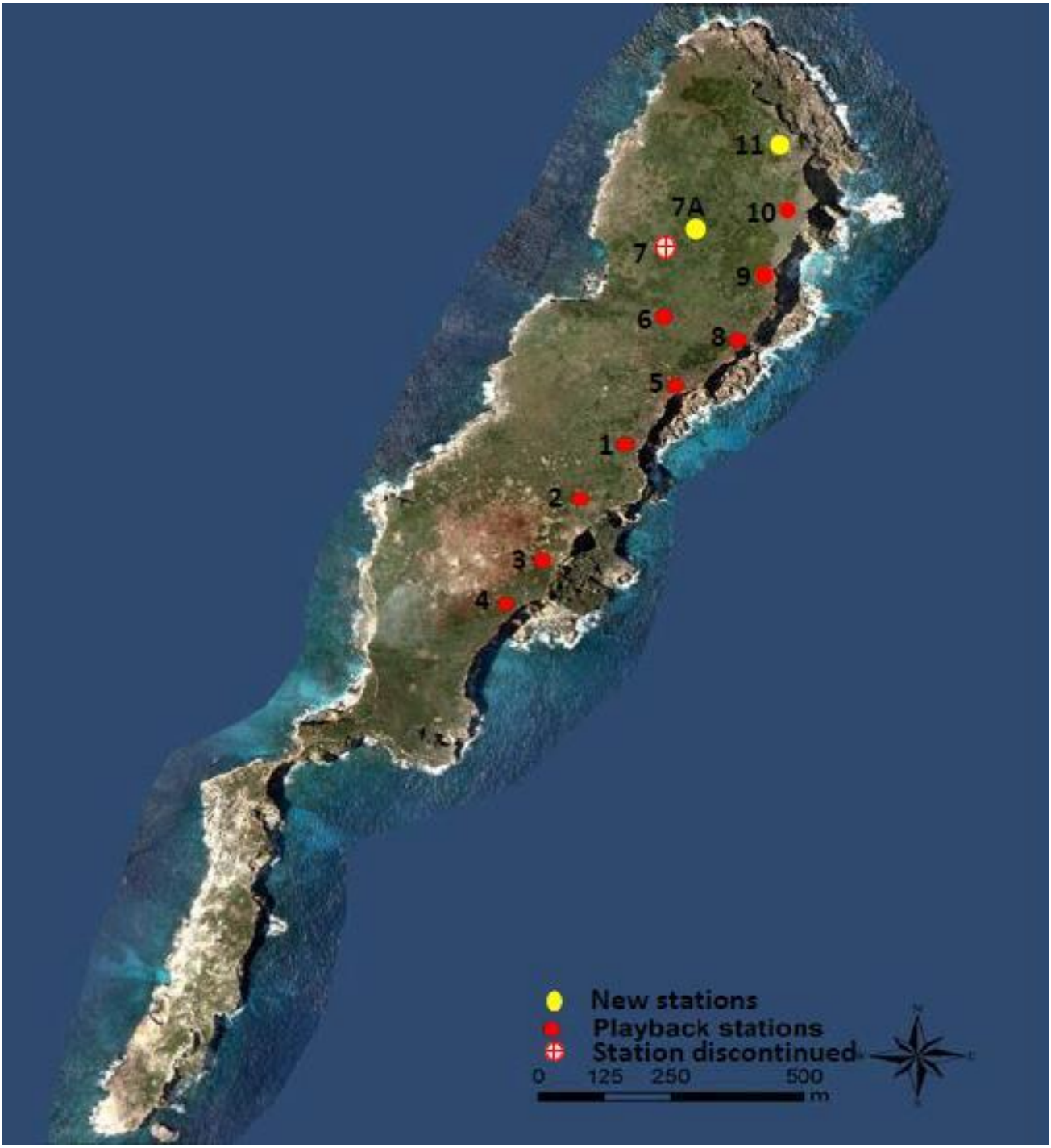


Figure 11. Map of Survey Areas

Mariana Common Moorhen Surveys – Tinian

Location: Tinian, CNMI **Period of Performance:** SEP2020-AUG2021

Project Objective

Ongoing monitoring of moorhens (*Gallinula chloropus guami*) at Hagoi and Bateha wetlands in the Tinian MLA. (Previous Mariana Islands Range Complex [MIRC] BO Requirement, continued as an INRMP project).

Conservation Benefit

Long-term population trends inform our understanding of the success and urgency of management efforts.

FY21 Status

- Four surveys were conducted at Lake Hagoi in 2021. Total detected moorhen were 23 in January, 10 in March, 13 in May, and 18 in July with water present during all surveys (Table 2, Figure 13 and 14).
- Five total nests and 6 total eggs were observed at Lake Hagoi during March and May surveys.
- Long-term population trend at Hagoi appears to be stable.
- Two surveys were conducted at the Bateha wetlands in January and July. No water was present during either survey and no moorhens were detected.
- A new cooperative agreement was established in August 2021 that substantially expands the project scope.

EPR: 1 S RP MAR CNMI ESA and MBTA Species Management; 61128NR211

2019 JRM INRMP Reference: TPS-3; 11-65

Hagoi Moorhen Detections FY 2021			
	Birds	Nests	Eggs
January	23	0	0
March	10	2	0
May	13	3	6
July	18	0	0

Table 3. Moorhen Detections 2021

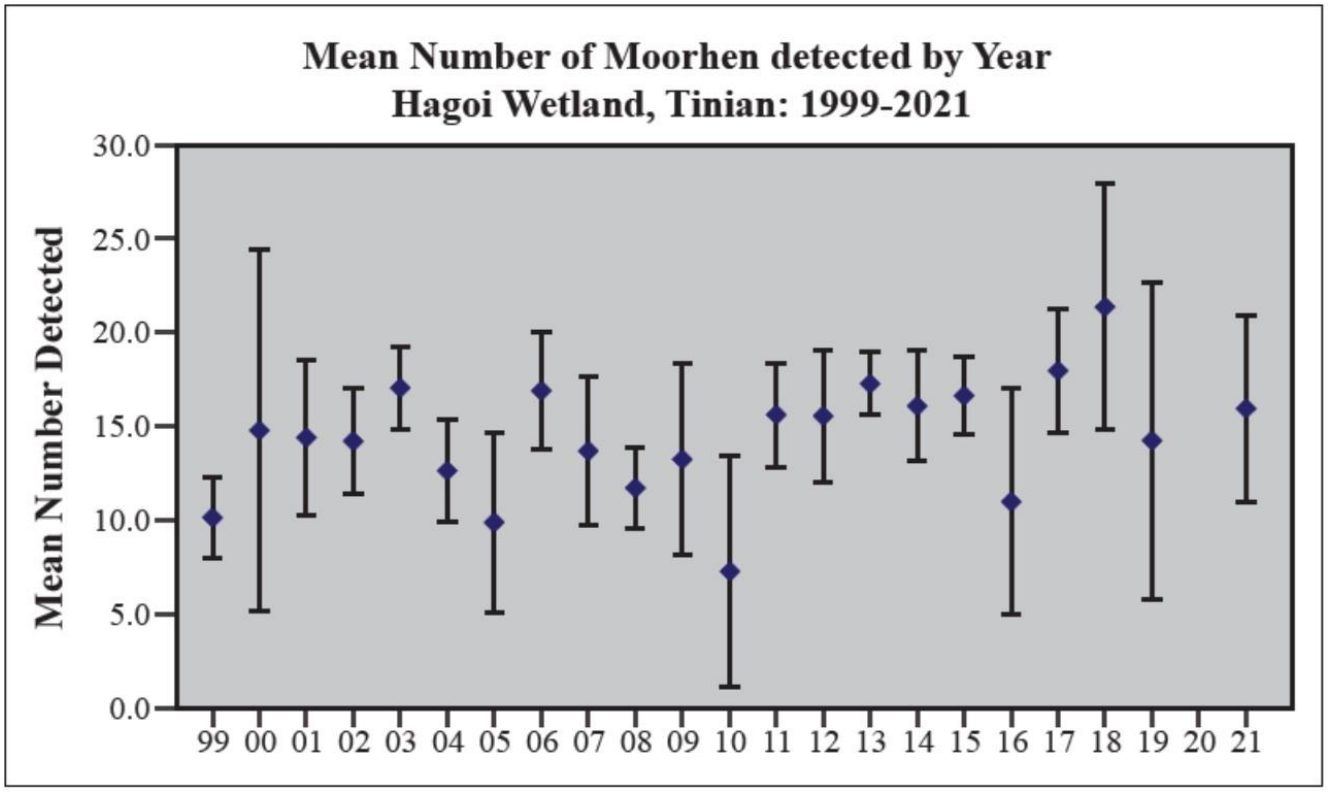


Figure 12. Average Moorhen Detected between 1999 and 2021



Figure 13. Map of Moorhen Survey Locations

Tinian Forest Bird Monitoring and Assessment

Location: Tinian, CNMI **Period of Performance:** SEP2018 – MAR2022

Project Objective

Monitor forest bird populations with a focus on Tinian monarch and Micronesian megapode. Conduct basic ecological studies of Tinian monarch to guide future management strategies.

Conservation Benefit

Long-term population trends inform our understanding of the success and urgency of management efforts. Tinian monarch research will enable effective and efficient management for Tinian monarch.

FY21 Status

- Field data collection commenced in February 2021.
- Forest bird VCP surveys were conducted on the MLA at 123 stations across 5 transects in May/June 2021. Data analysis is pending.
- Two Micronesian megapode playback surveys were completed at 34 stations in limestone forest on the MLA in May/June 2021. No megapodes were detected.
- Tinian monarch research as of July 31, 2021:
    - 89 birds banded
    - Ongoing monitoring of 50 territories in three habitat types
    - 15 nests found. Of these, four nests are active. Three successfully fledged. Six nests failed due to predation by cat, rat, or Mariana kingfisher. One nest failed for unknown reason, and one nest was abandoned.
    - Vegetation surveys (paired plots) completed at 11 nests
    - Telemetry will begin fall 2021

EPR: CHS MAR JRM Tinian Forest Bird Monitoring; EPR 61755NR303

2019 JRM INRMP Reference: TPS-4; 11-64

MIGRATORY BIRD MANAGEMENT

Monitoring of MBTA-Listed Bird Species – FDM

Location: FDM **Period of Performance:** OCT2020 – SEP2021

Project Objective

To identify migratory bird species on FDM; examine trends in abundance; identify and quantify suitable habitat relationships of migratory birds. Monitor long-term trends of three booby species (Brown, Masked, Red-footed) on FDM via aerial surveys.

Conservation Benefit

Provides information of bird species present and habitat usage to guide implementation of appropriate conservation practices.

FY21 Status

- No aerial seabird surveys conducted during this reporting period.
- JRM continuing to explore options to continue monitoring long-term seabird trends for the three booby species.
- During Micronesian megapode surveys on April 25, 2021, nesting Sooty terns and juvenile Sooty terns were observed on the ground along the eastern cliff line, the three species of booby were observed on island and in flight, and species observed in flight: Greater frigatebird, Oriential partincole, Pacific reef-heron, Brown noddy, Black noddy, and White tern.

EPR: 1 S MAR NBG Endangered Species Surveys; 61128NR211

2019 JRM INRMP Reference: MIG-1; 12-35

NATURAL RESOURCES EDUCATION AND OUTREACH

JRM Natural Resources Stewardship Outreach & Public Engagement Program

Location: JRM AOR **Period of Performance:** AUG2020 - AUG2021

Project Objective

To develop materials and training enabling JRM Natural Resource (NR) managers to effectively and efficiently implement a NR stewardship engagement program. This program aims to better educate uniformed and civilian staff, their dependents, JRM contractors, and the general public in order to improve NR stewardship and awareness within the Area of Responsibility (AOR). The AOR includes DoD lands within Guam and the CNMI.

Conservation Benefit

The 2019 INRMP outlines JRM NR responsibility to reach as many uniformed and civilian staff, their dependents, and JRM contractors with focused, consumable environmental education and outreach. The development and production of NR education materials and training is a beneficial support to increasing awareness of T&E species, proper stewardship behavior, and threats to local ecosystems.

FY21 Results

- Swag materials produced
- Planned dissemination of swag materials throughout JRM AOR by DEC 2021
- Training and Outreach presentations created and delivered
- Project finalized AUG 2021

2019 JRM INRMP Reference: TEDU-1; 5-91, MEDU-1; 5-104

PACFLT Funded JRM Natural Resources Stewardship Outreach & Public Education Program

Location: JRM AOR **Period of Performance:** AUG2020 - AUG2021

Project Objective

Improve NR stewardship and awareness within DoD lands within Guam and the CNMI

Conservation Benefit

The 2019 INRMP outlines JRM NR responsibility to reach as many uniformed and civilian staff, their dependents, and JRM contractors with focused, consumable environmental education and outreach. The development and production of NR education materials and training is a beneficial support to increasing awareness of T&E species, proper stewardship behavior, and threats to local ecosystems.

FY21 Results

- Planned expansion of outreach to CNMI
- Development of Stewards of the Sea branded sustainable products
- Continued implementation of Young Environmental Stewards youth educational program
- Held art contest for YES! logo
- Rash guards and stickers for YES! participants produced with logos from art contest

2019 JRM INRMP Reference: TEDU-1; 5-91, MEDU-1; 5-104

Figure 14. Winning Logo Submission from YES! Participant Cianna Allen



Horeg, Jennifer A CIV USN NAVFAC

From: Horeg, Jennifer A CIV USN NAVFAC
Sent: Tuesday, May 4, 2021 3:28 PM
To: 'Flores, Jacqueline B'; 'tammy_summers@fws.gov'; Arlene Pangelinan; 'Kevin Brindock - NOAA Federal'; Joel Moribe - NOAA Federal; Jonathan Brown - NOAA Federal; Steven McKagan - NOAA Federal; 'jay.gutierrez@doag.guam.gov'; 'glenna.sakisat.palacios@gov.mp'
Cc: Lujan, Dana T CIV USN NAVFACMAR; Salas, John F CIV USN NAVFACMAR; jeffrey.laitila@us.af.mil; Moon, Edward E CIV USN NAVFAC; Borja, ALBERT (USMC); Diebel, Sarah E (USAF); Sablan, Randel L CIV USN JRM
Subject: FY21 Joint Region Marianas Natural Resources Metrics - September 2021

Hafa Adai Resource Partners,

I hope you are all doing well! I would like to get the FY21 Joint Region Marianas Natural Resource Metrics meetings on your calendars for the following dates:

16 Sep: CNMI
22-23 Sep: Guam

We are planning to have the meetings be available in person and virtually. More information regarding the venues and agenda will be provided prior to the meetings.

Thank you and we look forward to seeing everyone again.

Best,

Jennifer Cruce Horeg
Conservation Resources Program Manager
NAVFAC Marianas
Joint Region Marianas
Jennifer.horeg@fe.navy.mil
CVR (MS Teams) email: jennifer.a.horeg.civ@cvr.mil

* Please note that I am currently teleworking and am available at the following number: (671) 487-2040

FY21 Natural Resources/INRMP Metrics Attendee List

Frank Alig, NAVFACMAR, (671) 339-5621, Franklin.Alig@fe.navy.mil

Candice Arceo, NAVFACMAR AAFB, 671-366-5012, candice.arceo@us.af.mil

Vinney Atalig-Hocog, CNMI Office of Governor, 671-488-0550, vinney.ahocog@gov.mp

Kristine Barker, NAVFAC Pacific, 808-472-1384, kristine.barker@navy.mil

Heather Benedict, USFWS Ecological Services, 671-688-9947, Heather_benedict@fws.gov

Kevin Brindock, NMFS, 808-725-5146, kevin.brindock@noaa.gov

Jonathan Brown, NMFS, jonathan.brown@noaa.gov

Noah Burrell, NAVFACMAR, 671-339-5310, noah.burrell@fe.navy.mil

Matthew Burt, NAVFACMAR AAFB, 671-366-5058, matthew.burt.4@us.af.mil

Cory Campora, Terrestrial Natural Resources Supervisor, NAVFACSYSCOM Pacific, 808-472-1463, cory.e.campora.civ@us.navy.mil

CJ Cayanan, GDAWR, 671-735-0281, cjcayanan671@gmail.com

Art Charfauros, CNMI DCRM, acharfauros@dcrm.gov.mp

Coralie Cobb, NAVFACPAC, coralie.cobb@navy.mil

Ann Colt, NAVFACMAR NBG, 671-339-2065, ann.colt@fe.navy.mil

Tammy Conkle, NAVFAC HQ, 202-685-9203, tamara.conkle@navy.mil

Jane Dia, GDAWR, 671-735-0285, Jane.dia@doag.guam.gov

Sarah Diebel, NAVFACMAR AAFB, 671-366-1849, sarah.diebel@us.af.mil

Kevin Donmoyer, USFWS, 808-225-1883, kevin_donmoyer@fws.gov

Christine Fejeran, Guam Div of Forestry, 671-300-7975, Christine.Fejeran@doag.guam.gov

Jackie Flores, USFWS Ecological Services, 671 989-6744, jacqueline_flores@fws.gov

Shermaine Garcia, NAVFACMAR, 671-339-5620, shermaine.garcia@fe.navy.mil

Jay Gutierrez, GDAWR, 671-735-0285, Jay.Gutierrez@doag.guam.gov

Lauren Gutierrez, Camp Blaz, 671-355-8050, lauren.gutierrez@fe.navy.mil

Marc Hall, NAVFACMAR, 671-339-2349, marc.hall@fe.navy.mil

Jennifer Horeg, NAVFACMAR, 671-339-7348, jennifer.horeg@fe.navy.mil

Matt Kedziora, NAVFACMAR, 671-339-2198, matthew.kedziora@fe.navy.mil

James Kwon, Fish and Wildlife Biologist • DoD Coordinator, USFWS, 808-792-9433, james_kwon@fws.gov

Jill Liske-Clark, NAVFACMAR, 670-787-8983, jliskeclark@gmail.com

FY21 Natural Resources/INRMP Metrics Attendee List (continued)

Adrienne Loerzel, Camp Blaz, 671-355-8058, Adrienne.loerzel@fe.navy.mil

Dana Lujan, NAVFACMAR, 671-333-1185, dana.lujan@fe.navy.mil

Mario Martinez, NAVFACMAR, 670-339-7348, Mario.Martinez@fe.navy.mil

Jude Martinez, NAVFACMAR, 670-339-8707, Jude.Martinez@fe.navy.mil

Steve McKagan, NMFS, 670-234-0004, steven.mckagan@noaa.gov

Suzanne Medina, GDAWR, 671-735-3995, medinasuzanne@gmail.com

Toni Mizerek, USFWS Ecological Services, 671-989-6744, toni_mizerek@fws.gov

Joel Moribe, NMFS, 808-725-5142, joel.moribe@noaa.gov

Steve Mosher, NAVFACMAR, 671-339-2349, Stephen.Mosher@fe.navy.mil

Benton Pang, Invasive Species Team Manager, USFWS, 671-989-6744, Benton_Pang@fws.gov

Manny Pangelinan, Director, CNMI DFW, (670) 664-6080, mpangelinan.cnmidfw@gmail.com

Megan Parker, NAVFACMAR, 671-339-2344, charles.sayon@fe.navy.mil

Anjelica Perez, NAVFACMAR, 671-339-7281, anjelica.perez@fe.navy.mil

Jerome Perez, Camp Blaz, 671-355-8059, Jerome.Perez@fe.navy.mil

Jeff Quitugua, GDAWR, 671-735-0294, Jeffquitugua@yahoo.com

Andres Reyes, NAVFACMAR, 671-333-1104, andres.reyes@fe.navy.mil

Glenna Reyes, CNMI Special Assistant to the Governor for Military Affairs, (670) 237-2231, glenna.reyes@gov.mp

Maria Santos, NAVFACMAR, 671-339-5148, Maria.Santos@fe.navy.mil

Lorraine Shaughnessy, lorraine.shaughnessy, 808-472-1475, lorraine.shaughnessy@navy.mil

Tammy Summers, USFWS GNWR, 671-355-5096, Tammy_Summers@fws.gov

Sheeka Tareyama, Camp Blaz, 671-355-8420, sheeka.tareyama@fe.navy.mil

Lauren Taylor, PIFWO, USFWS, 808-792-9528, lauren_taylor@fws.gov

Anthony Tornito, GDAWR, 671-735-3990

Michael Tenorio, CNMI DFW, mtenorio_dfw@live.com

Brent Tibbetts, GDAWR, 671-735-0259, brent.tibbetts@gmail.com

Diane Vice, GDAWR, 671-735-3990, dianevice@gmail.com

Scott Vogt, NAVFACMAR AAFB, 671-366-2522, scott.vogt.1@us.af.mil

Tyler Willsey, USFWS, tyler_willsey@fws.gov

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D4 2022 Annual Report

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DEPARTMENT OF THE NAVY
JOINT REGION MARIANAS
PSC 455, BOX 211
FPO AP 96540-1000

5090
Ser J4/120
6 Mar 23

From: Commander, Joint Region Marianas
To: Resource Partners

Subj: FISCAL YEAR 2022 NATURAL RESOURCES/INTEGRATED NATURAL RESOURCES MANAGEMENT PLAN METRICS SUMMARY REPORT

Ref: (a) OPNAV-M-5090.1

Encl: (1) JRM INRMP Summary of FY22 Projects for Guam and CNMI
(2) FY 2022 Natural Resources INRMP Metrics Results
(3) FY 2022 Natural Resources INRMP Metrics Invitation and Attendee List

1. In accordance with reference (a), Navy installations are required to submit an annual report summarizing the recent Natural Resources/Integrated Natural Resources Management Plan (INRMP) Metrics meeting and status of the INRMP enclosure (1). The Natural Resources/INRMP Metrics summary scores presented in enclosure (2) are generated from the Navy Conservation website to reflect current status of INRMP execution.

2. The Fiscal Year (FY) 22 Joint Region Marianas (JRM) Natural Resources/INRMP Metrics meeting for Commonwealth of the Northern Mariana Islands (CNMI) resource partners was held at the Pacific Islands Club in Saipan on September 15, 2022 and the JRM INRMP Metrics meeting for Guam resource partners was held at the Hyatt Regency Guam on September 21 and 22, 2022 enclosure (3).

3. The Final 2019 JRM INRMP was completed and signed by partner agencies (U.S. Fish and Wildlife Service, National Marine Fisheries Service, Guam Department of Agriculture, and CNMI Department of Land and Natural Resources-Division of Fish and Wildlife) in June through August 2019. Annual updates are conducted each calendar year beginning in 2020 and a 5-year review for operation and effect will be conducted in 2024 per the OPNAVINST 5090.1E, reference (b), sections 670a-f. The FY22 JRM INRMP update will be completed and distributed in March 2023.

4. Thank you for your participation in our Natural Resources/INRMP Metrics meeting and for your support of the JRM Natural Resources Program. If you have any questions, please contact Jennifer Horeg, Natural Resources Program Supervisor, at 671-339-1275 or via e-mail at Jennifer.a.horeg.civ@us.navy.mil.

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Date: 2023.03.05 02:22:02 +10'00'

B. R. NICHOLSON

Subj: FISCAL YEAR 2022 NATURAL RESOURCES/INTEGRATED NATURAL RESOURCES MANAGEMENT PLAN METRICS SUMMARY REPORT

Distribution:

Earl Campbell, PhD
Field Supervisor
U.S. Fish and Wildlife Service
Pacific Islands Fish and Wildlife Office
300 Ala Moana Boulevard, Room 3-122 Box 5008
Honolulu, HI 96816

Mr. Michael Tosatto
Regional Administrator
National Marine Fisheries Service
Pacific Islands Regional Office
1845 Wasp Blvd., Bldg 176
Honolulu, HI 96818

Ms. Chelsa Muna-Brecht
Director
Guam Department of Agriculture
163 Dairy Road
Mangilao, GU 96913

Mr. Anthony Benavente
Director
CNMI Department of Land and Natural Resources
P.O. Box 10007
Saipan, MP 96950

Programmatic Division U.S. Fish and Wildlife Service
Pacific Islands Fish and Wildlife Office
Marianas Office, U.S. Fish and Wildlife Service, Pacific Islands Fish and Wildlife Office
300 Ala Moana Boulevard, Room 3-122 Box 5008
Honolulu, HI 96816

Mariana Islands Refuges and Monument Complex
P.O. Box 8134, MOU-3
Dededo, GU 96912

U.S. Fish and Wildlife Service
Ecological Services
P.O. Box BT
Hagatna, GU 96932

CNIC Washington DC (N45) NAVFACENGCOM Washington DC (EV2)

FY22 Natural Resources/INRMP Metrics Results

2022 Natural Resources Annual Report: NSA ANDERSEN

Summary Score

Focus Area	Score
1 - Natural Resources Management	0.61
2 - Listed Species Critical Habitat	0.73
3 - Recreation Use and Access	0.95
4 - Sikes Act Cooperation	0.89
5 - Team Adequacy	0.60
6 - INRMP Implementation	0.88
7 - Support of Installation Mission	0.64
NSA ANDERSEN - Overall Score	0.77

202 Natural Resources Annual Report: NB Guam

Summary Score

Focus Area	Score
1 - Natural Resources Management	0.76
2 - Listed Species Critical Habitat	0.87
3 - Recreation Use and Access	0.95
4 - Sikes Act Cooperation	0.91
5 - Team Adequacy	0.89
6 - INRMP Implementation	0.76
7 - Support of Installation Mission	0.68
NB Guam - Overall Score	0.84

FY22 Natural Resources/INRMP Metrics Results

2022 Natural Resources Annual Report: Tinian MLA

Summary Score

Focus Area	Score
1 - Natural Resources Management	0.56
2 - Listed Species Critical Habitat	0.71
3 - Recreation Use and Access	0.83
4 - Sikes Act Cooperation	0.88
5 - Team Adequacy	0.74
6 - INRMP Implementation	0.80
7 - Support of Installation Mission	0.68
Tinian MLA - Overall Score	0.74

2022 Natural Resources Annual Report: Farrallon de Medinilla FDM

Summary Score

Focus Area	Score
1 - Natural Resources Management	0.58
2 - Listed Species Critical Habitat	0.53
3 - Recreation Use and Access	N/A
4 - Sikes Act Cooperation	0.88
5 - Team Adequacy	0.84
6 - INRMP Implementation	0.64
7 - Support of Installation Mission	0.68
Farrallon de Medinilla - Overall Score	0.84

2022 Natural Resources Annual Report: OVERALL SCORE SUMMARY

Summary Score

Focus Area	Score
1 - Natural Resources Management	0.64
2 - Listed Species Critical Habitat	0.73
3 - Recreation Use and Access	0.91
4 - Sikes Act Cooperation	0.89
5 - Team Adequacy	0.77
6 - INRMP Implementation	0.77
7 - Support of Installation Mission	0.67
Overall Score Summary (Farrallon de Medinilla FDM, NB Guam, Tinian MLA, NSA ANDERSEN)	0.76

- The Navy Conservation Website is the tool used to collect data
- Scoring and Weighting
  - INRMP Implementation Focus Area
    - Red = 0-50% , Yellow = 50%-75%, Green = 75%-100%



  - Remaining 6 Focus Areas
    - Key questions have higher weighted values to influence the total score
    - The score of each Focus Area is a “weighted average”
  - The final score of Focus Area is expressed as a decimal value between 0 and 1.
    - Not a percentile measurement
    - Red = 0.0 to 0.33, Yellow = 0.34 to 0.66, Green = 0.67 to 1.0





Ifit Flower
Photo: US NAVY

Joint Region Marianas Integrated Natural Resources Management Plan Project Summaries 2022

GUAM REPORT

Naval Facilities Engineering Systems Command
NAVFAC Marianas

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ACRONYMS AND ABBREVIATIONS

ACRONYM	DESCRIPTION
AAFB	Andersen Air Force Base
ADS	Automated Delivery System
AFPMB	Armed Forces Pest Management Board
AOR	Area of Responsibility
BO	Biological Opinion
BTS	Brown Treesnake
CESU	Cooperative Ecosystem Studies Units Network
CEMML	Center for Environmental Management of Military Land
CGAPS	Coordinating Group on Alien Pest Species
CIS	Center for Island Sustainability
CNMI	Commonwealth of the Northern Mariana Islands
COMPACFLT	Commander, U.S. Pacific Fleet
COTS	Crown-of-thorns Seastar
CP	Closed Population
CRB	Coconut Rhinoceros Beetle
CRU	Cooperative Research Unit
CSU	Colorado State University
DAWR	Division of Aquatic and Wildlife Resources
DFW	Division of Fish and Wildlife
DLNR	Department of Lands and Natural Resources
DNM	Dead Neonatal Mice
DoD	Department of Defense
EOD	Explosive Ordnance Disposal
ERA	Ecological Reserve Area
ESA	Endangered Species Act
FDM	Farallon de Medinilla
Ft	foot/feet
FY	Fiscal Year

GIS	Geographic Information System
GISAC	Guam Invasive Species Advisory Committee
GISC	Guam Invasive Species Council
GMK	Guam Micronesian Kingfisher
GNWR	Guam National Wildlife Refuge
GPEPP	Guam Plant Extinction Prevention Program
GDOAg	Guam Department of Agriculture
ha	hectare(s)
HACCP	Hazard Analysis and Critical Control Points
HMU	Habitat Management Unit
ISU	Iowa State University
INRMP	Integrated Natural Resources Management Plan
IRP	Installation Restoration Program
JRM	Joint Region Marianas
LFA	Little fire ant
LFTRC	Live Fire Training Range Complex
M	meter(s)
MEDU	Marine Natural Resources Educational Outreach
MCBCB	Marine Corps Base Camp Blaz
MGIS	Marine GIS and Data Management
MHM	Marine Habitat Management
MIG	Marine Bird Management
MIRC	Mariana Islands Range Complex
MIS	Marine Invasive Species Management
MISMP	Marine Invasive Species Management Plan
MITT	Mariana Islands Training and Testing
MLA	Military Lease Area
MLAW	Marine Natural Resources Law Enforcement
MOA	Memorandum of Agreement
MPS	Marine Protected Species Management

MSA	Munitions Storage Area
NAVFAC	Naval Facilities Engineering Systems Command
NBG	Naval Base Guam
NBGTS	Naval Base Guam Telecommunications Site
NMFS	National Marine Fisheries Service
NMS	Naval Base Guam Naval Munitions Site
NNE	Non-Nesting Emergence
NOAA	National Oceanic and Atmospheric Administration
NWF	Northwest Field
NWRC	National Wildlife Research Center
PACOM	Pacific Command
PIERC	Pacific Island Ecosystems Research Center
QA/QC	Quality Assurance/Quality Control
SOP	Standard Operating Procedure
TEDU	Terrestrial Natural Resources Educational Outreach
TGIS	Terrestrial GIS and Data Management
THM	Terrestrial Habitat Management
TIS	Terrestrial Exotic and Invasive Species Management
TLAW	Terrestrial Natural Resources Law Enforcement
TPS	Terrestrial Protected Species Management
RBP	Regional Biosecurity Plan for Micronesia and Hawaii
RFMP	Range Fire Management Plan
RISC	Micronesian Regional Invasive Species Council
UOG	University of Guam
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
USDA-WS	United States Department of Agriculture- Wildlife Services
WERI	Water and Environment Research Institute

MARINE HABITAT MANAGEMENT

JRM Marine Invasive Species Management Plan (JRM MISMP)

Location: JRM AOR **Period of Performance:** OCT 2022 – SEP 2023

Project Objective

To develop standard operating procedures (SOP) and protocols to avoid and minimize: (1) the spread of new marine invasive species (MIS) into the Department of Defense (DoD) submerged lands within the JRM Area of Responsibility (AOR), and (2) the transfer of any MIS from DoD submerged lands within the JRM AOR to the Pacific region.

Conservation Benefit

The development of SOPs and protocols for a MISMP shall support natural resource managers to monitor, detect, respond, control, eradicate, and prevent the risk of MIS incursions into, out of, and within the JRM AOR, thus maintaining marine biodiversity and ecosystem functions within JRM's AOR.

FY22 Status

- Awarded August 22, 2022

EPR: 61128NR168: Ecosystem Monitoring and Coral Reef Indicators

2019 JRM INRMP Reference: MIS-1; 5-102, MIS-2; 5-102, MIS-1; 8-64, MIS-2; 8-65, MIS-1; 9-88, MIS-2; 9-88, MIS-1; 11-75, MIS-2; 11-75

Water Quality Monitoring on JRM Submerged Lands

Location: JRM AOR **Period of Performance:** JUN2021 – Ongoing

Project Objective

To quantify the conductivity, temperature, depth, pH, chlorophyll A, dissolved oxygen, nitrate, and phosphate concentrations in shallow reef systems.

Conservation Benefit

These quantitative data will assist in determining the parameters associated with climate change that may be impacting coral reefs in order to avoid, minimize or mitigate potential adverse effects to the marine resources within these areas, especially marine protected species.

FY22 Status

- Ongoing project with the UOG WERI
- Fieldwork was delayed due to COVID-19
- Sensor deployment is ongoing for Guam and will be completed by SEP 2022
- Sensor deployment is planned for OCT 2022

EPR: CHS MAR JRM Monitoring and Control of Acute Impacts on Coral Reefs; 61128CN222

2019 JRM INRMP Reference: MIS-2; 8-65, MHM-1; 8-62, MHM-2; 8-63, MHM-3; 8-63, MGIS-1; 8-68, MHM-1; 11-73, MHM-2; 11-74, MHM-3; 11-74, MIS-2; 11-75, MPS-1; 11-76

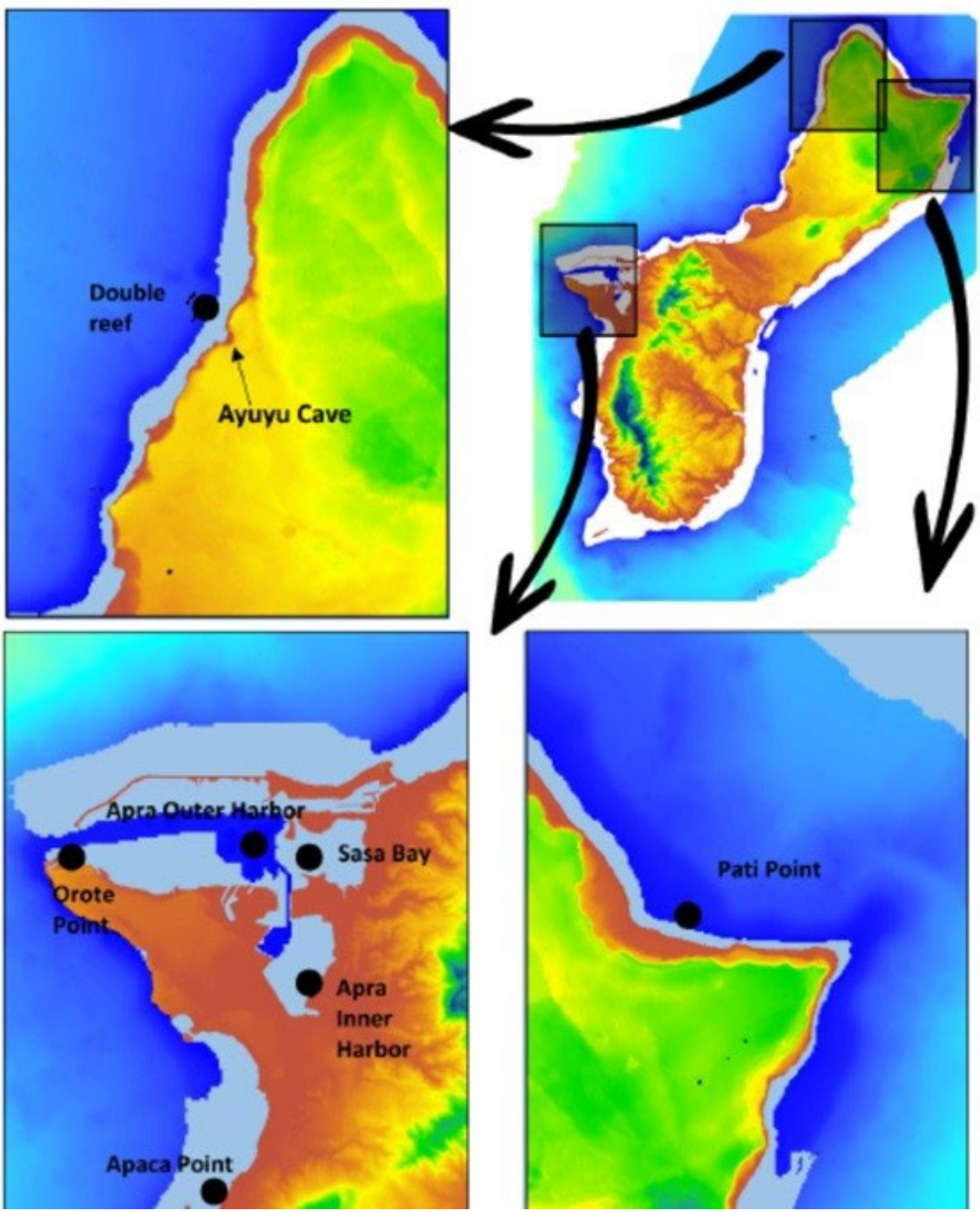


Figure 1. Proposed deployment locations of water quality sensors in JRM submerged lands, Guam.

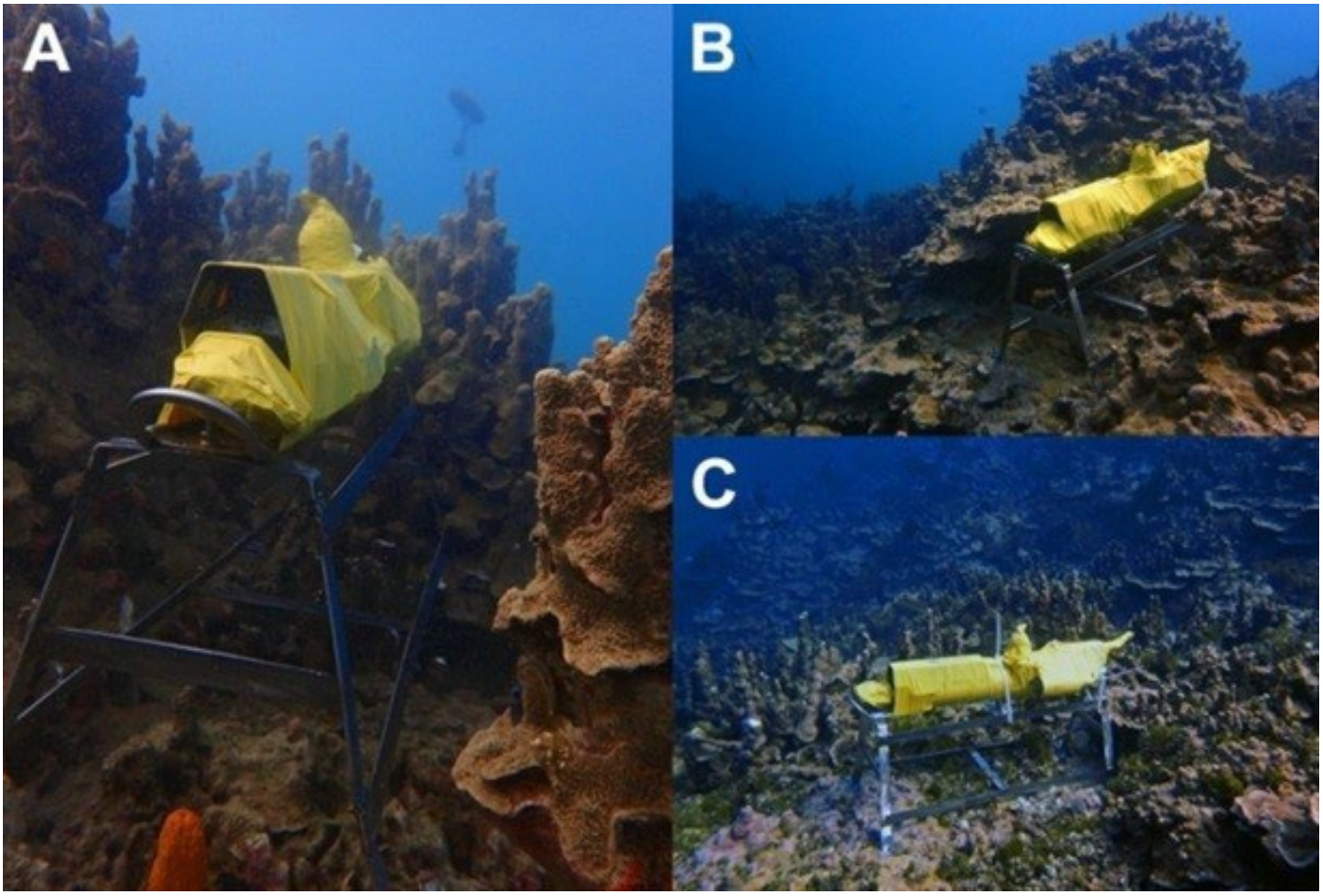


Figure 2. In 2014, several SeaBird water quality sensors (model 19plus V2) were deployed and installed on a (stainless steel) mounting frame in Apra Harbor, Guam (A = Anchor Reef; B = Middle Shoals; C = Orote Point). For this proposed action, the same methodology will be employed.



Figure 3. A CTD sensor mounted on a stainless steel frame. The mounting frame will be installed on the benthic substrate so that the sensor can be easily retrieved for data acquisition and servicing, and also prevents physical contact with the benthic substrate.

Identification and Removal of Non-Permitted Buoys on JRM Submerged Lands

Location: NBG **Period of Performance:** JUL2020 - SEP2022

Project Objective

To identify, locate, and remove the non-permitted buoys (NPBs) in JRM submerged lands.

Conservation Benefit

The identification, location, and removal of NPBs will allow individuals to use authorized (i.e., USACE-permitted) moorings in order to avoid, minimize or mitigate potential adverse effects to the marine resources within these areas, especially marine protected species.

FY22 Status

- Ongoing project with the Navy Information Warfare Center
- Fieldwork was delayed due to COVID-19; completed in July 2021
- 26 total buoys were located (10 in Orote ERA and 16 in the harbor); of the 19 Shallow Water Mooring System (SWMS) buoys deployed in 2019 , 14 were located and five were not located.

EPR: CHS MAR JRM Monitoring and Control of Acute Impacts on Coral Reefs; 61128CN222

2019 JRM INRMP Reference: MIS-2; 8-65, MHM-1; 8-62, MHM-2; 8-63, MHM-3; 8-63, MGIS-1 8-68



Figure 4. A Shallow Water Mooring System (SWMS) buoy installed at Gab Gab Beach, Apra Harbor, Guam.



Figure 5. The approximate locations of the 26 buoys in Apra Harbor and Ortote ERA.



Figure 6. A possible NPB in Apra Harbor, Guam.



Figure 7. A possible NPB in Apra Harbor, Guam showing extensive damage to the surrounding benthos.



Figure 8. A possible NPB in Apra Harbor, Guam showing extensive damage to the surrounding benthos.

Coral Bleaching and Crown of Thorns Seastar (COTS) Monitoring on JRM Submerged Lands

Location: JRM AOR **Period of Performance:** JUN2021 – Ongoing

Project Objective

To quantify the coral bleaching and abundance distribution of COTS, and if necessary conduct COTS culling.

Conservation Benefit

These quantitative data will assist in determining the parameters associated with coral bleaching and COTS outbreak events that may be impacting coral reefs in order to avoid, minimize or mitigate potential adverse effects to the marine resources within these areas, especially marine protected species.

FY22 Status

- Ongoing project with the UOG Sea Grant Office
- Fieldwork was delayed due to COVID-19; fieldwork is ongoing for Guam
- COTS workshop hosted on March 21-22, 2022; consisted on classroom and in-water training; participants from state, federal, and NGO participants

EPR: CHS MAR JRM Monitoring and Control of Acute Impacts on Coral Reefs; 61128CN222

2019 JRM INRMP Reference: MIS-2; 8-65, MHM-1; 8-62, MHM-2; 8-63, MHM-3; 8-63, MGIS-1; 8-68, MHM-1 11-73, MHM-2; 11-74, MHM-3; 11-74, MIS-2; 11-75, MPS-1; 11-76

Characterization of Marine Benthic Habitats in Outer Apra Harbor Guam and Haputo ERA

Location: NBG; MCBCB **Period of Performance** SEP2019 – Ongoing

Project Objective

To provide habitat predictions and maps of submerged lands (i.e., coral reef) in Outer Apra Harbor and Haputo ERA using a variety of GIS data (e.g., lidar, side scan, multibeam, aerial imagery, etc.) and underwater photos and videos.

Conservation Benefit:

Identification and characterization of the marine benthic habitats will inform military training and testing, as well as the consultations with regulatory agencies, in order to avoid, minimize or mitigate potential adverse effects to the marine resources within these areas, especially marine protected species.

FY22 Status

- Ongoing project with the NOAA NCCOS
- Fieldwork completed May 1-13, 2022 at Outer Apra Harbor and Haputo ERA
- A drop camera, mapping grade global positioning system (GPS) and ultra-short baseline (USBL) equipment were used to collect 24 MP photographs, HD video, and location data at over 500 sites throughout the project areas.
- Ground control points (GCPs) were recorded at ~20 locations in the project areas on land
- Data acquisition complete and analyses ongoing

EPR: 1 CP MAR NBG Benthic Habitat and Coral Mapping and Management (CHS); 61755NR818

2019 JRM INRMP Reference: MIS-2; 8-65; MHM-1; 8-62, MHM-2; 8-63, MHM-3; 8-63, MGIS-1; 8-68

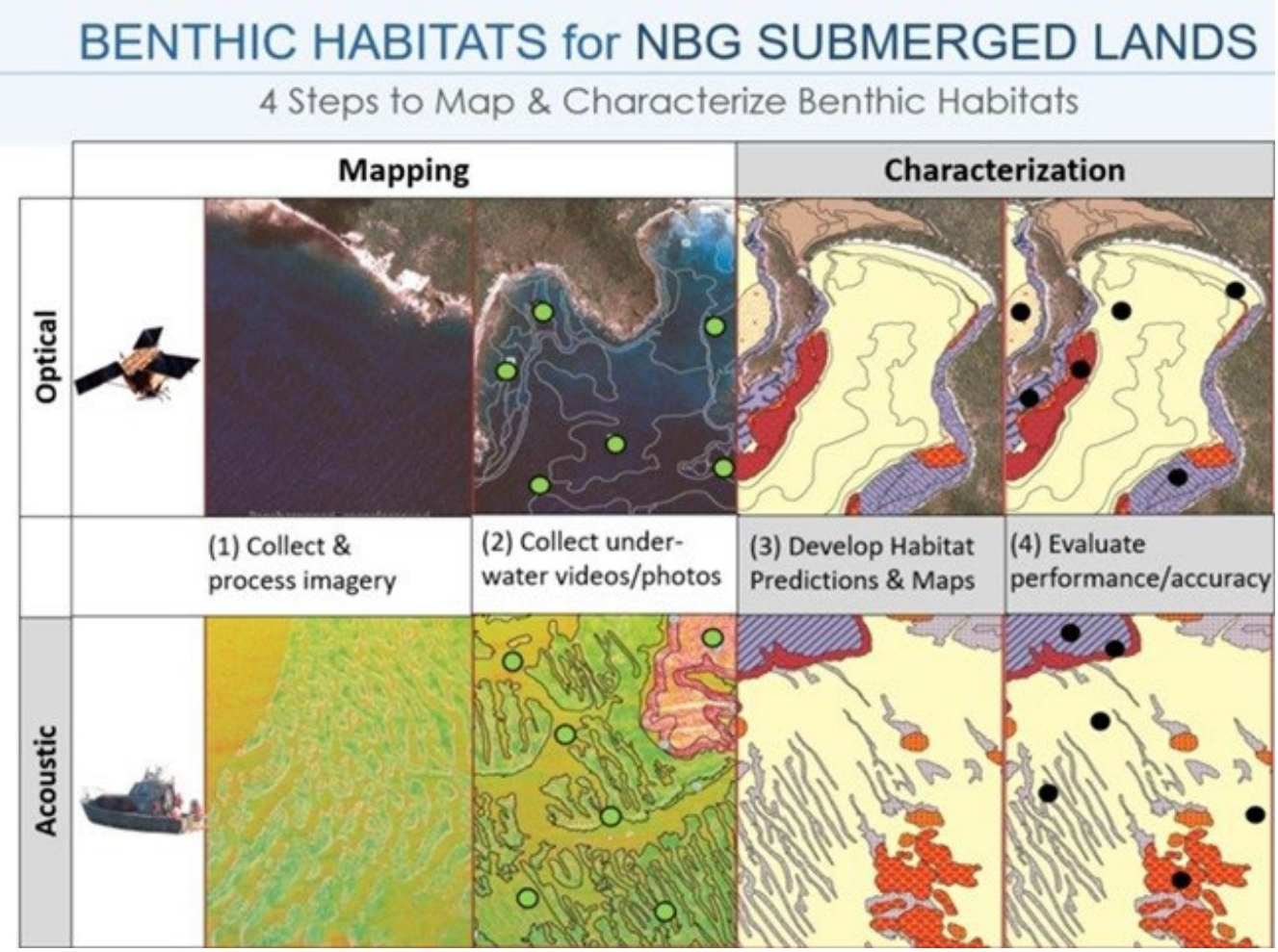


Figure 9. The process of mapping and characterizing benthic habitats in Outer Apra Harbor and Haputo ERA.

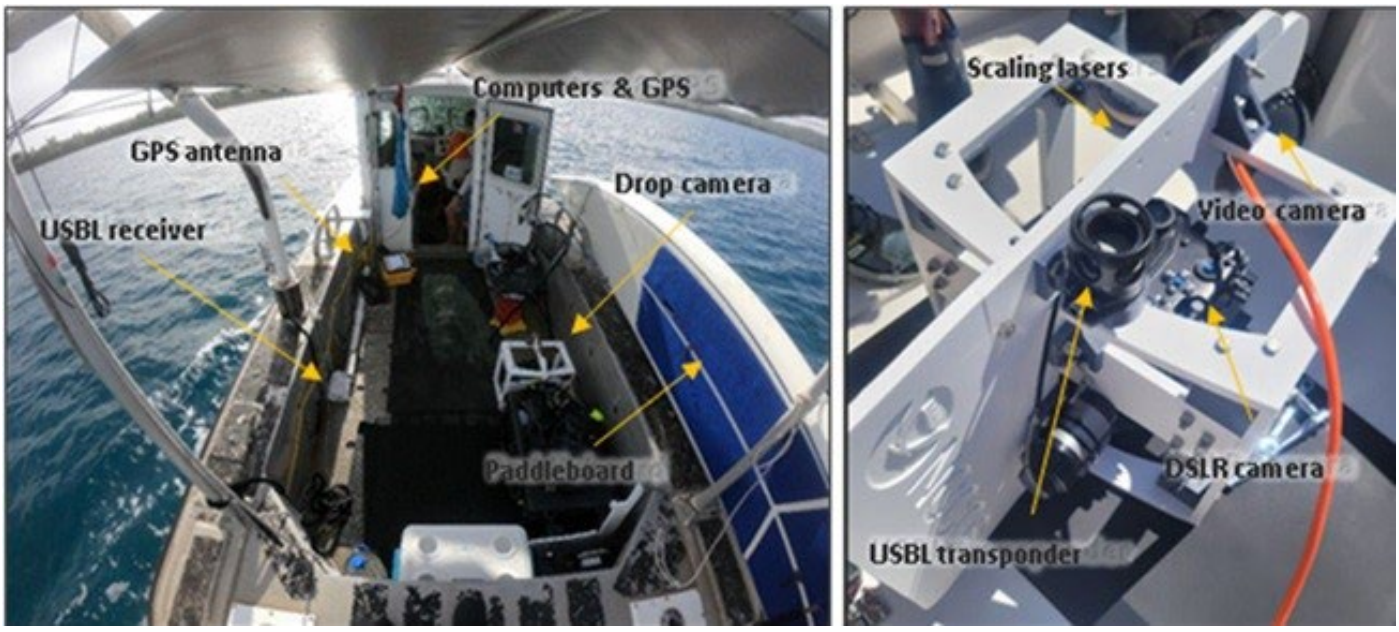


Figure 10. (Left) Vessel set up and (right) drop camera used to collect information about benthic habitats in/around Haputo ERA and NBG. The drop camera was designed and 3D printed by NOAA NCCOS, and included DSLR camera (for high resolution photographs), video camera (for real-time feed), USBL (for underwater positioning), GPS (for above water positioning) and lasers (spaced at 10cm for scaling).

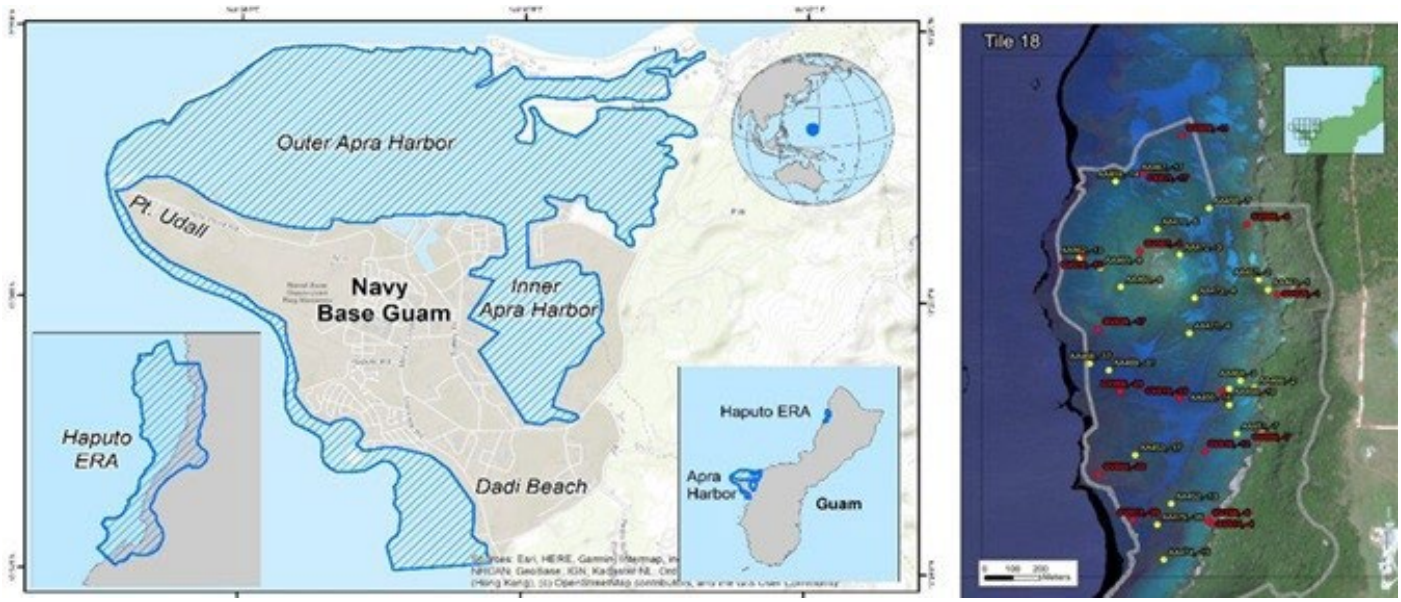


Figure 11. (Left) Map showing location of field work (blue hatched areas), including NBG and Haputo ERA. (Right) Map showing a subset of sites photographed in/around Haputo ERA.



Figure 12. The proposed benthic habitat types that may occur in JRM submerged lands.



Figure 13. Giant Triton (*Charonia tritonis*) eating a sea star (*Linckia laevigata*) in Outer Apra Harbor, Guam.

MARINE PROTECTED SPECIES MANAGEMENT

Sea Turtle Distribution and Habitat Use

Location: NBG **Period of Performance:** AUG2018 - SEP2022

Project Objective

In an effort to protect and enhance sea turtle population in the marine waters of Navy-submerged lands, JRM entered a multi-year interagency agreement with NOAA NMFS. The goal of this project is to understand the distribution and habitat use of sea turtles on Navy-submerged lands. Information generated from the project will inform management actions to protect sea turtles and be used to assess potential impacts from proposed actions within Navy-submerged lands.

Conservation Benefit

The conservation benefits of project are to (a) sustain and enhance the sea turtle population; (b) maintain sea turtle species range and distribution; and (c) increase the use of adaptive management techniques for sea turtles.

FY22 Status

- Local participation from DAWR, USFWS, Sea Grant, JTS
- In-water surveys/capture occurred in Jul 2022
- 11 green/hawksbill sea turtles satellite-tagged
- Data analyses expected in Oct 2022
- Multi-year report to be submitted in CY 2023

EPR: 1 S CP MAR NBG Sea Turtle Distribution and Habitat Use; 61755NR815

2019 JRM INRMP Reference: MPS-2; 5-103

Table 1. Summary of turtle observations, captures and satellite tag deployments between 2015 and 2022.

	Turtle Encounters	
Survey Year	Observerd + Captured	Satellite-Tagged
2015	90	16
2016	25	4
2017	75	22
2019	69	12
2020	IAA Extension due to COVID pandemic	
2021	IAA Extension due to COVID pandemic	
2022	98	11
All Years	**357**	**65**



Figure 14. Study area and in-water sites surveyed by NMFS during the July 2022 expedition.



Figure 15. Sea turtle equipped with satellite tag to capture location, temperature and depth is released into Outer Apra Harbor (Photo: NOAA NMFSS).

TERRESTRIAL EXOTIC AND INVASIVE SPECIES MANAGEMENT

Monitoring to Evaluate Effectiveness of HACCP Plan Implementation at Construction Sites

Location: MCBCB; NBG; AAFB **Period of Performance:** Multiple

Project Objective

Monitor terrestrial vegetation to aid in evaluating the success of implemented HACCP plans. The goal is to minimize the spread and effects of invasive plant species due to construction activities.

Conservation Benefit

Invasive species are among the greatest threats to Guam's native habitats and listed species. HACCP plans are an operational tool to minimize the spread of invasive species between sites and to prevent new introductions.

FY22 Status

- Ongoing projects for construction activities:
- J001B Finegayan Utilities and Site Improvements Phase 1
- J-006 Apra Medical Clinic
- J-007 Waterfront Head Quarters
- J-609 Apra Embark Facility
- J-755 Urban Combat Training
- P-103 Water Well Field
- P-290 Earth Covered Magazines
- P-295 Ordnance Ops.
- P-296 Ordnance Ops. Admin Facility

- P-715 Live-Fire Training Range Complex Known Distance Ranges
- P-735 Machine Gun Range

DPRI: Marine Corps Relocation 2017/2018 amendment to 2015 BO, Conservation Measures to Contribute to the Recovery of Listed Species

Reference: Guam Relocation Biological Opinion



Figure 16. All MCBCB construction sites have washdown areas to reduce risks of spreading invasive species.

Implementation of the Regional Biosecurity Plan of Micronesia and Hawaii (RBP) - Guam

Location: JRM AOR **Period of Performance**: AUG2021 - Ongoing

Project Objective

Implement priority actions from the RBP aimed at: 1) Preventing the spread of invasive species within and in/out of JRM Area of Responsibility (AOR); 2) Foster regional coordination and collaboration; 3) Invasive species management and control; and 4) Strengthening capacity for biosecurity.

Conservation Benefit

Protection of native species, particularly those that are threatened and endangered, from the threat of invasive species within the JRM AOR.

FY22 Status

- Implement arrival and/or pre-departure biosecurity inspections of non-training military equipment and cargo movements into/out of JRM AOR to ensure Armed Forces Pest Management Board Technical Guide No. 31 (AFPMB TG-31) cleanliness standards, therefore devoid of biomaterial.
- Movements included Navy Mobile Construction Battalion (NMCB) cargo and equipment to/from Tinian and Palau for Navy public works projects.
    - Colorado State University Center for Environmental Management of Military Lands (CSU CEMML) conducted arrival and pre-departure biosecurity cleanliness inspections and USDA-WS conducted pre-departure BTS canine inspections.
    - Eleven (11) pre-departure biosecurity and Brown treesnake inspection events on Guam for cargo and equipment movements to Tinian (5) and Palau (6). One pre-departure biosecurity inspection event on Tinian for cargo and

equipment movement to Guam and one arrival biosecurity inspection event for cargo and equipment arriving from Palau.

- Continued interagency coordination and consultation regarding invasive species management and biosecurity concerns within the region (CRB Working Group, LFA Working Group, GISC, GISAC, RISC, CNMI DLNR, Guam Biosecurity Division, CGAPS).

EPR: CHS NISA MAR JRM Implementation of the Regional Biosecurity Plan; 61128NR860

2019 JRM INRMP Reference: TIS-4; 5-85, TIS-5; 6-44, TIS-5; 7-53, TIS-4; 8-51, TIS-6; 9-73, TIS-1; 11-62, TIS-1; 12-32

Invasive Species Management within the Joint Region Marianas Area of Responsibility - Guam

Location: JRM AOR **Period of Performance**: AUG2021 – Ongoing

Project Objective

In support of Mariana Islands Training & Testing (MITT) activities:
1) Conduct Early Detection Surveys (EDS) non-native species at training and cargo staging locations within the JRM AOR (Guam and CNMI (Military Leased Area);
2) Develop and implement standard operating procedures for the control and removal of high-risk invasive species;
3) Develop and implement invasive species rapid response protocols;
4) Develop and implement bio-sanitation standards along with quality assurance/quality control standards via biosecurity inspections;
5) Development of a programmatic pathway risk analysis for the movement of equipment and personnel within the JRM AOR; and
6) Targeting high-risk invasive arthropod species for control and eradication.

Conservation Benefit

Prevent the movement and establishment of invasive species into and out of Guam and the CNMI during training exercises.

FY22 Status

- Ongoing cooperative agreement CSU CEMML.
- Early Detection Surveys Conducted
    - All-Taxa Surveys – AAFB: 9 of 32 sites; NBG: 10 of 30 sites
    - Weed Surveys – AAFB: 5 of 29 sites; NBG: 27 of 34 sites
- Development of SOPs for the Control/Eradication of High-Risk Species
    - Little Fire Ant (LFA; *Wasmannia auropuncta*) Revised
    - Lollipop Climber (*Diplocyclus palmatus*) Draft

  - Mile-a-Minute vine (*Mikania mircantha*) Draft
  - Greenhouse frog (*Eleutherodactylus planirostris*) Draft
  - Greater Banded Hornet (*Vespa tropica*) Draft in progress
- Invasive Species Rapid Response
  - Thirteen (13) CSU CEMML personnel USGS BTS Rapid Response certified
  - Assisted Guam Biosecurity Division with initial monitoring effort at Won Pat International Airport after a Coqui frog was intercepted at the Saipan International Airport (September 2021)
  - Monitoring and manual removal of Lollipop Climber at AAFB (Figure 17)
  - Monitoring and manual removal of Itch grass (*Rottboellia cochinchinensis*) clump at NBG Mainbase (Figure 18)
  - Pellitory (*Parietaria judaica*) detected at on NBG Mainbase with control pending University of Guam species confirmation (Figure 19)
  - Pencil cactus (Euphorbia tirucalli) removal and monitoring at AAFB Northwest Field (Figure 20)
- Bio-sanitation QA/QC Biosecurity Inspections during Military Training Events
  - Four (4) major training events (>100 cargo items; Forager 21, 31st MEU, Cope North 22, Valiant Shield 22)
  - Seven (7) minor training events (25 – 100 cargo items)
  - Seven (7) unit level training events (<25 cargo items)
  - >5,500 items inspected during arrival and pre-departure biosecurity inspections to meet AFPMB TG-31 cleanliness standards
  - Bio-material interceptions (plant material, seeds, soil/gravel, insects, spiders/webs/eggs, wasp nests, dead frog, etc.)(Figure 21)
- Development of a Programmatic Pathway Risk Analysis for Movements into the Mariana Islands and between Islands
- Ongoing data collection to support the risk analysis

EPR: 2 BO MAR Mariana Islands Training and Testing (MITT) Implementation; 61128NR218
CHS NISA MAR JRM Implementation of the Regional Biosecurity Plan; 61128NR860
USMC HQ MITT Biological Opinion Conservation Measures Implement (FY21 Non-EPR)

2019 JRM INRMP Reference: TIS-6; 5-86, TIS-7; 6-44, TIS-6; 7-53, TIS-5; 8-51, TIS-7; 9-73, TIS-2; 11-62, TIS-1; 12-32; TIS-2; 12-33

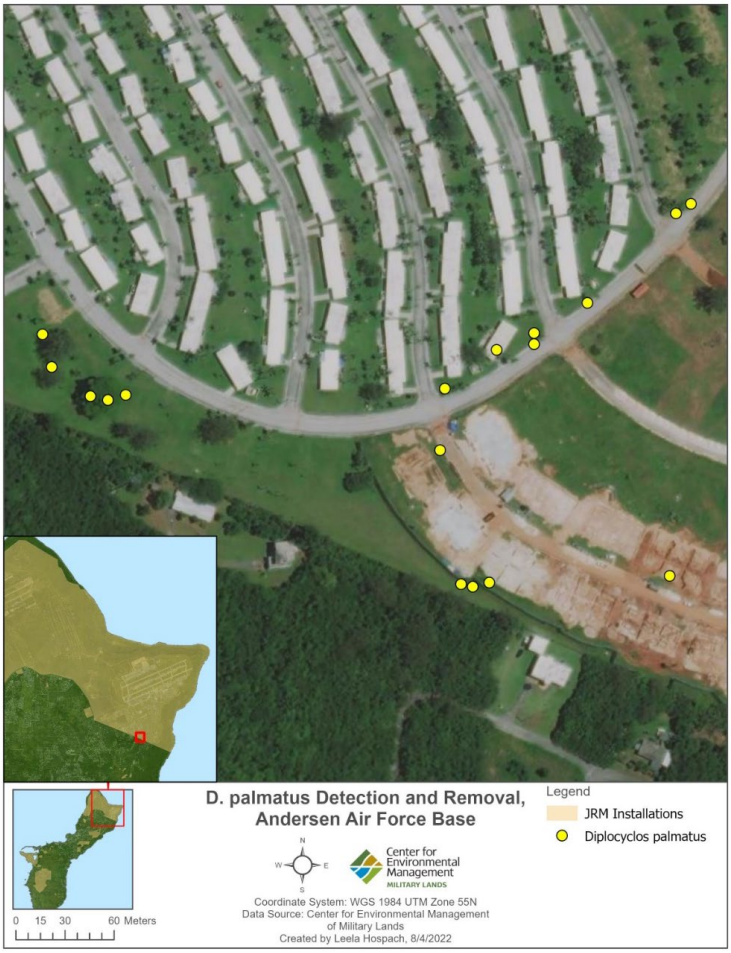






Figure 17. Lollipop Climber (*Diplocyclus palmatus*) detection, removal, and monitoring locations at Andersen Air Force Base.

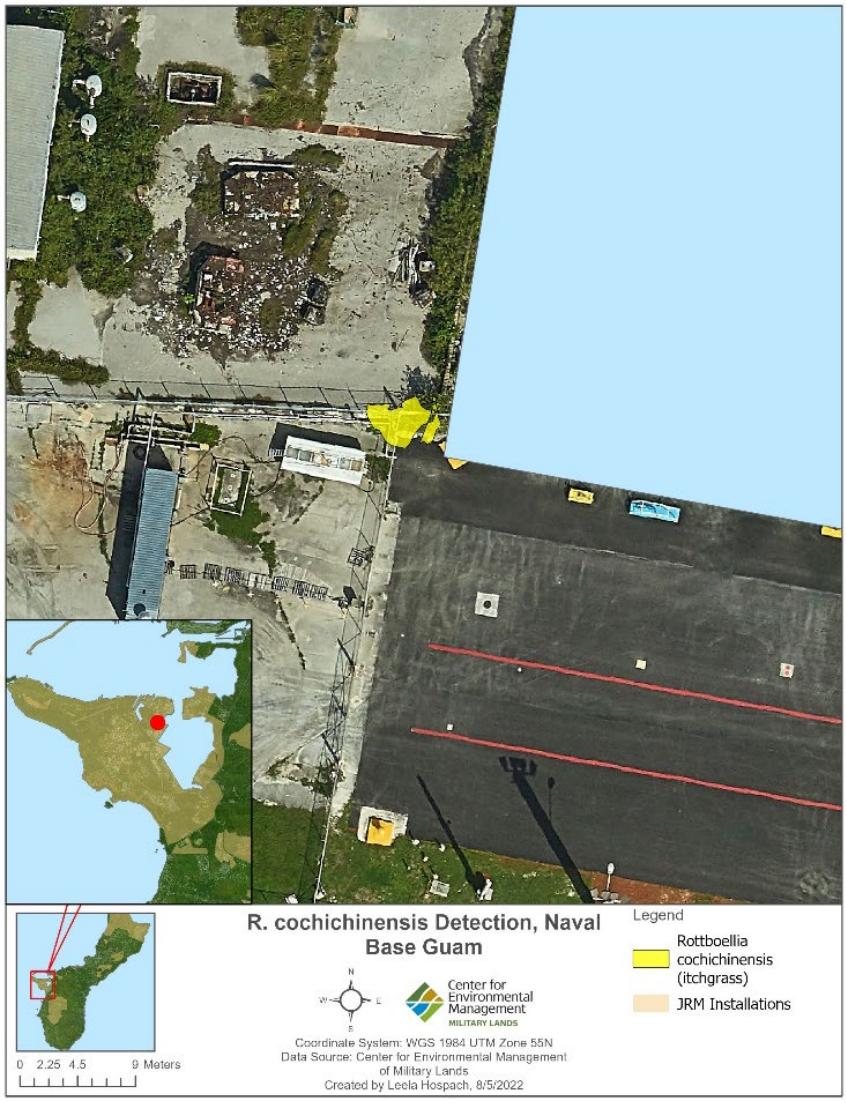






Figure 18. Itch Grass (*Rottboellia cochinchinensis*) detection, removal, and monitoring location at Naval Base Guam Mainbase.

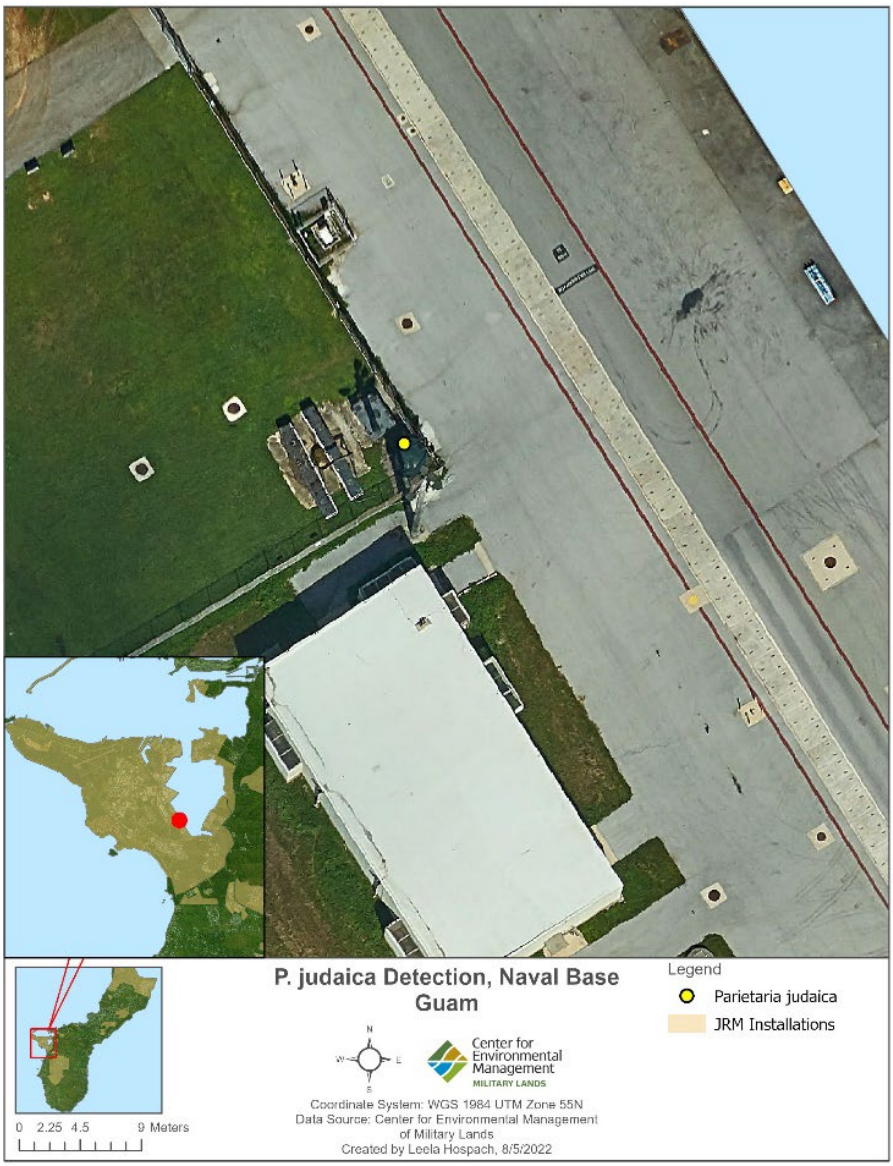




Figure 19. Pellitory (*Parietaria Judaica*) detection and monitoring location at Naval Base Guam Mainbase.

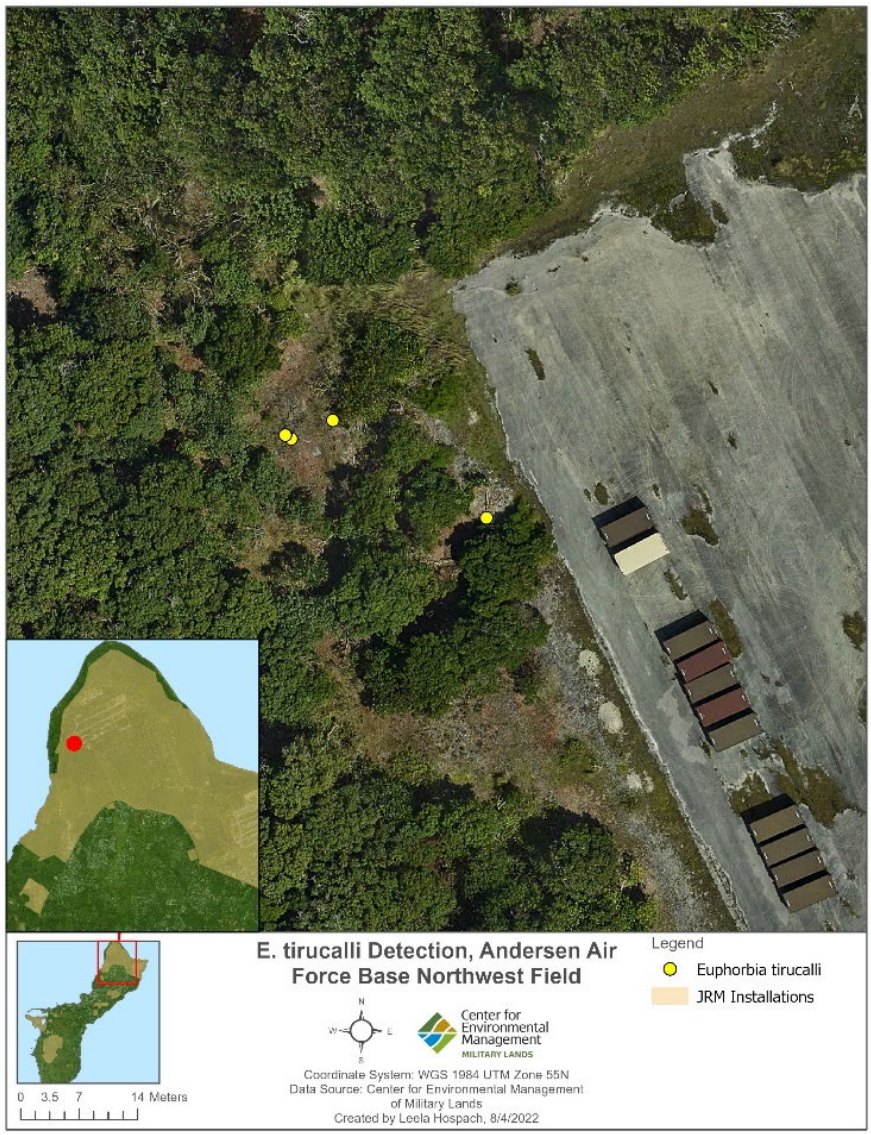






Figure 20. Pencil Cactus (*Euphorbia tirucalli*) detection, removal, and monitoring locations at Andersen Air Force Base.



Figure 21. Examples of biomaterial interceptions during arrival biosecurity cleanliness inspections of cargo and equipment on Guam prior to the start of training events. From left to right: black widow spider, soil with vegetation, snail, and mud wasp larvae.

Coconut Rhinoceros Beetle (CRB; *Oryctes rhinoceros*) Surveys, Interdiction, and Monitoring - Guam

Location: JRM AOR **Period of Performance:** AUG2021 – Ongoing

Project Objective

To implement CRB best management practices: 1) identify and remove breeding sites, 2) implement interdiction and sentinel trapping, and 3) implement CRB awareness; coordinate and collaborate with resources partners, and provide outreach materials to installation and military training participants to reduce impacts to native ecosystems and military readiness activities.

Conservation Benefit

Prevention of the spread and establishment of the invasive CRB to other locations within and outside of the JRM AOR.

FY22 Status

- CSU CEMML implementing CRB best management practices
    - Breeding Site Identification
    - Biannual breeding site surveys in urbanized areas of AAFB and NBG: November 2021 & May 2022 (Figures 22 – 23).
        - AAFB – Potential sites identified: 676 NOV & 756 MAY
        - NBG – Potential sites identified: 141 NOV & 144 MAY
- Interdiction/Sentinel Trapping
    - CRB black panel traps serviced biweekly on AAFB (144 traps) and NBG (143 traps), since August 2020
    - CRB Tekken netting traps serviced biweekly on AAFB (50 traps), since April 2021
    - Over 19,400 CRB captured over the past 22-month period (AAFB: 11,637 & NBG: 7,765; Figure 24)

  - During the most recent trapping period (April to June 2022) at AAFB 107 of 138 traps activated had at least one CRB capture (77%; Figure 22) and at NBG 118 of 143 traps had at least one CRB capture (82%; Figure 23).
- Coordination with regional partners (USDA-PPQ, GovGuam Dept. Ag., CNMI DLNR, Hawaii Dept. Ag.)

EPR: 2 BO MAR Mariana Islands Training and Testing (MITT) Implementation; 61128NR218
CHS NISA MAR JRM Implementation of the Regional Biosecurity Plan; 61128NR860
USMC HQ MITT Biological Opinion Conservation Measures Implement (FY21 Non-EPR)

2019 JRM INRMP Reference: TIS-5; 5-86, TIS-6; 5-87, TIS-6; 6-44, TIS-7; 6-45, TIS-4; 7-53, TIS-6; 7-53, TIS-5; 8-52, TIS-6; 8-52, TIS-5; 9-72, TIS-7; 9-73, TIS-1; 11-62, TIS-2; 11-63, TIS-1; 12-32, TIS-2; 12-33

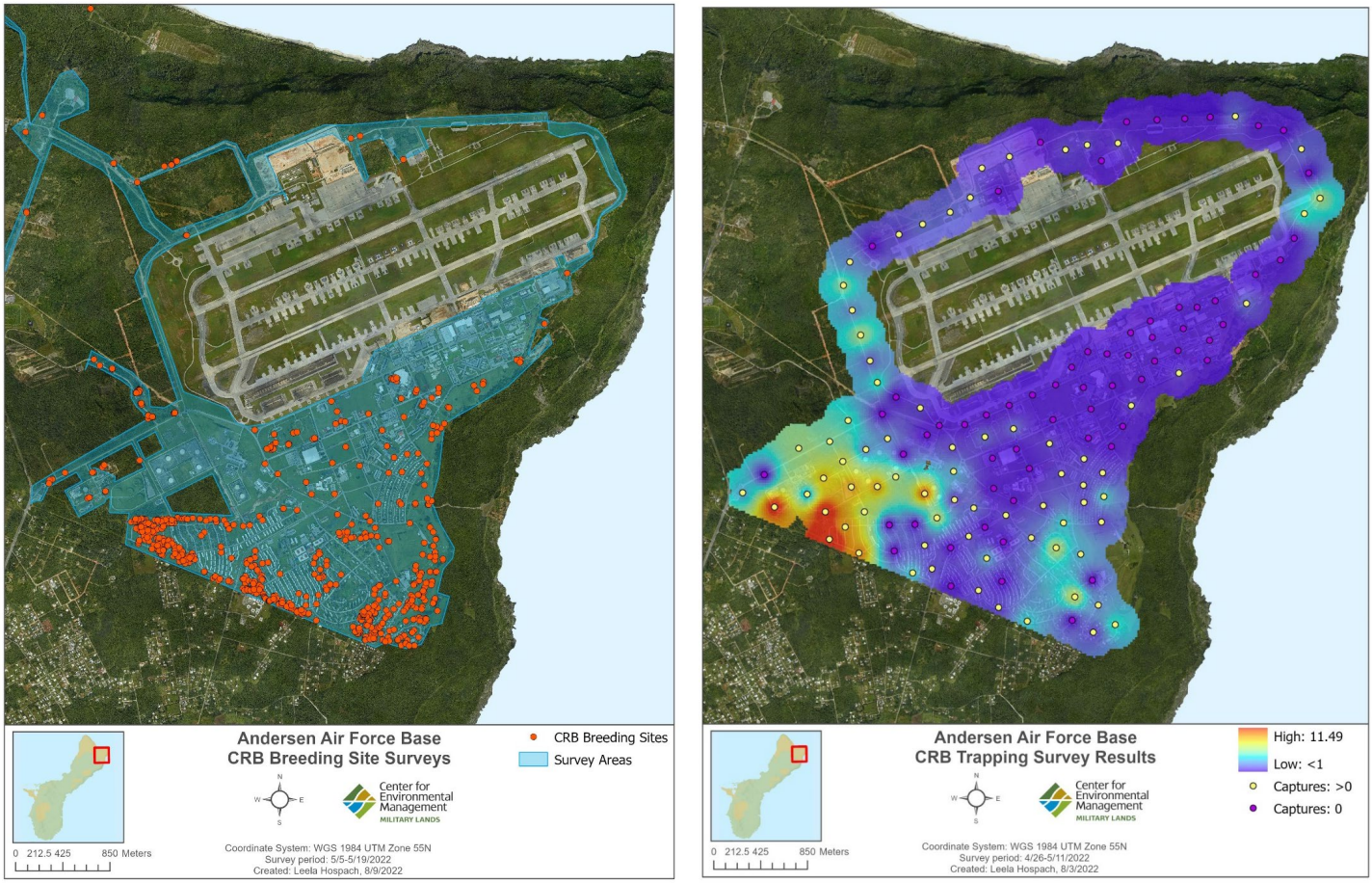


Figure 22. CRB interdiction efforts at Andersen Air Force Base. Left map depicts biannual breed site survey area conducted in May 2022 and identified potential breeding sites (RED). Right heat map depicts capture rates from April to June 2022 across the CRB survey area (225 m buffer zone) shown. Capture rates were spatially interpolated across the inverse distance weight (IDW) in ArcGIS Pro 2.7.0.

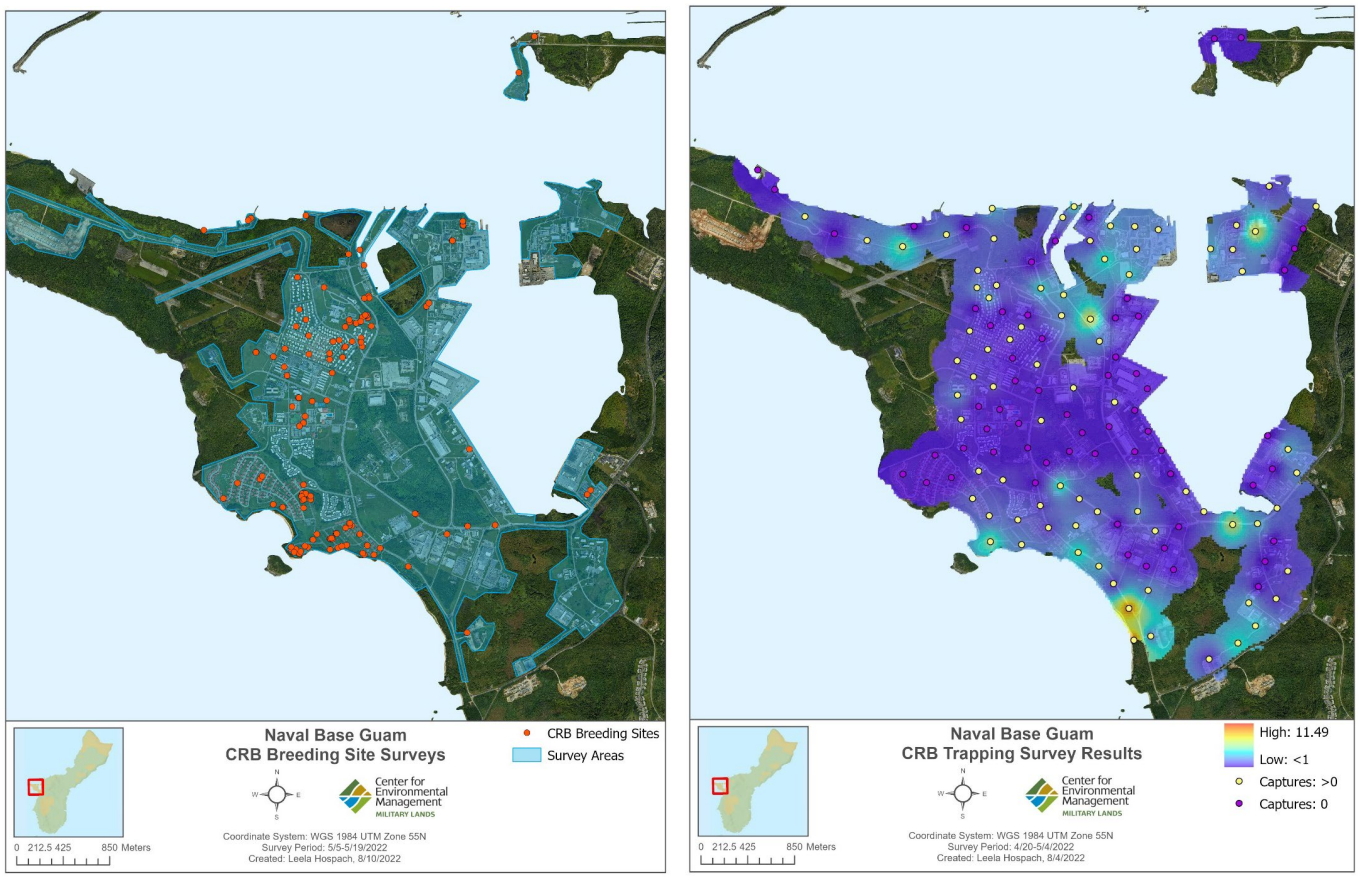


Figure 23. CRB interdiction efforts at Naval Base Guam. Left map depicts biannual breed site survey area conducted in May 2022 and identified potential breeding sites (RED). Right heat map depicts capture rates from April to June 2022 across the CRB survey area (225 m buffer zone) shown. Capture rates were spatially interpolated across the inverse distance weight (IDW) in ArcGIS Pro 2.7.0.

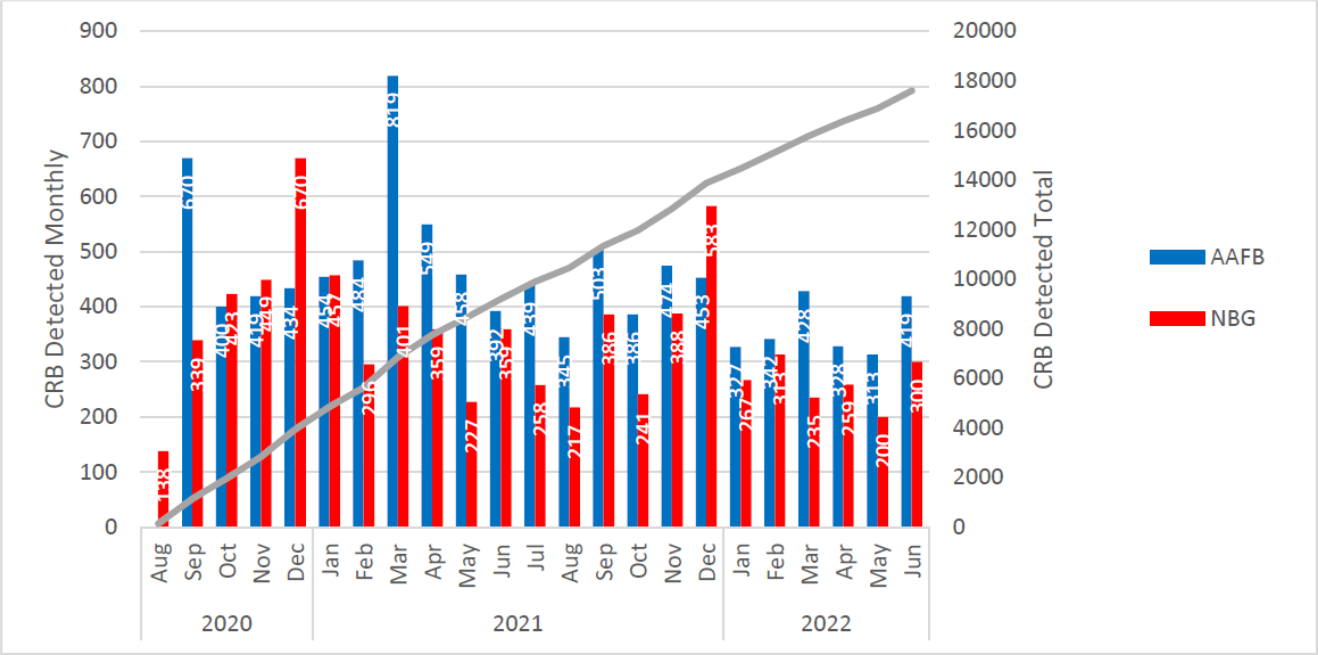


Figure 24. Monthly total beetle captures shown for Andersen Air Force Base (BLUE) and Naval Base Guam (RED) and cumulative total from black panel traps since initial activation on August 2020 through June 2022. Gray line indicates cumulative panel trap capture totals.

Little Fire Ant (LFA), *Wasmannia auropunctata*, Surveys, Eradication, and Monitoring - Guam

Location: JRM AOR **Period of Performance**: AUG2021- Ongoing

Project Objective

To implement LFA Early Detection Surveys (EDS); control and eradicate LFA on DoD lands: coordinate and collaborate with resources partners; and provide outreach materials to reduce impacts to native ecosystems and military readiness activities.

Conservation Benefit

Enhance and restore habitats by prevention of the spread and establishment of the invasive LFA.

FY22 Status

- Ongoing Cooperative Agreement with CSU CEMML:
- LFA Early Detection Surveys
    - 129 LFA surveys at 84 sites out of 133 total sites covering approximately 108 miles (Figures 25 - 27)
    - AAFB: 28 surveys at 20 sites out of 49 total sites (38.1 miles)
    - NBG: 92 surveys at 58 sites out of 81 total sites
    - MCBCB: 9 LFA surveys at 6 sites out of 6 total sites
- New LFA Infestation Detections
    - Four (4) new infestations detected along installation borders and one (1) infestation within installation borders (Figures 25 - 27).
    - AAFB: Northwest Field Hunter's Shack
    - NBG NMS: Firebreak Road #3, Cross Island Road West Drainage
    - MCBCB: Haputo Beach trail bottom
- LFA Infestations Status

- Twelve (12) known LFA locations (not including Andersen South locations) on AAFB (2), MCBCB (2), NBG (3), and NBG NMS (5) (Table 2).
- Ongoing border treatment occurring at five (5) locations, pending eradication efforts at three (3) locations, delineation pending at two (2) locations, and post eradication monitoring occurring at two (2) locations (Table 2).

EPR: CHS EO 13751 MAR Little Fire Ant Surveys and Eradication; 61128NR207

2019 JRM INRMP Reference: TIS-5; 5-86, TIS-6; 6-44, TIS-4; 7-52, TIS-6; 8-52, TIS-5; 9-72

Table 2. Status of Twelve LFA infestations on installations

Installation	Site	Status	Acres
AAFB	Back Gate Fence Line	Treatment: Border	1.0
AAFB	NW Field Hunter's Shack	Eradication: Start Sept. 2022	0.8
MCBCB	Haputo Beach Trailhead	Monitoring: Post Eradication	1.86
MCBCB	Haputo Beach (trail bottom)	Eradication: Pending Sec. 7	0.4
NBG Mainbase	Dadi Beach	Monitoring: Post Eradication	19.0
NBG Mainbase	Polaris Point Fence Line	Treatment: Border	3.1
NBG Mainbase	Nimitz Hill Facilities	Delineation: Pending	N/A
NBG NMS	Cross Island Road Boundary	Treatment: Border	3.0
NBG NMS	Firebreak Road #3	Eradication: Start Sept. 2022	0.6
NBG NMS	Cross Island Road W. Drainage	Delineation: Pending	N/A
NBG NMS	Route 12 Fence Line	Treatment: Border	1.0
NBG NMS	Route 12 Near NMS Gate	Treatment: Border	0.7

Note: AAFB = Andersen Air Force Base; MCBCB = Marine Corps Base Camp Blaz; NBG = Naval Base Guam; NMS = Naval Munitions Site

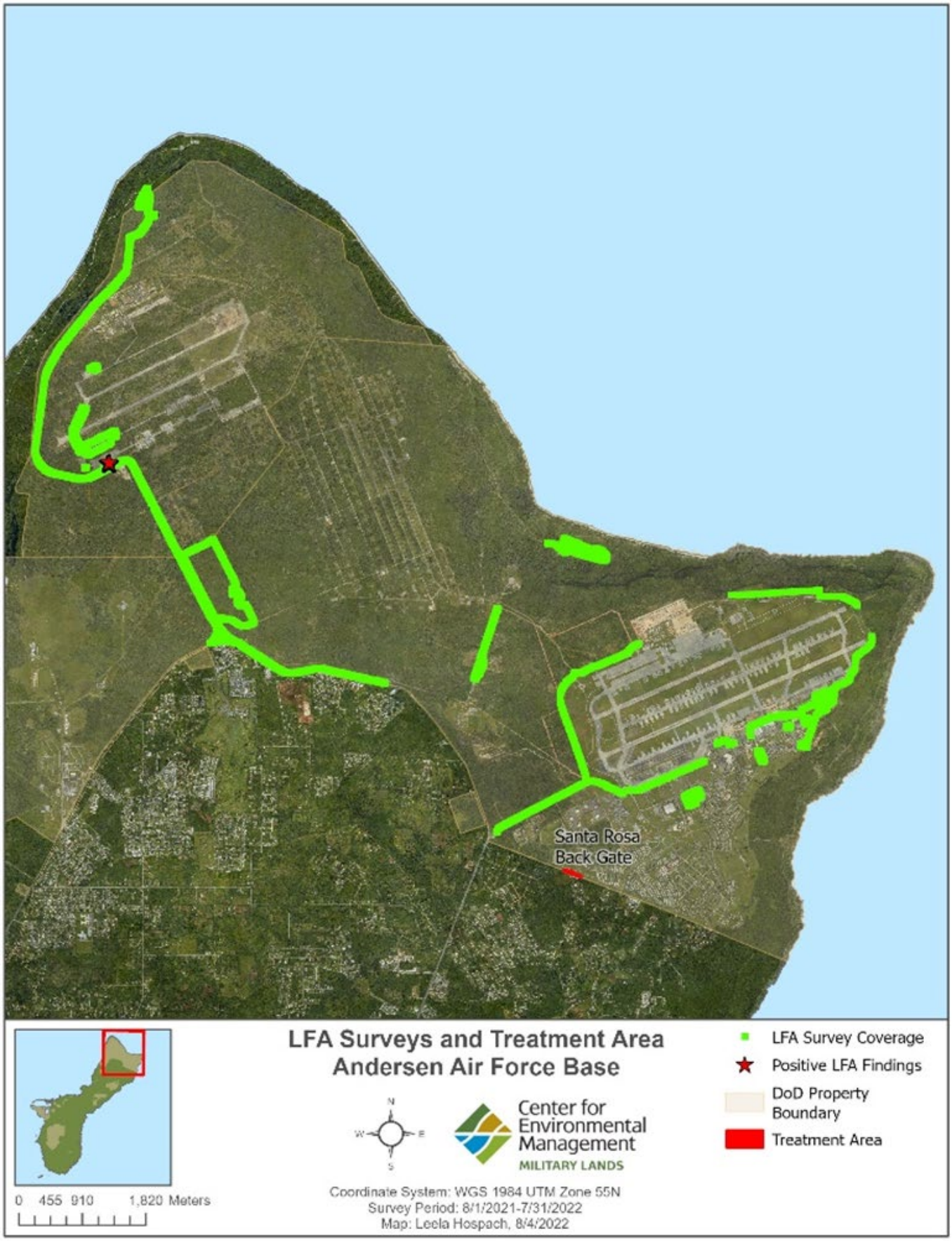


Figure 25. LFA Survey and Treatment Areas on Andersen Air Force Base.

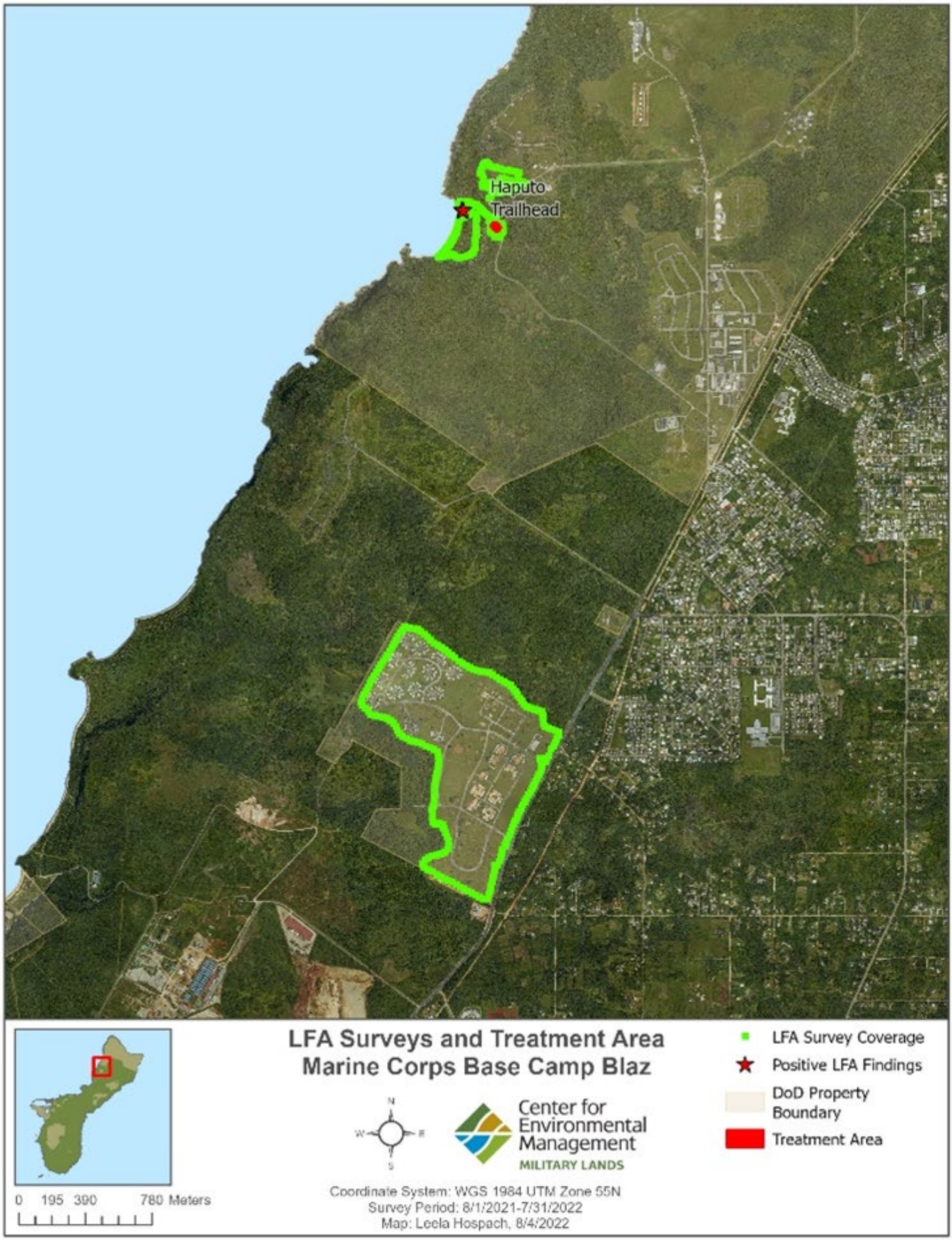


Figure 26. LFA Survey and Treatment/Monitoring Areas on Marine Corps Base Camp Blaz.

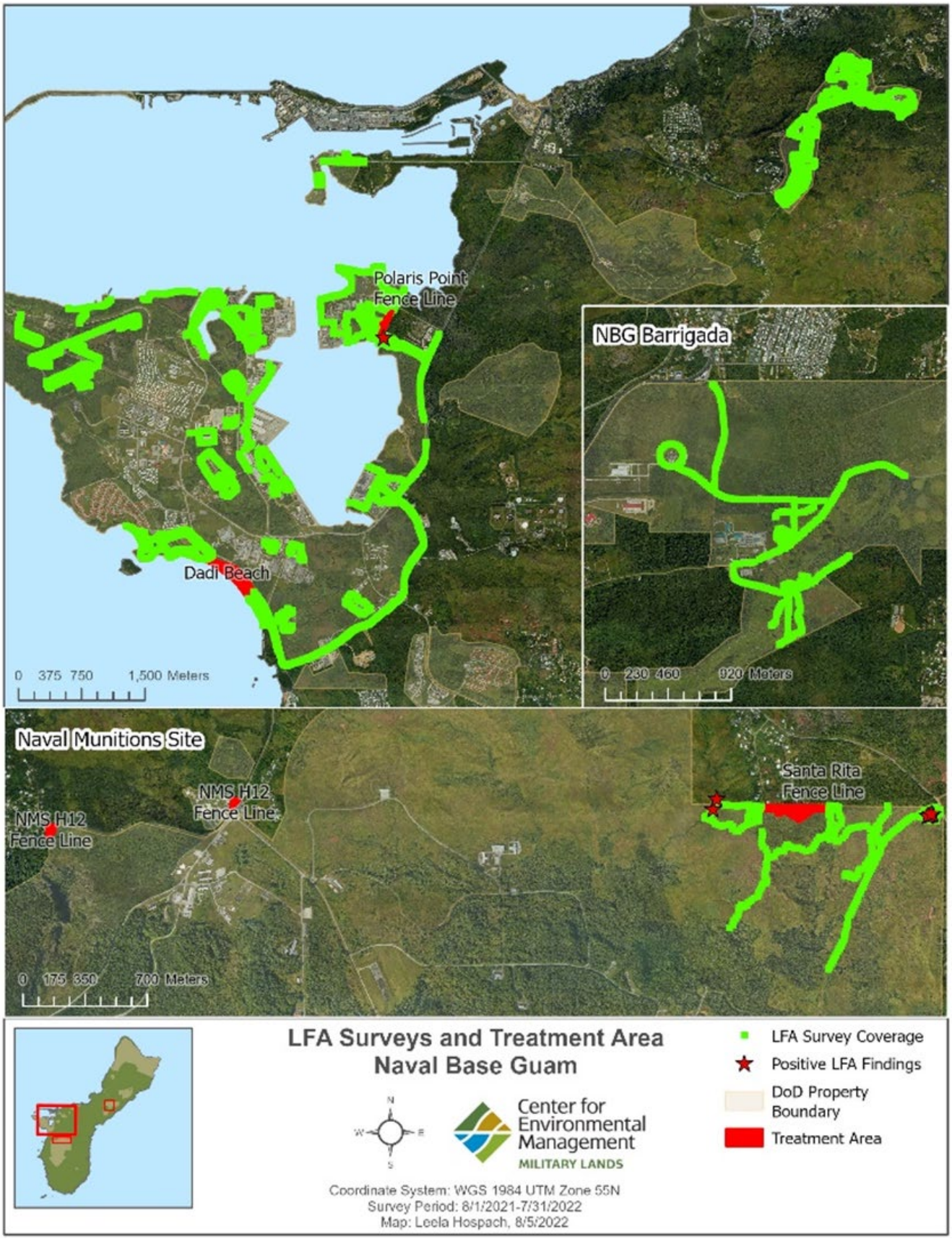


Figure 27. LFA Survey and Treatment/Monitoring Areas on Naval Base Guam Mainbase and Naval Munitions Site.

Eradication of Little Fire Ant within Skaggs Urban Training Complex

Location: MCBCB **Period of Performance:** SEP2017 – SEP2022

Project Objective

Delimit targeted LFA infestations at Skaggs before implementing eradication protocols to eradicate these ants. Post-treatment monitoring will evaluate treatment effectiveness.

Conservation Benefit

Little fire ants pose significant threats to listed species. Eradication will benefit the species directly as well as the habitat that supports them.

FY22 Status

- Cooperative agreement with University of Guam subcontract Colorado State University
- Conduct new delimiting surveys from 2020/1 data points to determine current infestation boundaries for sites 6, 7, 8 and 1
- New cooperative agreement with Colorado State University

DPRI: Marine Corps Relocation 2017/2018 amendment to 2015 BO, Conservation Measures to Contribute to the Recovery of Listed Species

Reference: Guam Relocation Biological Opinion

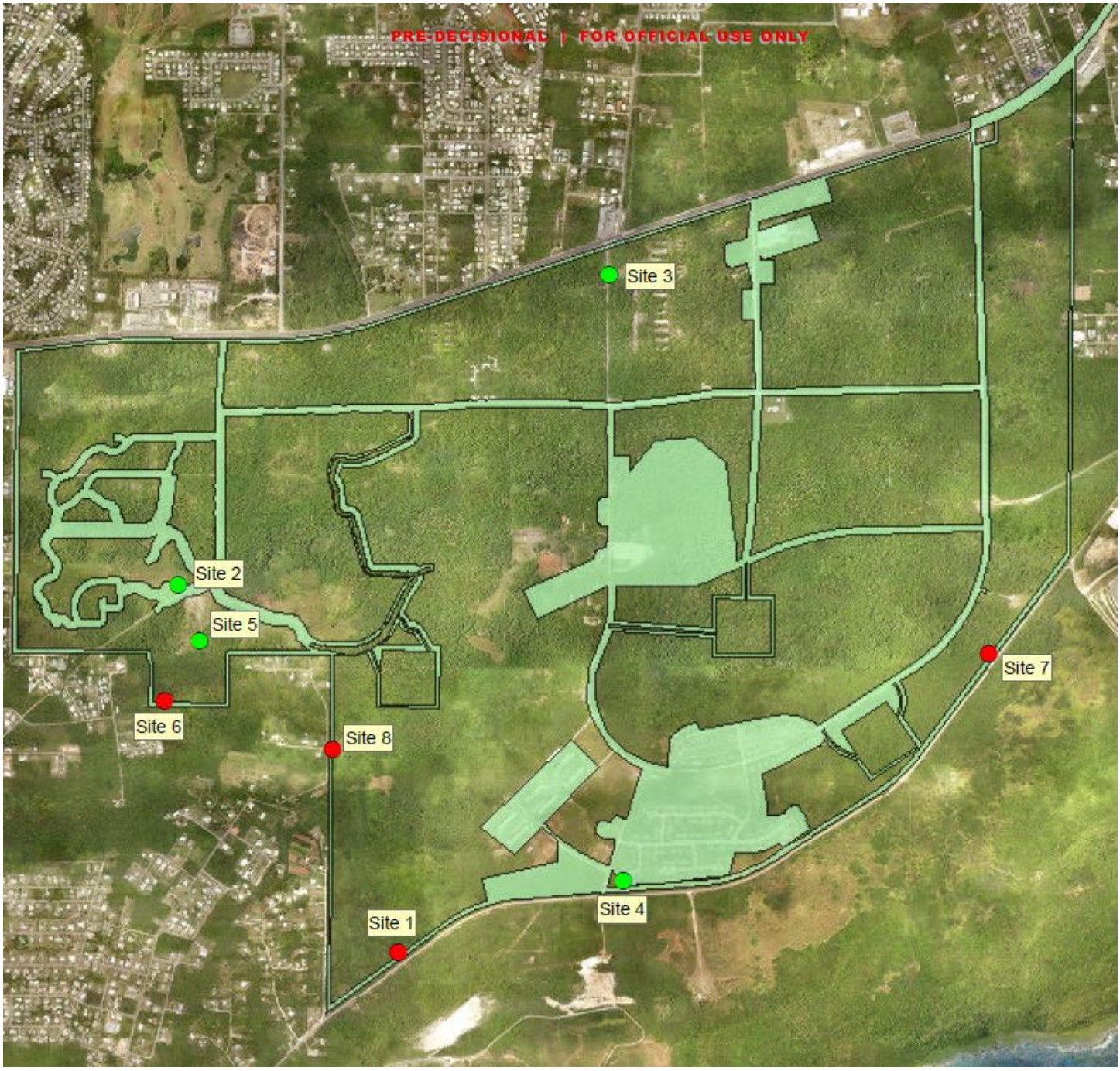


Figure 28. Efforts to eradicate little fire ants from the Skaggs Urban Training Complex are complicated by re-infestation from off-installation properties.

Feral Dog and Cat Control

Location: NMS **Period of performance:** SEP2021 - Ongoing

Project Objective

Remote sensing, live trapping and removal of target feral animals in sensitive habitats (remote wetlands).

Conservation benefit

The conservation benefits of the project are to a) protect and preserve habitats needed for sensitive species conservation and to b) provide response to incipient invasive and nuisance species populations to ensure no loss of moorhen species range.

FY22 Status

- IAA with USDA APHIS-WS
- Identify and remove feral cats and dogs in NMS wetlands
- Remote camera deployment identified 8 cats and 14 dogs
    - 5 cats removed/transferred to GAIN
    - 2 monitor lizards captured
- Future efforts
    - Remove lizards from habitat
    - Document stomach contents
- Continuous immigration due to open property boundaries
- USDA-APHIS WS report pending

EPR: CHS MAR NBG Feral Dog and Cat Control and Management; 617555NR358

2019 JRM INRMP Reference: TIS-7; 5-87, TIS-4; 6-43, TPS-5; 6-47

Table 3. NMS dog and cat trap log

NMS Location	Trap Session	Cats	Dogs	Non-target Monitor lizards	Non-target Feral swine	Non-target Deer	Non-target Chickens	Non-target Rats	Cat Traps	Dog Traps	Nights	Trap Nights
WL90	Session 1 Total Seen	2	4	2	Many	Few	1	0	6	4	20	200
	Session 1 Captured	2	0	2	0	0	0	0				
Parsons	Session 2 Total Seen	0	3	0	Many	1	0	0	6	4	20	200
	Session 2 Captured	0	0	0	1	0	0	0				
Shelf Pond	Session 3 Total Seen	4	4	1	Many	Few	0	0	12	0	20	240
	Session 3 Captured	2	0	1	0	0	0	0				
High Road	Session 4 Total Seen	2	3	0	0	Few	0	1	6	4	20	200
	Session 4 Captured	1	0	0	0	0	0	0				
	Grand Total Seen	8	14	3	Many	Few	1	1				
	Grand Total Captured	**5**	**0**	**3**	**1**	**0**	**0**	**0**	**30**	**12**	**80**	**840**



Figure 29. FY21 NMS dog and cat trapping locations

Brown Treesnake Interdiction to Prevent the Spread Via the DOD Transportation Network Originating On Guam

Location: JRM **Period of Performance:** AUG2021 – JUL2022

Project Objective

To prevent the spread of BTS to other Pacific islands including the CNMI and Hawaii, this JRM project is funded to conduct BTS control and interdiction efforts on Navy Base Guam (NBG) and Andersen AFB (AAFB) to prevent snakes from getting into the DoD transportation network. Methods include BTS trapping, toxicants, nighttime visual fence line searches, and canine inspections of outbound items. The BTS Interdiction program also supports training events occurring in the region that originate from Guam. Joint Region Marianas develops BTS control and interdiction plans for each training exercise that requires the movement of personnel and assets to the CNMI from Guam. Additional BTS inspections and control measures are implemented in the CNMI when determined necessary by the stakeholders.

Conservation Benefit

Preventing the spread of BTS via the military transportation network keeps BTS on Guam and from establishing in other ecologically sensitive areas in the Pacific region where vulnerable island species would be susceptible to BTS predation.

FY22 Status

- Ongoing and enduring JRM requirement
- Interdiction support provided to X military exercises during FY2022
- Traps on AAFB and NBG re-spaced to 30m
- 6 missed Inspections (99.99%)
- No BTS detections in outbound cargo

EPR: Project is funded by facilities maintenance dollars, no conservation funding for this project.

2019 JRM INRMP Reference: TIS-1; 5-84, TIS-1; 6-42; TIS-1; 7-51, TIS-1; 8-50, TIS-1; 9-70

Table 4. BTS Take and K9 Inspections AUG2021 – JUL2022.

*Average number of traps per installation per month due to respacing during FY22
** CPUE = BTS spotlight captures/nights (104) of spotlighting

	Number Traps*	Trap Captures	CPUE	Spotlight Captures	CPUE**	# Baits	# Bait Takes	% Bait Take		
AAFB	578	1407	1 BTS per 149 nights:trap	236	2.3	34,608	5812	17%		
NBG	419	864	1 BTS per 177 nights:trap	379	3.6	48,646	3457	7%		
	ITEM				**DESTINATION**					
	Cargo	**Aircraft**	**Vehicles**	**HHG**	**Navy Vessel**	**CNMI**	**Hawaii**	**CONUS**	**Other Pacific**	**Other**
AAFB K9	85246	3303	1175	1105	3001	953	6357	43331	4814	30940
NBG K9	98593	1641	2366	1588	62717	4748	1862	16990	1227	18077
Total	***183839***	***4944***	***3541***	***2693***	***65718***	***5701***	***8219***	***60321***	***6041***	***49017***

Brown Treesnake Control at Mariana Swiftlet Caves

Location: NBG; NMS **Period of Performance**: OCT2018 – Ongoing

Project Objective

To provide long-term sustained protection for the Mariana Swiftlet (*Aerodramus bartschi*) from brown treensnake (BTS) predation. Protection consists of ground-based oral toxicants for BTS around the areas surrounding Mahlac, Fachi, and Maemong caves, Naval Munitions Site (NMS).

Conservation Benefit

Protection from BTS predation is focused on maintaining or increase swiftlet populations at the three occupied caves and enhance or restore habitat by reducing predation by BTS.

FY22 Status

- Ongoing project - renewed annually
- Testing camera traps for estimating BTS bait take
- Baiting remains once per week to reduce disturbance
- 5313 baits deployed since August 2021
- Average annual toxicant take rate = 36% (1925/5313)

EPR: 1 RP NBG Mariana Swiftlet Population Protection; 67155NR834: BTS Trapping

2019 JRM INRMP Reference: TIS-3; 6-43, TPS-4; 6-47

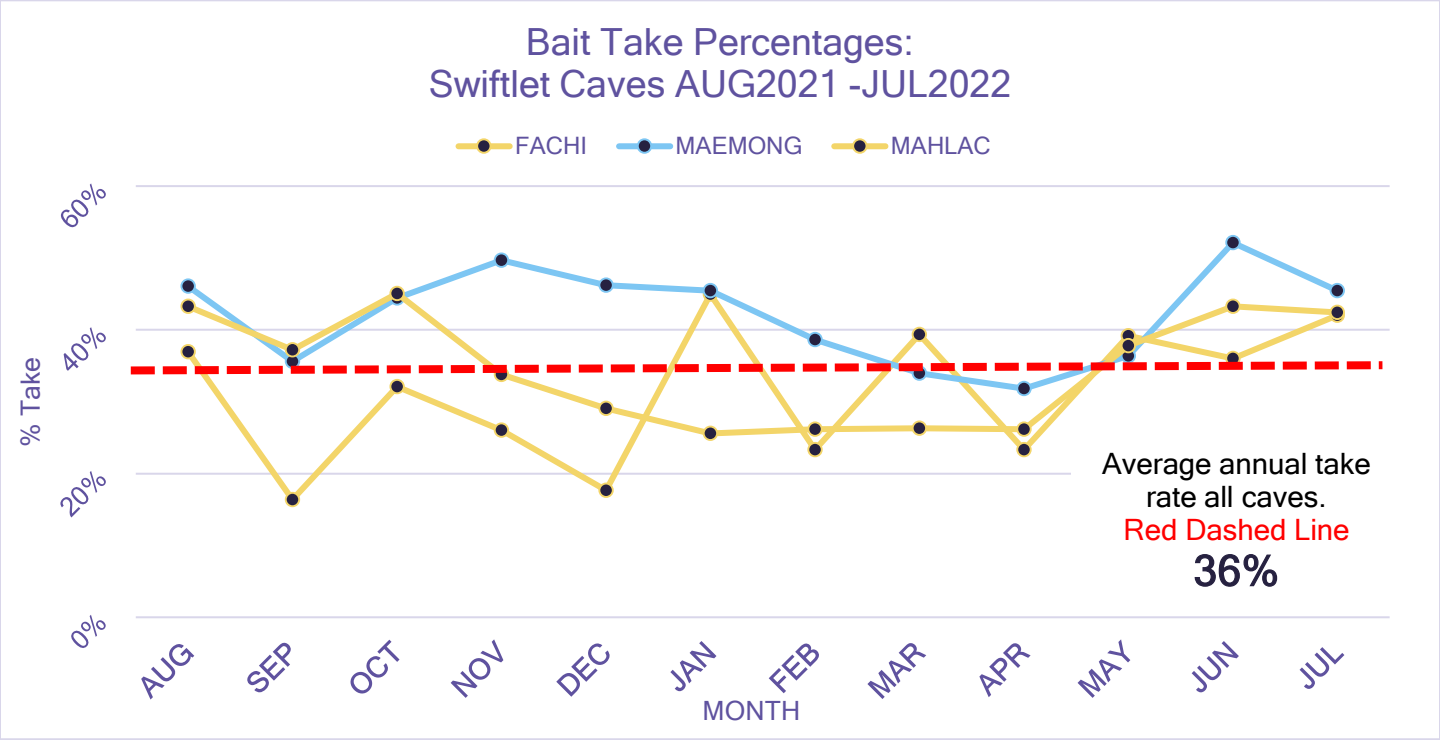


Figure 30. Monthly bait take percentages for swiftlet caves. Red dashed line is annual average bait take (36%).

Developing a Framework for Coordinated Management of Vertebrate Restoration and Brown Treesnake Control on Guam

Location: JRM **Period of Performance:** SEP2021 – MAR2023

Project Objective

This project consisted of furthering the development of a decision-analytic framework to guide brown treesnake management and vertebrate species restoration on Guam. The project builds on the subject matter experts previous efforts building a decision model. The group are from management agencies, regulators, stakeholders, and scientific experts and uses a workshop model to for the purpose of framework development.

Conservation Benefit

The decision model will help with planning for future conservation management decisions through an analytical process to enhance the planning phase. This includes prioritization, management application, problem solving, evaluating specific actions, and collaboration to manage costly, complex long-term conservation problems. The process should provide a more structured approach to addressing conservation challenges.

FY22 Status

- Questionnaire for expert response under development
- Workshop planned for late 2022
- Experts from federal, territorial, universities, and non-governmental organizations.

EPR: 1 RP JRM Brown Tree Snake Eradication and Control to Support Recovery of ESA-Listed Species; 61128NR202

2019 JRM INRMP Reference: TIS-3; 9-71

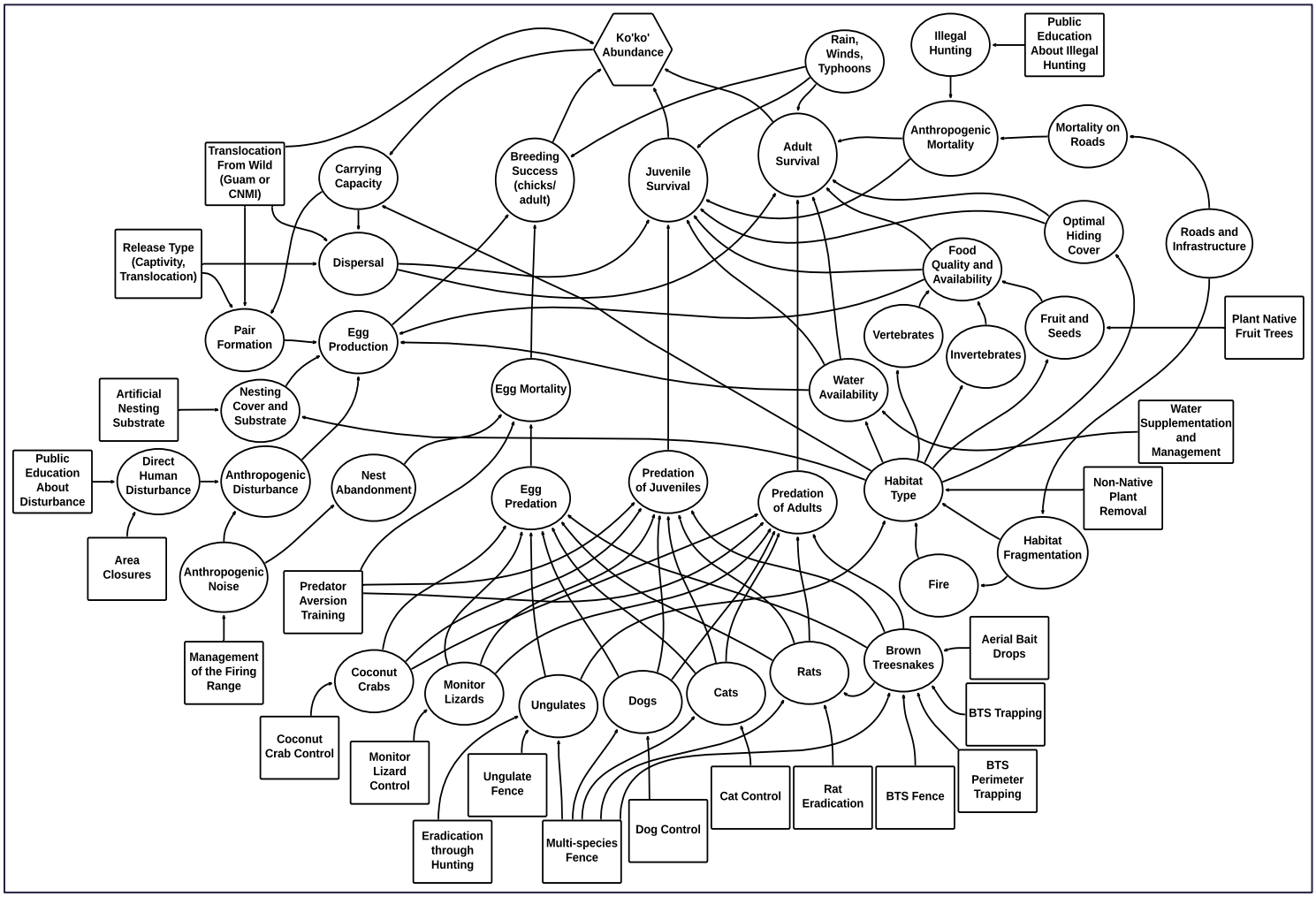


Figure 31. Full Ko'ko' influence diagram incorporating the species-specific management actions (boxes) that may be important to the objective of Ko'ko' abundance (hexagon, top center) via demographic processes (circles). Management actions indirectly influence the objective through various hypothesized processes and dynamics (ovals).

Dynamic Monitoring and Management of Brown Treesnakes

Location: JRM **Period of Performance:** JAN2022 – JUN2024

Project Objective

This project seeks to identify a suite of combined *monitoring* and *management* alternatives for managers depending on the status of a target brown treesnake (BTS) population before and after treatments. With further objects of identifying thresholds where *monitoring methods* and *management efforts* shift in efficacy based on the existing/remaining population of BTS in a targeted management area. The project will also create a cost model and application to assess the cost of monitoring and management actions

Conservation Benefit

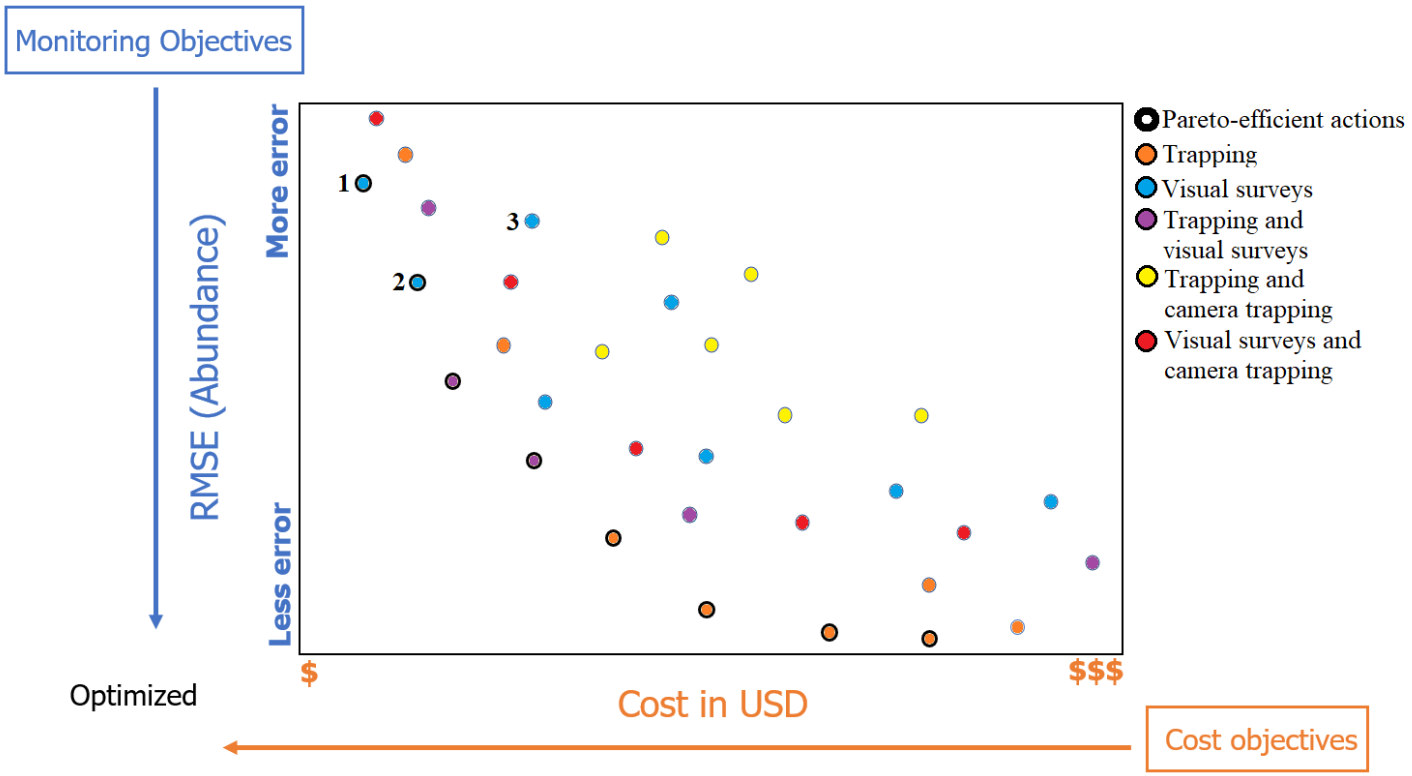
Landscape-scale BTS management is predicted to incur substantial costs. Planning and management at scales of hundreds of hectares will require new tools and methods to plan and assess management efforts. The dynamic modeling for monitoring and management for BTS could help with cost efficient management and assist with a structured approach to BTS management decision making.

FY22 Status

- Data sets from previous BTS projects being collated analyzed.
- Initial modeling simulations being conducted.
- Analysis Costs and time related to methods and results help identify optimal scenarios.

EPR: 1 RP JRM Brown Tree Snake Eradication and Control to Support Recovery of ESA-Listed Species; 61128NR202

2019 JRM INRMP Reference: TIS-3; 9-71



1. Visual surveys conducted on 14 transects for 30 days.
2. Visual surveys conducted on 27 transects for 15 days.
3. Visuals surveys conducted on 27 transects for 30 days. This scenario is more expensive to carry out and does not result in a gain in precision in abundance (i.e., does not reduce RMSE), making it an inefficient option.

Figure 32. Hypothetical graph demonstrating potential optimized points where methods are assumed to be efficient (an optimized BTS management method [both device and cost]) based on management's choice of monitor technique.

Replacement and repair of the USGS Closed Population Mesh to Maintain Viability as a Study Site for Brown Treesnake Management

Location: AAFB **Period of Performance:** JUL2020 – DEC2021

Project Objective

This project is to replace the mesh on the Closed Population unit on AAFB. The mesh has decayed beyond the point where patching and painting can sustain the integrity of the barrier. This increases the risk of brown treesnake (BTS) movement through the barrier both ways, and thus, impacts ongoing data collection. The project will replace the entire outer mesh material, as well as application of an anti-rust coating for the mesh and internal chain-link fence.

Conservation Benefit

The USGS Closed Population (CP) facility was constructed in 2004 and function and provides a study site to improve understanding of BTS population dynamics/demographics, BTS control tool efficacy, and numerous other studies that have helped refine implementation of management programs for BTS. The loss of integrity (allowing BTS in and out of the CP) of the fence would impact current and future studies large enough to replicate approximate conditions for understanding landscape-level condition but small enough to conduct projects under controllable conditions, and enumerate the BTS population. Such long-term project management and data collection allows for in depth understanding of the effects of BTS control tools and methods.

FY22 Status

- Project start delayed by COVID-19, contracting issues, supply change delays.
- Refurbishment of mesh in progress.
- Anticipated completion September 2022.

EPR: No EPR - Guam Micronesian Kingfisher MOA funds.

2019 JRM INRMP Reference: TIS-2, 5-85, TIS-3; 5-85, TIS-2; 6-42, TIS-3; 6-43; TIS-2; 7-52, TIS-3; 7-52, TIS-2; 8-50, TIS-3; 8-51, TIS-2; 9-71, TIS-3; 9-71; TPS-6; 9-77



Figure 33. Closed Population Fence with temporary barrier to prevent BTS movement in/out during refurbishment. Northwest Field, Andersen AFB. Photo. USGS Fort Collins.

Using BTS Behavior and Movement to Refine Control on AAFB & for Improved Management of Native Forest Birds

Location: AAFB **Period of Performance:** AUG2021 – JAN23

Project Objective

This project continues studying movement pathways and habitat preferences of brown treesnakes (BTS) on AAFB with abundant prey present, estimate abundance of BTS in relation to resources important to birds, and conduct known-fate evaluation of BTS susceptibility to control based on size, sex, and food preferences of snakes. This project is one of four projects that, collectively, will further develop information on BTS behaviors related to predation and movement in the presence of abundant avian species.

Conservation Benefit

Better understanding of hotspots of BTS activity, travel pathways, and decision-making during foraging are critical to improve the coverage and efficacy of BTS control in a cost- effective manner. Knowledge of BTS movements and behaviors can help determine BTS management strategies for maximizing snake suppression within critical conservation and transportation sites.

FY22 Status

- 76 individual snakes were radio tracked (123 snakes during entire project)
- 110 BTS captured and tagged, 37 unique recaptures (465 snakes captured and tagged during the entire project)
- Automated telemetry array collecting fine-scale activity data
- BTS smaller home ranges; move shorter distances compared to other areas
- BTS have strong foraging associations with specific tree species (*Casuarina* and *Ficus*) and Sali are most at risk when roosting in these trees.

EPR: 1RP JRM Brown Tree Snake Eradication and Control to Support Recovery of ESA-Listed Species; 61128NR202.

2019 JRM INRMP Reference: TIS-2, 5-85, TIS-3; 5-85, TIS-2; 6-42, TIS-3; 6-43; TIS-2; 7-52, TIS-3; 7-52, TIS-2; 8-50, TIS-3; 8-51, TIS-2; 9-71, TIS-3; 9-71

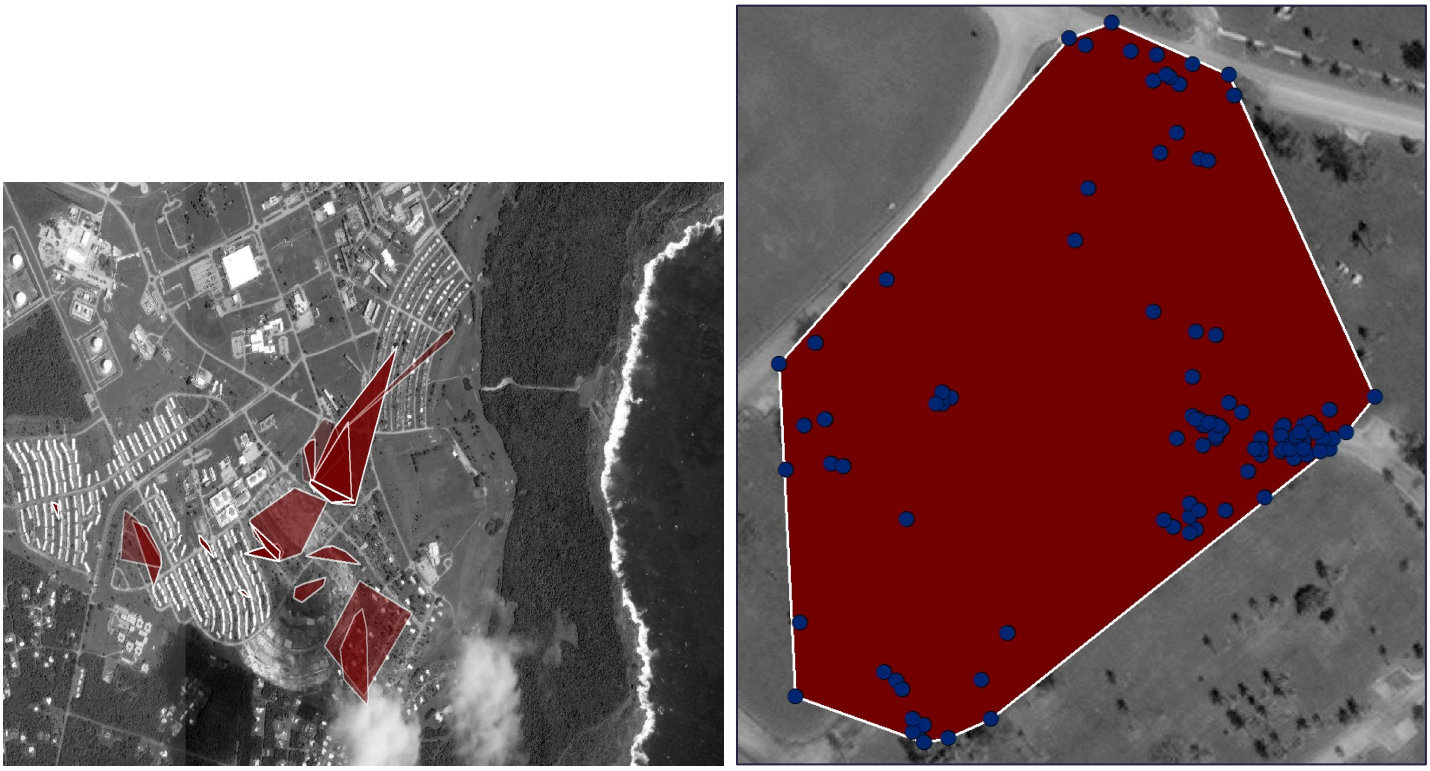


Figure 34. a) Red polygons represent home ranges of tracked brown treesnakes in the Andersen AFB study site; b) enlarged polygon shows data points collected from individual brown treesnake to estimate home range. Images: USGS Pacific Island Ecosystem Research Center (PIERC).

Tracking Movement of Micronesian Starlings and Brown Treesnakes on AAFB with an Automated Telemetry Tracking Network

Location: AAFB **Period of Performance:** JAN2022 – FEB2023

Project Objective

This project continues tracking the movement of Micronesian starlings (*Aplonis opaca* [Sali]) and BTS on AAFB to identify areas of high use and routes of transit through a network automated telemetry towers, and to document areas where BTS and Sali may interact. This project is one of four projects that, collectively, will further develop information on BTS behaviors related to predation and movement in the presence of abundant avian species.

Conservation Benefit

Tracking animals across the landscape over time can provide important information on habitat selection, resource needs, and factors influencing distribution and density. For a predator such as BTS, tracking movement can provide information on hunting patterns, dispersal potential, and identify areas that may be particularly susceptible to predation. Overlapping simultaneous movement from both predators and their prey can help identify areas of greatest contact, which may vary spatially and temporally. Additionally, population demographics that could be useful for supporting future avian restoration projects and controlling BTS in low density with competing food sources in the presence of control regimes.

FY22 Status

- 94 network nodes arrayed across the landscape, seven (7) bases stations collect data
- Cellular tracking network has continuously operated since 2019
- Improved accuracy of tracking with multiple, daily signals of Sali and BTS

- Good alignment between cellular network, satellite, and traditional telemetry data points.

EPR: 1 RP JRM Brown Tree Snake Eradication and Control to Support Recovery of ESA-Listed Species; 61128NR202

2019 JRM INRMP Reference: TIS-2, 5-85, TIS-3; 5-85, TIS-2; 6-42, TIS-3; 6-43; TIS-2; 7-52, TIS-3; 7-52, TIS-2; 8-50, TIS-3; 8-51, TIS-2; 9-71, TIS-3; 9-71, TPS-6; 9-77

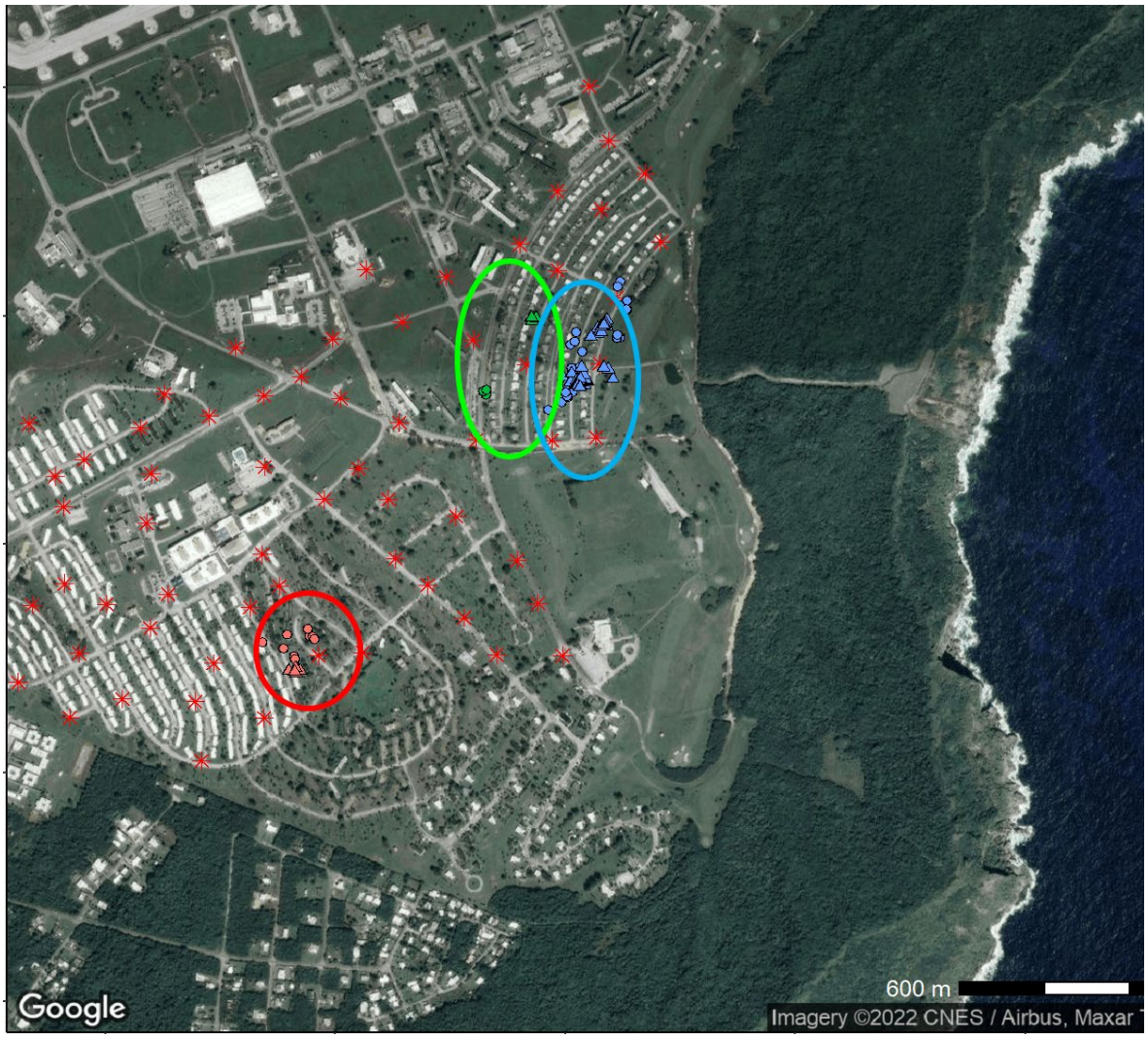


Figure 35. Map of locations for three brown tree snakes (BTS) tracked simultaneously on Anderson Air Force Base with a CTT internal transmitter and a satellite transmitter. Snake locations are estimated from trilateration of data from the node network (circles) and satellite transmitters (triangles). Nodes within the network are indicated by red stars. Source: USGS-PIERC

Evaluating and Reducing Brown Treesnake Predation Threat in Urban Micronesian Starling Habitat

Location: AAFB **Period of Performance:** AUG2021 – JAN2023

Project Objective

The project continues to evaluate control tools for urban BTS suppression in experimental high and low snake density plots. Also, monitor the relative abundance of BTS as a predation or dispersal threat via contact rates with baited camera devices. Overall this project will evaluate BTS control tools for suitability and efficacy in urban habitat, and use camera monitoring to index the decrease in Micronesian starling (*Aplonis opaca*) predation threat following snake removal. This project is one of four projects that will, collectively, further develop information on BTS behaviors related to predation and movement in the presence of abundant avian species.

Conservation Benefit

Previous studies on AAFB have demonstrated that snakes in the housing area are having a pervasive impact on Micronesian Starling survival at all age classes. Snakes in these urban areas also constitute a greater risk for accidental export of live snakes to other vulnerable regions because shipments of household goods are routine. Additionally, previous research has shown that very large snakes, which pose the greatest predation and reproduction risk, are more often found in urban areas. For these reasons, it is important to begin to consider BTS risk mitigation in urban habitats. Contact rates can be interpreted as an index of relative abundance and as a proxy for the residual level of predation threat posed by BTS in snake-suppressed areas. Traditional tools for estimating BTS density and relative abundance are costly and impractical for long-term and broad-scale monitoring (e.g., mark-recapture) or provide no information on the snake (e.g., DNM bait tubes).

FY22 Status

- Current phase of project will compare mice and bird baits
- Strong relationship between captures and forest edges
- BTS captures lower in areas of high bird presence
- Trapped BTS smaller than BTS captured after eating Micronesian starlings
- Some BTS overestimate ability to consume prey

EPR: 1 RP JRM BTS Eradication and Control to Support Recovery of ESA- Listed Birds

2019 JRM INRMP Reference: TIS-2, 5-85, TIS-3; 5-85, TIS-2; 6-42, TIS-3; 6-43; TIS-2; 7-52, TIS-3; 7-52, TIS-2; 8-50, TIS-3; 8-51, TIS-2; 9-71, TIS-3; 9-71

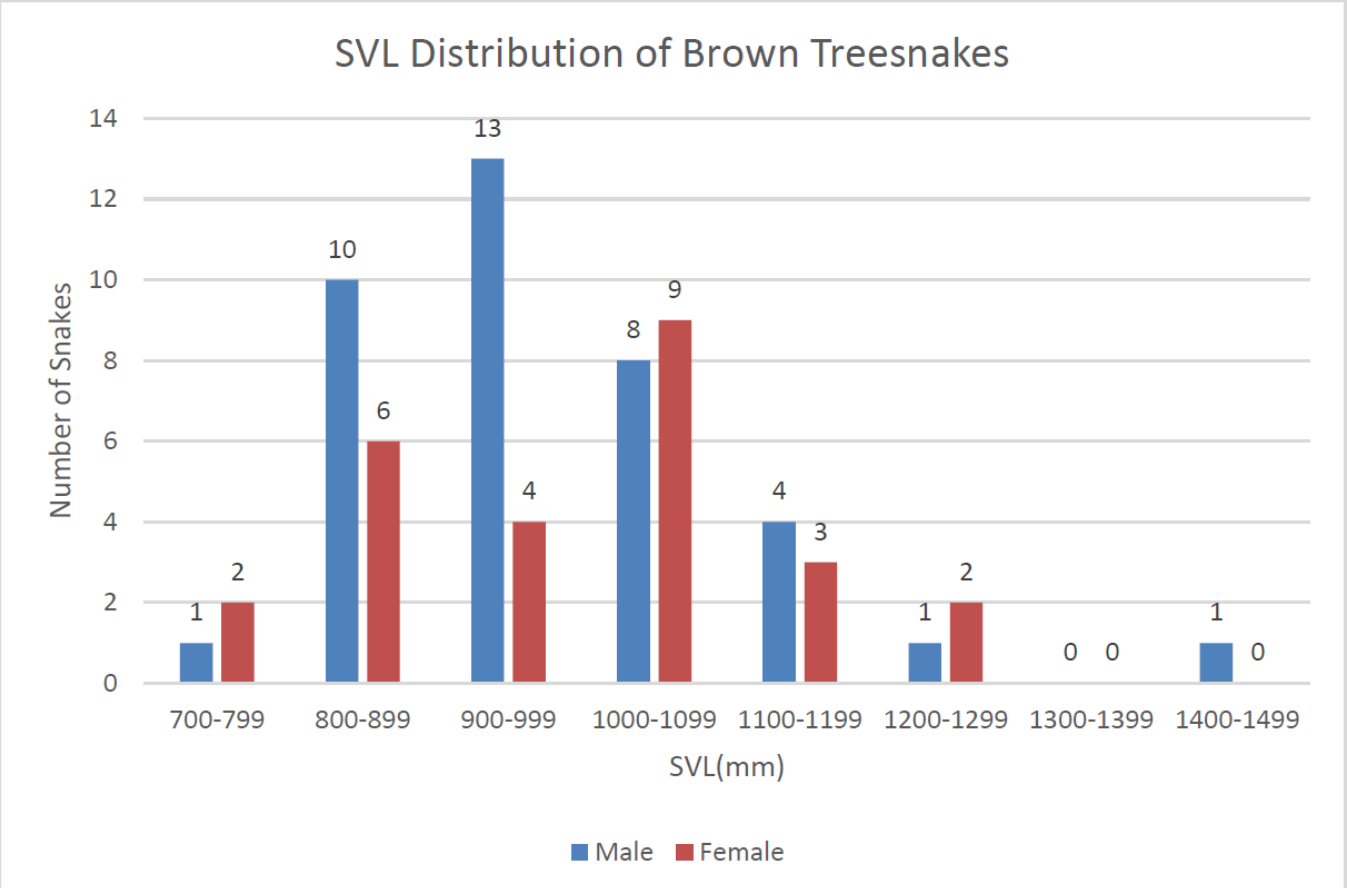


Figure 36. Snout-Vent Length Distribution of male vs. female brown tree snakes trapped in Anderson Housing from April 14, 2022, through June 21, 2022. Male range: 792-1415mm; mean ~968mm; n=38. Female range: 742-1227mm; mean ~997mm; n=26. Source: USDA-NWRC

Evaluation of BTS Control via Bait Delivery around the Swiftlet Caves and Investigation of BTS Control to Support Swiftlet Range Expansion

Location: NMS **Period of Performance:** SEP2020 – FEB2022

Project Objective

This project will assess the current control around the swiftlet caves by evaluating trapping, hand captures, and visual surveys capture data. This project will evaluate data based on seasonality, demographic, and behavioral aspects of brown treesnakes (BTS). Snakes captures in and out of caves (occupied and unoccupied) will be tracked via transmitters to determine movement, and if there are any potential dietary preferences.

Conservation Benefit

Swiftlet protection is a long-term effort that helps support goals of the swiftlet recovery plan. Since mid-2018 it has been 100% toxicant-based control, and while slightly more effective than trapping, the impacts to BTS have not been adequately assessed. Additionally, a better understanding of BTS population dynamics near a rich prey base needs to be improved. The data collected will inform future BTS management strategies in and around the swiftlets cave. Improved BTS population data will inform future conservation efforts for listed species on Guam.

FY22 Status

- 31 one-hour surveys in occupied caves (56 surveys during entire project)
- 10 snakes were radio tracked around caves (23 snakes during entire project)
- BTS captured inside swiftlet caves are larger than individuals captured outside of caves
- No BTS observed inside caves not occupied by Swiftlets
- Project renewed: SEP2022-MAR2024

EPR: 1 RP NBG Mariana Swiftlet Population Protection: BTS Trapping; 67155NR834

2019 JRM INRMP Reference: TIS-3; 6-43, TPS-4; 6-47

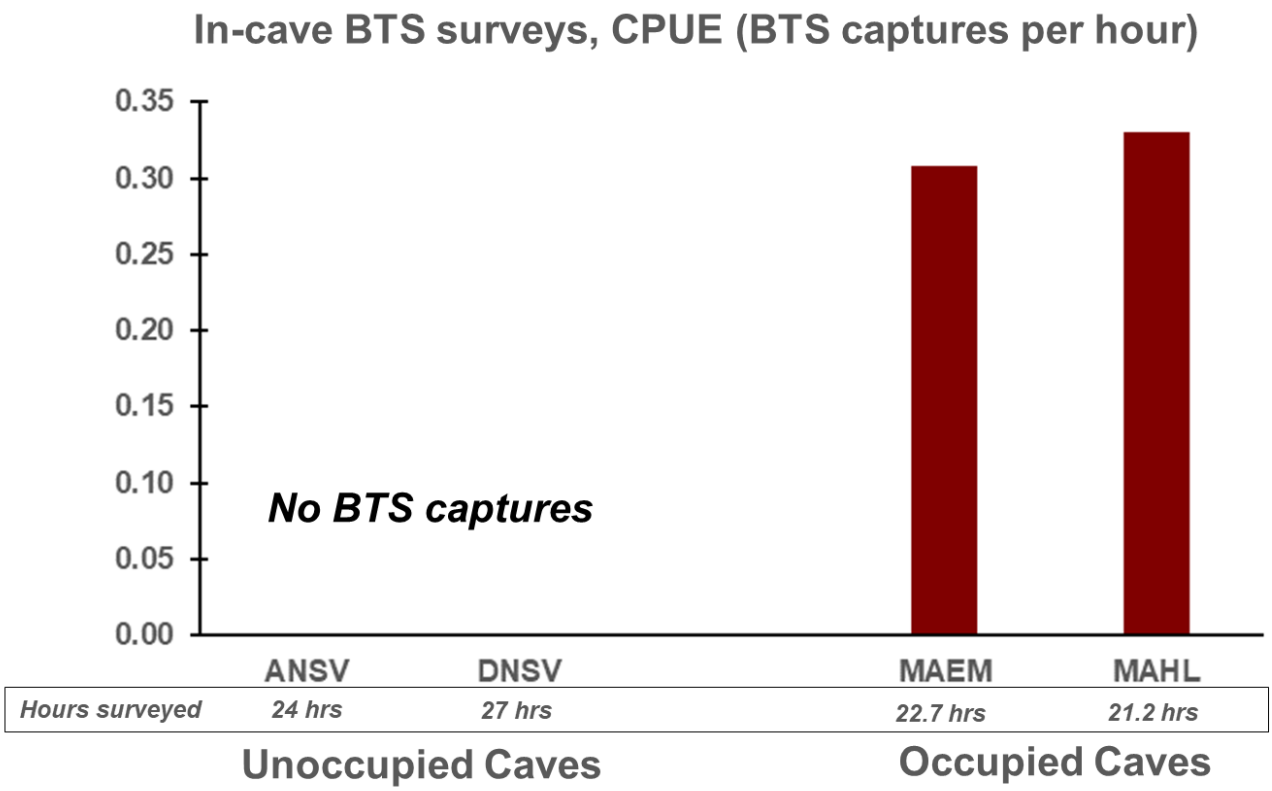


Figure 37. Comparison of hours of observations and captures per unit effort for brown treesnakes in occupied (Mahlac/Maemong)/unoccupied (ANSV/DNSV) caves on Naval Munitions Site, Naval Base Guam. Data source USGS Pacific Island Ecosystem Research Center (PIERC).

Aerial Baiting Operations and Ground Support for Suppression in the HMU, AAFB

Location: AAFB **Period of Performance**: MAR2022 – AUG2023

Project Objective

To provide operational helicopter support, including a pilot, mechanic, technical support, and post-drop data collection and monitoring of bait drops during aerial baiting applications within the Habitat Management Unit (HMU), AAFB.

Conservation Benefit

The development and performance of aerial delivery system for BTS suppression, demonstrates the potential for meaningful impacts on BTS populations at the landscape level. Dropping aerial baits in the HMU will provide data and insight into BTS responses to aerial baiting over time. Aerial baiting increases the amount of landscape targeted for BTS suppression and control. Landscape level control would likely improve JRM conservation efforts in support of the recovery of listed species on JRM lands and assist with interdiction efforts.

FY22 Status

- Aerial baiting recommenced MAY2022 (3 applications; 19,800 baits)
- New aerial baiting cycle commenced AUG2022; two bait applications every three (3) months instead of 3 applications every four (4) months
- Next two (2) applications in NOV2022
- Zero (0) fruit bats observed before or during aerial baiting operations
- Automated co-pilot module for bait in test phase

EPR: 1 RP JRM BTS Eradication and Control to Support Recovery of ESA- Listed Species; 61128NR202/ GMKI MOA Funds

2019 JRM INRMP Reference: TIS-2, 5-85, TIS-3; 5-85, TIS-2; 6-42, TIS-3; 6-43; TIS-2; 7-52, TIS-3; 7-52, TIS-2; 8-50, TIS-3; 8-51, TIS-2; 9-71, TIS-3; 9-71



Figure 38. a) USDA-WS deploying brown treesnake baits over Andersen, AFB Habitat Management Unit. Photo U.S. Navy. b) Automated co-pilot set up in helicopter for test run. Photos: US Navy/ USDA-WS.

Aerial and Ground-Based Brown Treesnake Control on Fenced and Unfenced Landscapes to Evaluate Suppression and Eradication Feasibility

Location: AAFB; MCBCB **Period of Performance:** SEP2022 – JAN2024

Project Objective

To provide operational and logistical helicopter, technical support, ground-based brown treesnake control (BTS), and monitoring of aerial baiting application impacts within the Northern Forest Enhancement Site (N-FES), Marine Corps Base Camp Blaz (MCBCB), and the Habitat Management Unit (HMU), Andersen Air Force Base (AAAFB). The project will use a multi-tool approach towards eradication in the HMU, and determine achievable levels of suppression in an unfenced area (N-FES).

Conservation Benefit

The development and performance of aerial delivery system for BTS suppression, demonstrates the potential for meaningful impacts at the landscape level, however, studies are showing that a multi-tool approach is likely necessary to remove larger snakes. Eradication in the HMU would create a BTS free environment to support future vertebrate conservation efforts. Determining levels of suppression in an unfenced area will provided insights in the feasibility of true landscape-scale management for BTS. Landscape level control would likely improve JRM conservation efforts in support of the recovery of listed species on JRM lands and assist with interdiction efforts.

FY22 Status

- Newly funded FY22 project.
- Multi-agency project: USGS-PIERC, USDA-NWRC, USDA-WS
- Long-term, multi-phased project (3+ years)

- Aerial baiting begins February 2023
- 14 treatments each - HMU & N-FES - through May 2024

EPR: No EPR - Guam Micronesian Kingfisher MOA funds.

2019 JRM INRMP Reference: TIS-2, 5-85, TIS-3; 5-85, TIS-2; 6-42, TIS-3; 6-43; TIS-2; 7-52, TIS-3; 7-52, TIS-2; 8-50, TIS-3; 8-51, TIS-2; 9-71, TIS-3; 9-71

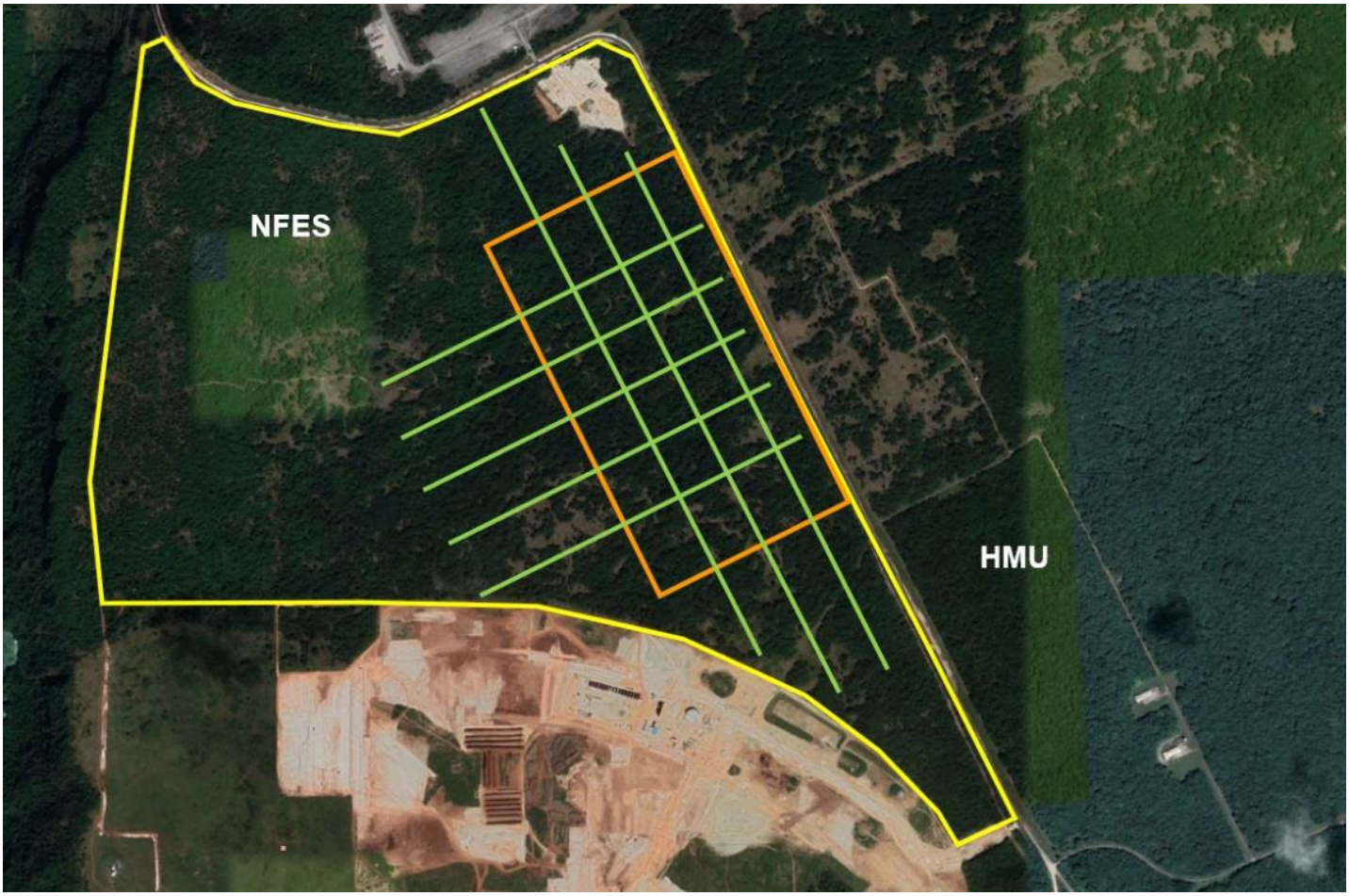


Figure 39. Northern Forest Enhancement Site (NFES, yellow polygon), including hypothetical unbounded aerial treatment (orange) with transects running perpendicular to the treatment boundaries (green). Source USGS-PIERC/USDA-NWRC.

Artificial Toxic Bait for Landscape-scale Brown Treesnake Suppression: Refinement and Capacity

Location: AAFB **Period of Performance**: SEP2020 – FEB2022

Project Objective

This project will further develop the program for artificial BTS bait production focusing on improving efficacy, automate production, and increase capacity for bait production and testing. Other objectives include evaluating the form of the bait for production, how to integrate acetaminophen into the bait, integration of artificial bait into bait cartridge assembly, scaling up production, how to deter invertebrates, establish a testing facility to trial formulations, and testing genetic susceptibility of birds to acetaminophen (enzyme testing). This project will collaborate with experts from USDA-ARS; the Oak Ridge Institute for Science and Education (ORISE), NWRC Hawai'i; and researchers at Clemson University, South Carolina.

Conservation Benefit

Further development and improvement of artificial bait to replace the standard dead neo-natal (DNM) mouse is an important technological goal. It will reduce overall cost and maintain the same level of impact to BTS populations as the DNM. If the bait component of the aerial bait cartridge can be achieved, cost savings would keep costs lower but potentially increase the amount of landscape that is covered by toxicants. Aerial baiting on a landscape scale is an important tool that can support recovery goals for listed species on Guam.

FY22 Status

- Testing facility established on Guam
- Very low acceptance of bait with integrated acetaminophen
- Ants can be deterred; maggots can reduce bait access to BTS
- Genetic susceptibility to acetaminophen varies across bird species

- Project complete, final report pending.

EPR: No EPR - funded with Relocation BO funds

2019 JRM INRMP References: TIS-2, 5-85, TIS-3; 5-85, TIS-2; 6-42, TIS-3; 6-43; TIS-2; 7-52, TIS-3; 7-52, TIS-2; 8-50, TIS-3; 8-51, TIS-2; 9-71, TIS-3; 9-71



Figure 40. a) Baits were approximately 1.2 x 1.2 x 5 cm with a mass of approximately 10 to 14 g with 80mg acetaminophen tablet inserted. b) Three-day old artificial baits. Left: bait in good condition, but dry and leathery. c) Extreme degradation by ants. In comparison, by three days dead mouse baits are decayed and putrefied and no longer effective. Photos USDA-NWRC.

Comparing Take of Mice and Artificial Brown Treesnake Baits from Operational Bait Tubes and Extension of Brown Treesnake Threat Reduction Monitoring in the Habitat Management Unit

Location: AAFB **Period of Performance:** SEP2020 – FEB2022

Project Objective

The project conducted an evaluation incorporating artificial baits with camera verification of species taking baits. Bait tubes were placed in current operational locations on AAFB. Alternating dead neo-natal mouse (DNM) baits and artificial bait were deployed in the same transect. Cost savings were evaluated by comparing the traditional operational schedule (every 2-3 days) while replacing artificial baits every 14 days. Metrics evaluated included, a) cost per tube per unit time, including costs of bait acquisition, preparation, and deployment; and b) cost per bait consumed by a snake. The project characterized the level of non-target bait takes for both DNM and artificial baits by identifying species and frequency of take with cameras. The project also supports further camera-based data collection in the HMU post aerial baiting.

Conservation Benefit

Previously funded artificial bait studies have confirmed their attractiveness to BTS and can be produced at a lower cost than purchasing DNM. Past testing has been in controlled environments or in limited field trials. Directly testing bait in an operational setting and with DNM mice as alternative will help provide greater certainty of viability for artificial baits. The operational use of artificial baits has the potential to reduce cost if aerial baiting is scaled-up and support other operational uses of acetaminophen-based toxicant. The use of acetaminophen-based toxicant is an important tool for managing BTS on a landscape scale to support recovery goals for listed species on Guam.

FY22 Status

- Bait comparison project suspended as baits failed in the field
- Final report pending

EPR: 2 BO MAR AAFB BTS Survivorship of Mariana Fruit Bat to support Guam ISR Strike Requirements; M5240CN042

2019 JRM INRMP Reference:

TIS-2, 5-85, TIS-3; 5-85, TIS-2; 6-42, TIS-3; 6-43; TIS-2; 7-52, TIS-3; 7-52, TIS-2; 8-50, TIS-3; 8-51, TIS-2; 9-71, TIS-3; 9-71, TPS-6; 9-77.

Trial Restoration and Probabilistic Evaluation of Vertebrate Reintroduction Techniques Using Species Traits in a Barrier Undergoing a BTS Eradication

Location: AAFB **Period of Performance:** SEP2020 – FEB2022

Project Objective

The project seeks to develop a conceptual demographic model for reintroduction strategies. Using three unlisted native lizard species *Nactus pelagicus* (Pacific slender-toed gecko), *Perochirus ateles* (Micronesian saw-tailed gecko), *Gehyra oceanica* (Oceania gecko) the objective is to develop a predictive response model to BTS predation based on species traits e.g., reproduction, habitat preference, behaviors, sensitivity to predation, etc. Once a model is built, a release strategy will be developed for hard and soft releases in plots controlled and uncontrolled for BTS. Success to be defined under the following two criteria: evidence of reproduction (juvenile lizards detected) and persistence of the species > 6 months following release.

Conservation Benefit

For reintroductions to occur, managers on Guam will need to understand if species 1) require snake eradication to establish or what level of suppression is required for establishment to occur; and 2) snake abundance thresholds that support persistence of prey species. Some of these metrics are likely to be dependent on the desirability of the species as a prey item and therefore their sensitivity to snake abundance. The use of native lizards presents a relatively safe species to study and inform decisions. In a system with numerous unknowns, their benefits include only small areas to establish populations, are not a federally listed species, have species with high variation in sensitivity to BTS predation, and could be used as a monitoring metric/tool to evaluate BTS suppression actions and inform reintroduction goals.

FY22 Status

- First batch of geckos released in September 2021
- Some indication of higher survivorship of geckos released in suppressed CP site versus control plot
- Substantial data delayed at this time due to changes at USGS-FORT
- Final report pending

EPR: 1 RP JRM BTS Eradication and Control to Support Recovery of ESA- Listed Species; 61128NR202

2019 JRM INRMP Reference: TIS-2; 5-85, TIS-3; 5-85, TIS-2; 6-42, TIS-3; 6-43, TIS-2; 7-52, TIS-3; 7-52, TPS-2; 8-50, TIS-3; 8-51, TIS-2; 9-71, TIS-3; 9-71



Figure 41. a) Oceania gecko (*Gehyra oceanica*) in Closed Population with radio transmitter; b) Brown treesnake tracked and captured after eating radio tagged Green Anole (*Anolis carolinensis).* Source: USGS-PIERC

Evaluating the Effect of Bait Size and Species on Removal of BTS That Are Not Susceptible to ADS Control

Location: AAFB **Period of Performance:** JUL2020 – JAN2022

Project Objective

The project will evaluate a multi-tool/multi bait approach to eradicating a small, known population of BTS in the Closed Population area on AAFB. The project will use a phased approach continuing with replicating aerial baiting (suspending baits from vegetation); adding a perimeter of larger rodent and bird baits in bait tubes; and use live bird and rodent lures. The baits will have transmitters to track the fate of the snakes. The same approach will be taken within the interior of the Closed Population to analyze for any spatial effects. As the population of BTS within the Closed Population is known, following the impacts by the multi-tool approach to provide useful data towards improving BTS suppression and eradication within enclosures.

Conservation Benefit

Aerial baiting can distribute bait across the landscape quickly but we still do not have enough data to state conclusively if eradication is achievable. Aerial baiting is the only method used to attempt suppression/eradication of BTS in the HMU. Data projections indicate aerial baiting alone may not be enough to meet the goal of eradication. This is, in part, due to a sub-set of the BTS population not consuming bait (too small/too large). The ability to better target all size classes of BTS with a complex of control tools could help achieve eradication within enclosures but also may provide a substantial benefit to recovery of listed species by severely suppressing the population to allow population recruitment to stay ahead of predation.

FY22 Status

- Preference for bird over rodent detected; size less of a factor
- High levels of non-target bait take, insects etc.

- Substantial data delayed at this time due to changes at USGS-FORT
- Final report pending

EPR: 1 RP JRM Brown Tree Snake Eradication and Control to Support Recovery of ESA-Listed Species; 61128NR202

2019 JRM INRMP Reference:

TIS-2, 5-85, TIS-3; 5-85, TIS-2; 6-42, TIS-3; 6-43; TIS-2; 7-52, TIS-3; 7-52, TIS-2; 8-50, TIS-3; 8-51, TIS-2; 9-71, TIS-3; 9-71, TPS-6; 9-77.

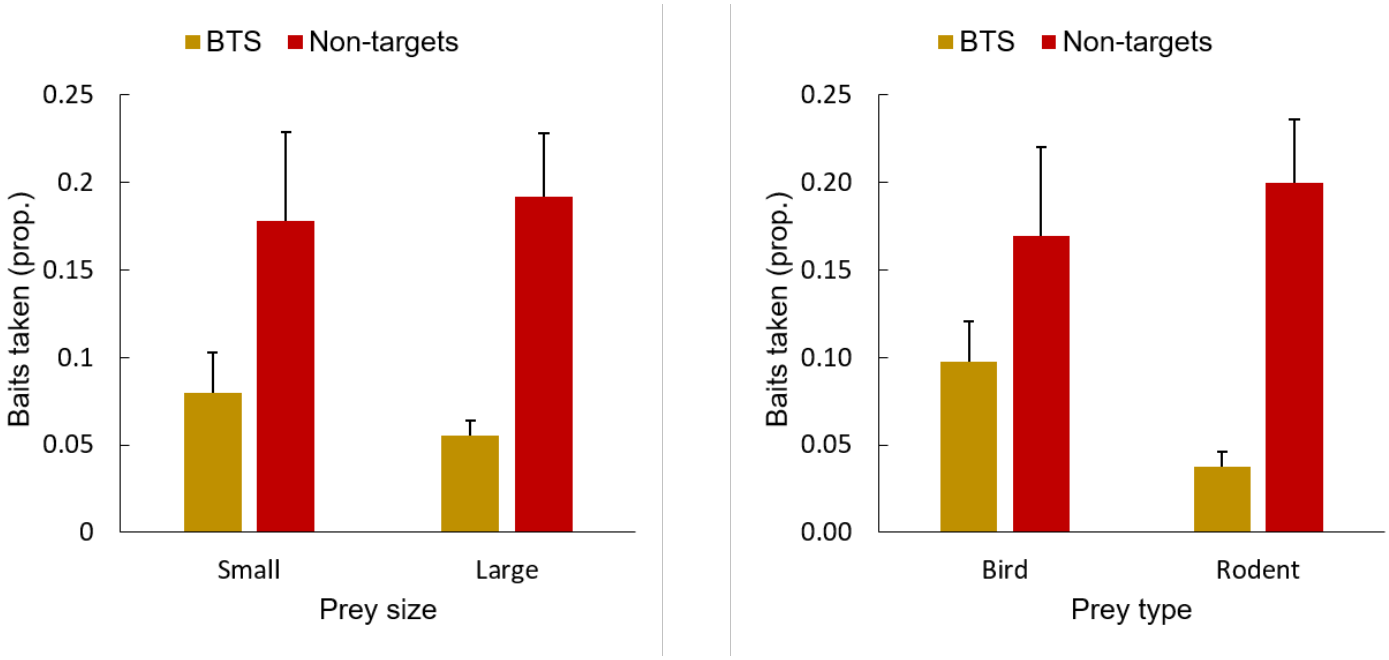


Figure 42: a) The proportion of bait-tube baits monitored with cameras taken by brown treesnakes (BTS) or non-target species by prey species type; b) The proportion of bait-tube baits monitored with cameras taken by brown treesnakes (BTS) or non-target species by prey size.

Identifying & Refining Tools for Landscape-scale Detection, Removal, and Monitoring of Brown Treesnakes

Location: AAFB **Period of Performance**: AUG2022 – JAN2024

Project Objective

The project develops and evaluates tools and methods for BTS control and monitoring including improving the effectiveness and reducing the costs of tools for BTS suppression and monitoring. Tasks include a) Evaluate whether abiotic factors such as moonlight, temperature, humidity, and rainfall affect BTS activity levels; b) Assess whether BTS produce recognizable images in thermographic cameras and can improve detection in the environment; c) evaluate a variety of market available cameras to help standardize technology and reduce costs; d) continue genetic evaluation of acetaminophen impacts to avian species.

Conservation Benefit

Brown treesnakes are difficult to detect and manage. Current standard tools i.e., visual surveys, camera traps can be improved with improve/alternate technology e.g., thermal, infra-red, night-vision, however, this technology needs to be properly evaluated to determine suitability and methods improvement. Deploying multiple cameras in the field is expensive and finding low-cost models with similar image quality is an important cost reduction. Data are available on abiotic factors such as moonlight, humidity, and rainfall, but the influence of these factors on BTS activity has not been evaluated. Knowing movement related to weather and moonlight could help refine management techniques. Collecting further data on acetaminophen impacts to avian species is important to improving predictions to which bird species on Guam may be sensitive to acetaminophen, where testing potential species for reintroduction is not feasible.

FY22 Status

- New project for FY22
- No data available at this time

DPRI: Marine Corps Relocation 2017/2018 amendment to 2015 BO, Conservation Measures to Contribute to the Recovery of Listed Species

Reference: Guam Relocation Biological Opinion

AAFB Invasive Plant Species Monitoring and Control

Location: AAFB **Period of Performance:** OCT2020 – SEP2021

Project Objective

Conduct surveys to document the spread of invasive plant species.

Conservation Benefit

Knowledge of which invasive species are dominant and most likely to spread further.

FY22 Status

- Project complete, data analysis is ongoing
- Resampled 534 plots previously sampled in 2008
- Plots are circular and 100 square meters in size
- Diversity declined by a small amount
- Tree mostly decreased with some exceptioins
- DBH on average increased on species that were examined
- Possibly regrowth and succession after typhoons in the early to mid-2000s
- Trend also exists in the HMU with some differences
- Dominant trees on AAFB - *Meiogyne cylindrocarpa (Guamia), Aglaia mariannensis, Ochosia mariannensis, Vitex parviflora and Ochrosia oppisitifolia (Neisosperma)*
- *Triphasia triofolia* and *Cestrum diurnum* increasing in numbers

EPR: CHS EO13751 JRM AAFB Invasive Plant Species Monitoring and Control, M524010013

2021 JRM INRMP Reference: THM-3; 8-49, TIS-1; 8-52, THM-1; 9-68

Table 5. Diversity indices and abundances by area

Diversity Indices by Area

	Total Plots	Woody Species Richness (No. spp/location)		Abundance (tot. ind./ location)[1]		Shannon Diversity (H)[1]		Simpson Index (D)[1]		Herbaceous Species Richness (No. spp/location)	
		2008	2021	2008	2021	2008	2021	2008	2021	2008	2021
1	51	26	20	589	295	2.726	2.570	0.918	0.907	61	53
2	126	33	32	2829	1815	1.739	1.903	0.713	0.744	78	80
3	62	35	26	1388	1203	2.246	2.015	0.804	0.769	64	47
4	122	32	49	1415	2682	2.267	2.415	0.808	0.854	62	68
5	144	47	45	3469	3800	2.165	2.012	0.801	0.785	61	61
6	29	27	21	990	684	1.941	2.029	0.754	0.791	75	41
HMU[2]	50	26	22	1005	799	1.566	1.814	0.672	0.742	54	29

1 – Woody species only.

2 – HMU plots are a subset of Area 2 and included in the Area 2 analyses.

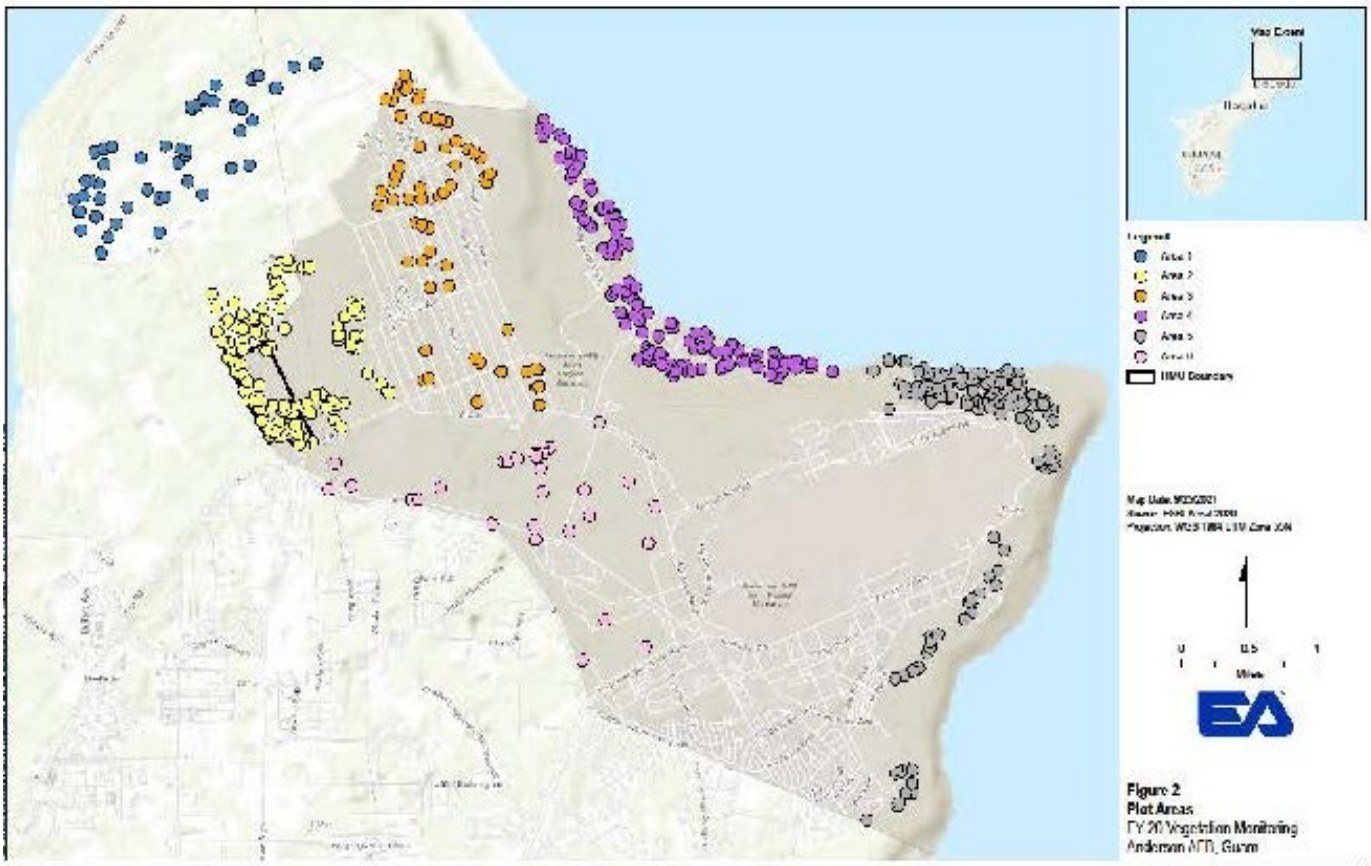


Figure 43. Map of vegetation plot locations

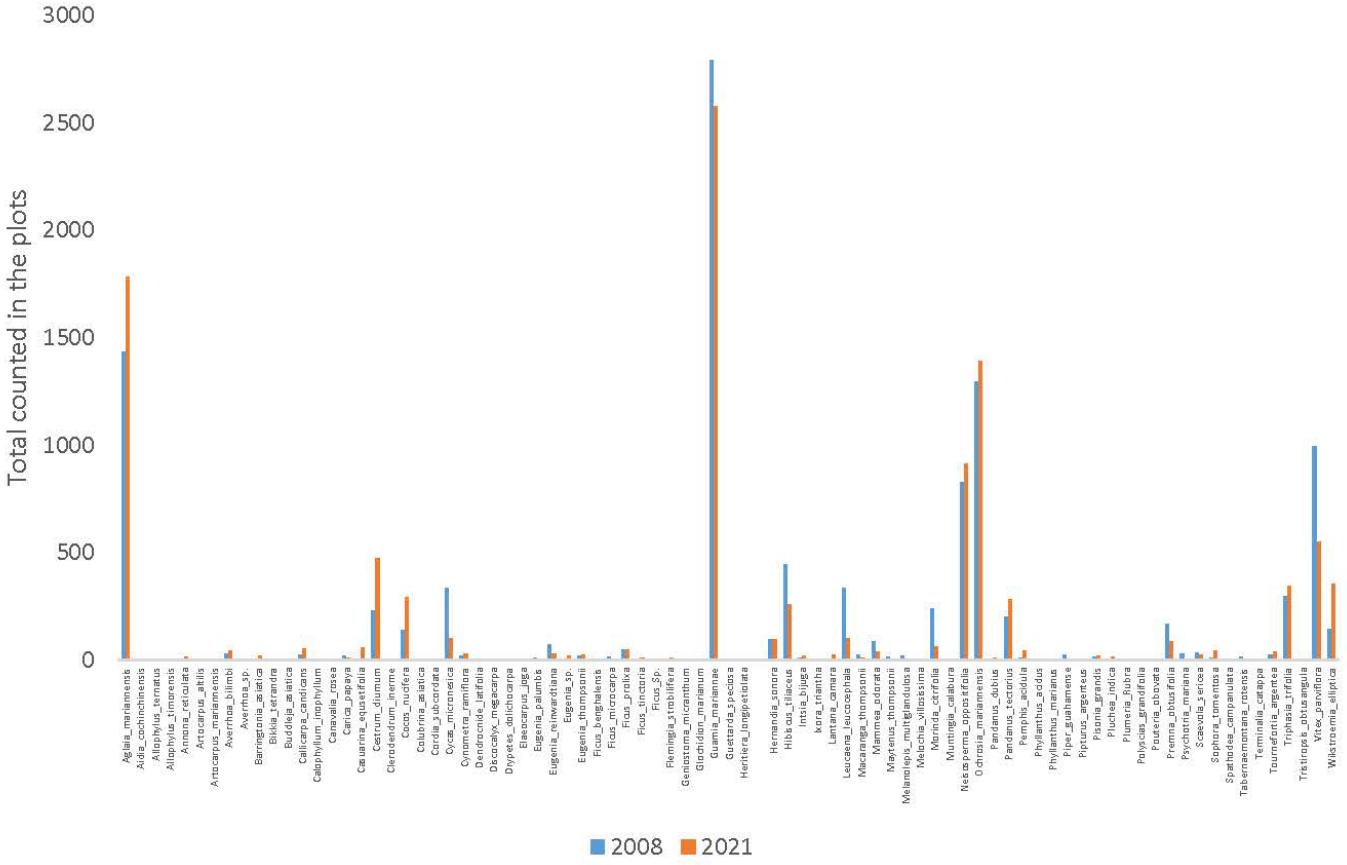


Figure 44. Vegetation plot results, 2008 vs 2021

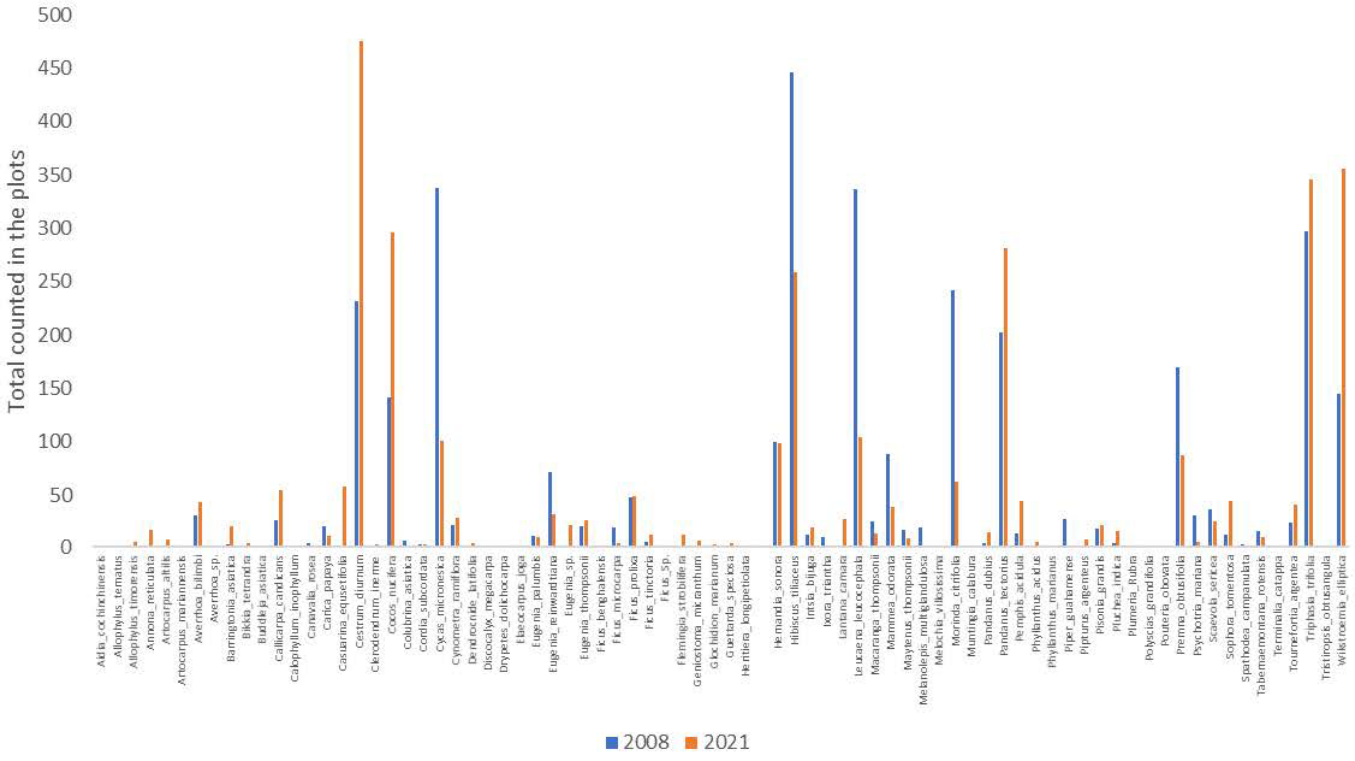


Figure 45. Vegetation plot results, 2008 vs 2021 minus the 4 dominant tree species

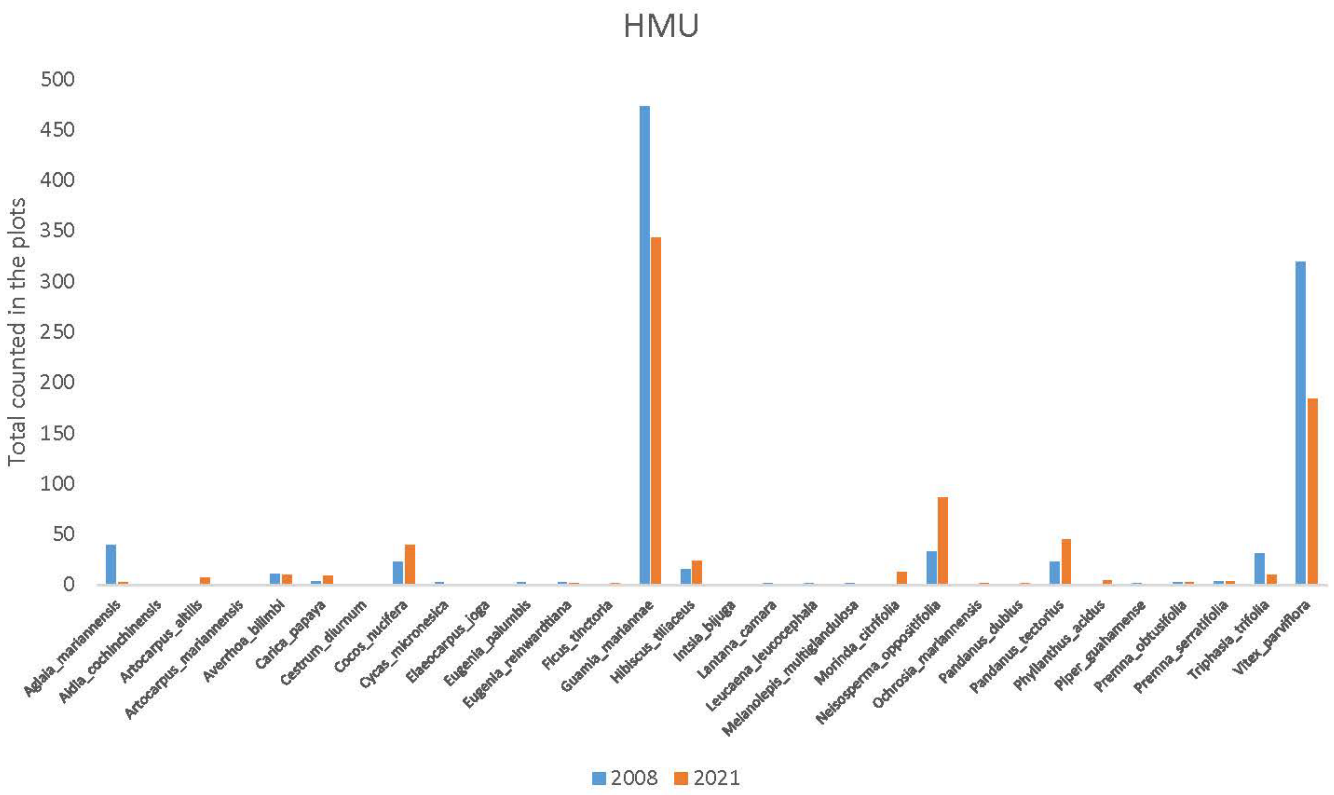


Figure 46. HMU vegetation plots, 2008 vs 2021

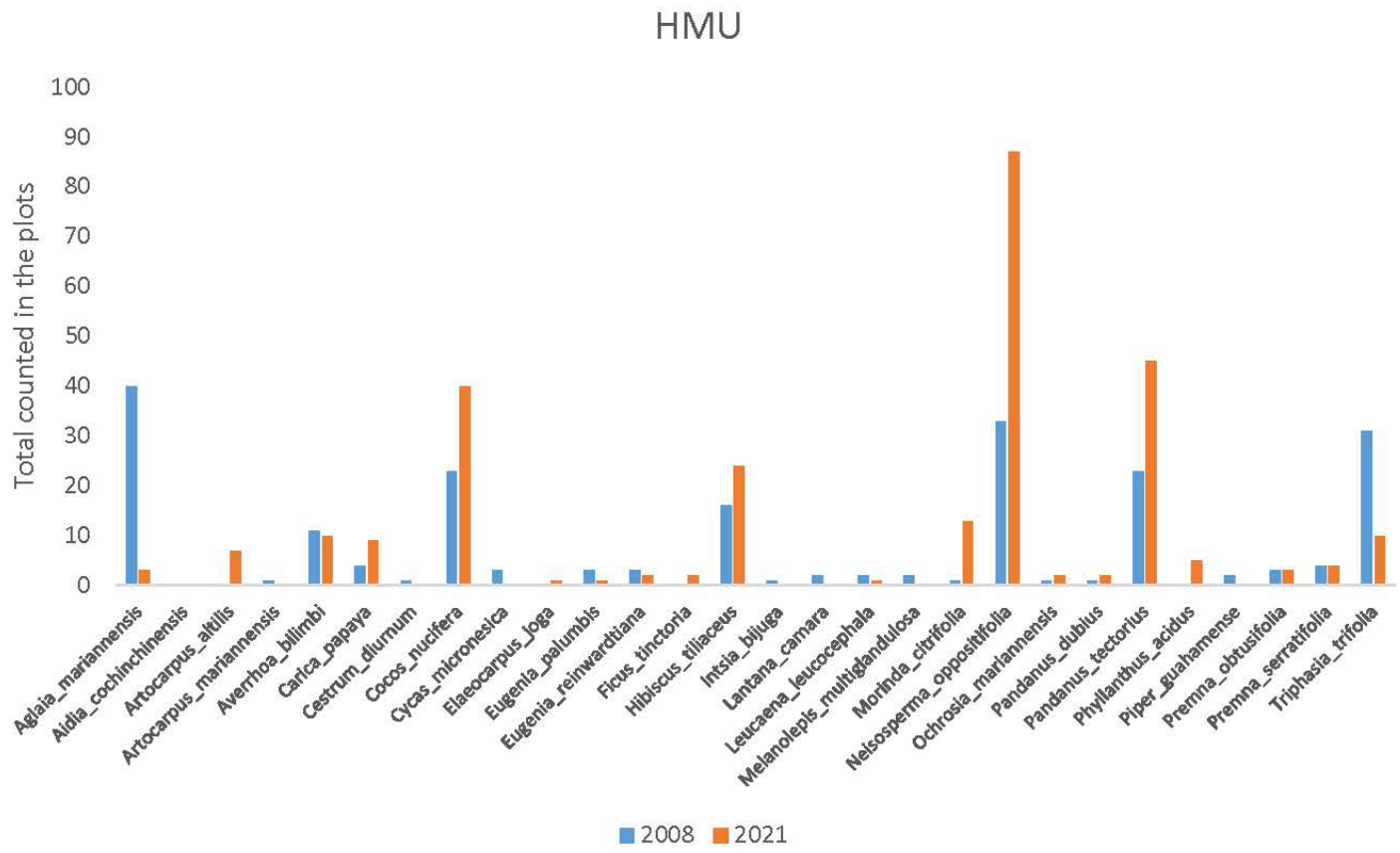


Figure 47. HMU vegetation plots, 2008 vs 2021 minus *Neisosperma* and *Vitex*

Invasive Plant Control MCBCB

Location: MCBCB **Period of Performance**: AUG2020 – FEB2023

Project Objective

Control limited infestations of *Antigonon leptopus* and *Mimosa diplotricha* in the Finegayan and Caiguat Forest Enhancement Sites.

Conservation Benefit

Invasive plants are a significant threat to Guam's native habitats. Removal of these invasive plant populations will improve the immediate area and reduce the likelihood of further spread of these weeds into the rest of the conservation site.

FY22 Status

- Mechanical and chemical removal of plants continued through FY22
- Period of performance has been extended to continue control of the infestations in an effort to achieve eradication

DPRI: Marine Corps Relocation 2017/2018 amendment to 2015 BO, Conservation Measures to Contribute to the Recovery of Listed Species

Reference: Guam Relocation Biological Opinion



Figure 48. Antigonon leptopus is one of three invasive weeds controlled through the on-going invasive plant project on MCBCB.

NATURAL RESOURCES EDUCATION AND OUTREACH

Outreach and Education – NBG

Location: NBG **Period of Performance:** JUL2021 - JUN2022; New Award SEP2022

Project Objective

Develop, design, and produce custom outreach materials for use by Public Works EV and NBG to educate incoming military personnel, their families, and civilian employees on the importance of conserving and protecting natural resources.

Conservation Benefit

Educational material provides military and civilian personnel and base visitors the ability to understand their role in protecting Guam resources.

FY22 Status

- Production and Distribution of one thousand 1000 2022 Marine Tide Calendars
- Replacement of five (5) rip current, fishing regulation, coconut crab, rules, and general area signs for Haputo Ecological Reserve
- Procurement of nine (9) informational “Off Limits” signs to be used ecologically sensitive areas on NBG and NMS
- Additional project awarded 09SEP2022 for the production of 3 to 5 minute outreach video

EPR: Listed Species Outreach Material; 61755NR306

2019 JRM INRMP Reference: TEDU-1; 5-91, MEDU-1; 5-104

Biosecurity Outreach and Education on Guam

Location: Islandwide **Period of Performance:** AUG2021 – AUG2022

Project Objective

Implement a targeted, comprehensive outreach and education program for DoD and civilian populations to highlight biosecurity issues and focus on prevention of new species introductions.

Conservation Benefit

Invasive species are among the greatest threats to Guam's native habitats and listed species. Raising awareness of biosecurity practices will help prevent new species becoming established on island.

FY22 Status

- Biosecurity outreach PSAs broadcast via radio, television and social media platforms
- Continued collaboration with Department of Agriculture's Biosecurity Division
- Final report submittal pending
- Recommendations provided in the FY21 final report will be considered to improve overall reach and effectiveness in FY22
- FY22 project scheduled to award September 2022

DPRI: Marine Corps Relocation 2017/2018 amendment to 2015 BO, Conservation Measures to Contribute to the Recovery of Listed Species

Reference: Guam Relocation Biological Opinion



Figure 49. The coconut rhinoceros beetle is one of the invasive pests highlighted in biosecurity outreach efforts.

JRM Natural Resources Stewardship Outreach & Public Engagement Program

Location: JRM **Period of Performance**: AUG2021 – Ongoing; New Award SEP2022

Project Objective

To develop outreach products to effectively and efficiently implement a NR stewardship engagement program. This program aims to better educate uniformed and civilian staff, their dependents, JRM contractors, and the general public in order to improve NR stewardship and awareness within JRM AOR.

Conservation Benefit

The development and production of NR education materials and training is a beneficial support to increasing awareness of T&E species, proper stewardship behavior, and threats to local ecosystems.

FY22 Results

- Ongoing production of Environmental Stewardship Website
- Ongoing production of outreach swag items to support Tinian Art Contest and Turtle Educational Outreach Project
- Ongoing update of Public Access Plan site descriptions and photos
- Ongoing 360 degree camera photos of 3 Public Access Plan sites to be featured on Environmental Stewardship Website
- Projected completion of tasks by 31OCT2022
- New project awarded 09SEP2022 for the production of 3 to 5 minute outreach video

EPR: 61128NR962 JRM Natural Resources Stewardship Outreach and Public Engagement Program

2019 JRM INRMP Reference: TEDU-1; 5-91, MEDU-1; 5-104

PACFLT Funded JRM Natural Resources Stewardship Outreach & Public Engagement Program

Location: JRM **Period of Performance:** SEP2020 - Ongoing

Project Objective

Improve NR stewardship and awareness within JRM AOR.

Conservation Benefit

The development and production of NR education materials and training is a beneficial support to increasing awareness of T&E species, proper stewardship behavior, and threats to local ecosystems.

FY22 Results

- Ongoing implementation and expansion of Young Environmental Stewards (YES!) youth educational program
- Ongoing CNMI outreach initiative in conjunction with EPR 61128NR962 JRM Natural Resources Stewardship Outreach and Public Engagement Program
- Distribution of 4 T&E species themed reusable shopping bags at installations, various DOD events, and public outreach events on Guam.
- Production and delivery of Nature Journals and Passport interactive materials estimated for OCT2022
- Ongoing development of Sea Turtle interactive classroom game

EPR: NA- Funding from PACFLT Stewards of the Sea Initiative

2019 JRM INRMP Reference: TEDU-1; 5-91, MEDU-1; 5-104

MIGRATORY BIRD MANAGEMENT

Migratory Bird Surveys on NBG-Administered Lands

Location: NBG; NMS **Period of performance:** SEP2021 – AUG2022; Ongoing

Project Objective

Conduct monthly bird surveys on NBG-administered lands; examine trends in abundance and habitat preference of migratory birds.

Conservation benefit

To improve long-term understanding of species protected by the MBTA and their preferred habitats and migratory patterns, in support of military readiness, and to avoid and minimize impacts to migratory birds.

FY22 Status

- Bird abundance was monitored at 15 NBG/NMS sites
- Bi-monthly surveys during nesting season
- 95 in-house surveys conducted
- Common occurrence of plovers, sandpipers and snipes
- Migrants prefer grass fields and paved surfaces

EPR: In-house only

2019 JRM INRMP Reference: MIG-1; 5-90, MIG-1; 6-48

TERRESTRIAL HABITAT MANAGEMENT

Threatened and Endangered Species Preconstruction Surveys

Location: MCBCB; NBG; AAFB **Period of Performance:** Ongoing, multiple awards

Project Objective

Conduct pre-construction surveys prior to vegetation clearing to minimize impacts to listed species.

Conservation Benefit

The preconstruction surveys ensure listed species are not harmed by construction projects. Healthy individuals may be moved to long-term conservation sites, preserving genetic variety within listed species populations.

FY22 Status

Ongoing projects for construction activities:

- J001B Finegayan Utilities and Site Improvements Phase 1
- J-006 Apra Medical Clinic
- J-007 Waterfront Head Quarters
- J-200 IV Utilities
- J-755 Urban Combat Training
- P-102 Power Upgrade-Harmon
- P-103 Water Phase 2
- P-290 Earth Covered Magazines
- P-295 Ordnance Ops.
- P-715 Live-Fire Training Range Complex Known Distance Ranges
- P735 Machine Gun Firing Range
- P-745 Guam National Wildlife Refuge

DPRI: Marine Corps Relocation 2017/2018 amendment to 2015 BO, Conservation Measures to Contribute to the Recovery of Listed Species

Reference: Guam Relocation Biological Opinion

Listed Plant and Invertebrate Surveys 1

Location: NMS; AAFB; Off-DoD **Period of Performance:** AUG2019- Ongoing

Project Objective

To conduct surveys for ESA-listed plant and invertebrates. Information collected adds to the baseline data for each the species.

Conservation Benefit

Identifying locations of ESA-listed plant and invertebrate species will allow for management actions to reduce habitat fragmentation, enhance and restore habitat, buffer protected areas, and implement new conservation strategies.

FY22 Status

- Acres surveyed AAFB (89), NMS (178), Andy South (1099), Off-DoD (295)
- Species found: *Bulbophyllum guamense, Cycas micronesica, Dendrobium guamense, Eugenia bryanii, Tabernaemontana rotensis, Tuberolabium guamense, Hypolimnas octula mariannensis, Partula radiolata, Elatostema calcareum, Procris pendunculata*

EPR: Listed plant surveys, Propagation, planting, and Establishment in the Wild; 61128NR209 and 1 S JRM AAFB - Monitoring and Surveys for Listed Tree Snails, Butterfly, Plants; M5240CN048

2019 JRM INRMP Reference: THM-2; 6-39, TPS-1; 7-55, TPS-5; 9-77

Table 6. Counts of ESA-listed species found during surveys between OCT 2021- JUL 2022

October 2021-July2022			
Species Scientific Name	Off-DoD Total	DoD Total	2021-2022 Complete Totals
Bulbophyllum guamense	13	1317	1330
Cycas micronesica	6884	196	7080
Dendrobium guamense	23	615	638
Eugenia bryanii	47	0	47
Hedyotis megalantha	0	0	0
Heritiera longipetiolata	0	0	0
Maesa walkerii	0	0	0
Nervilia jacksoniae	0	0	0
Phyllanthus saffordii	0	0	0
Serianthes nelsonii	0	0	0
Solanum guamense	0	0	0
Tabernaemontana rotensis	21	60	81
Tinospora homosepala	0	0	0
Tuberolabium guamense	363	3622	3985
Hypolimnas octula mariannensis	188	0	188
Vagrans egistina	0	0	0
Partula gibba	2*	0	2*
Samoana fragilis	0	0	0
Partula radiolata	221	33	254
Elatostema calcareum	15	0	15
Procris pendunculata	58	0	58

**Empty shells*

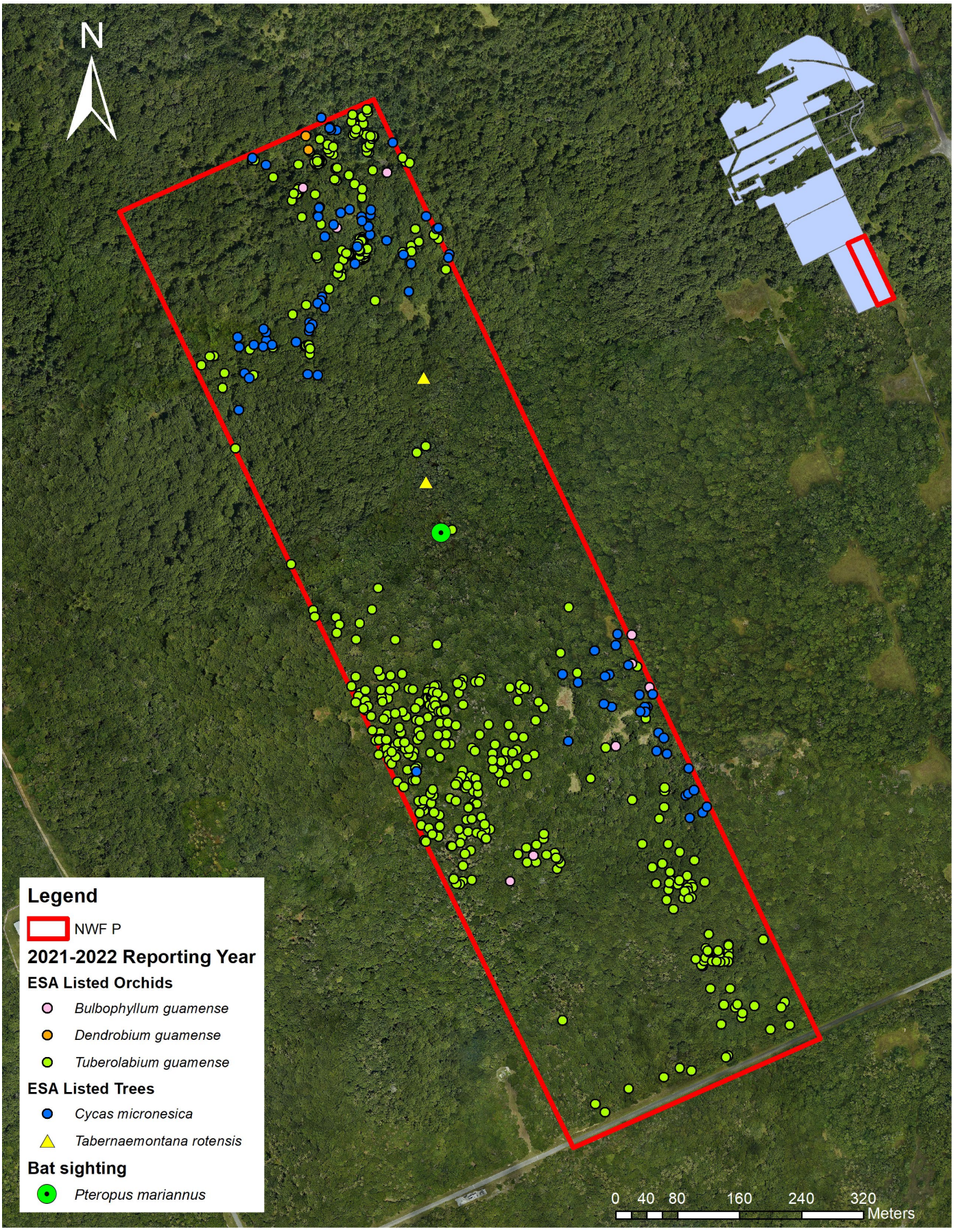


Figure 50. (Map) ESA-listed species found during surveys at AAFB

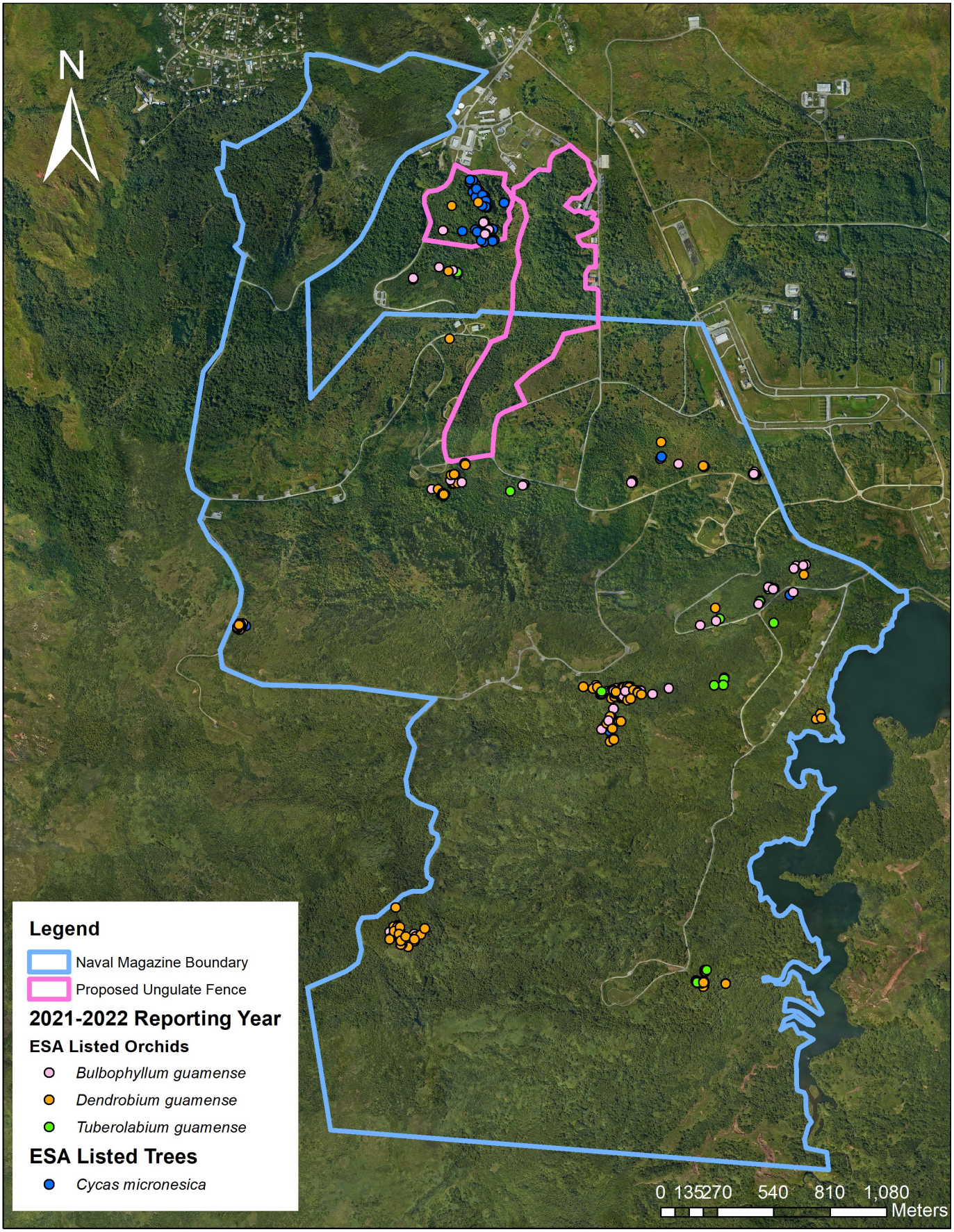


Figure 51. (Map) ESA-listed species found during surveys at NMS

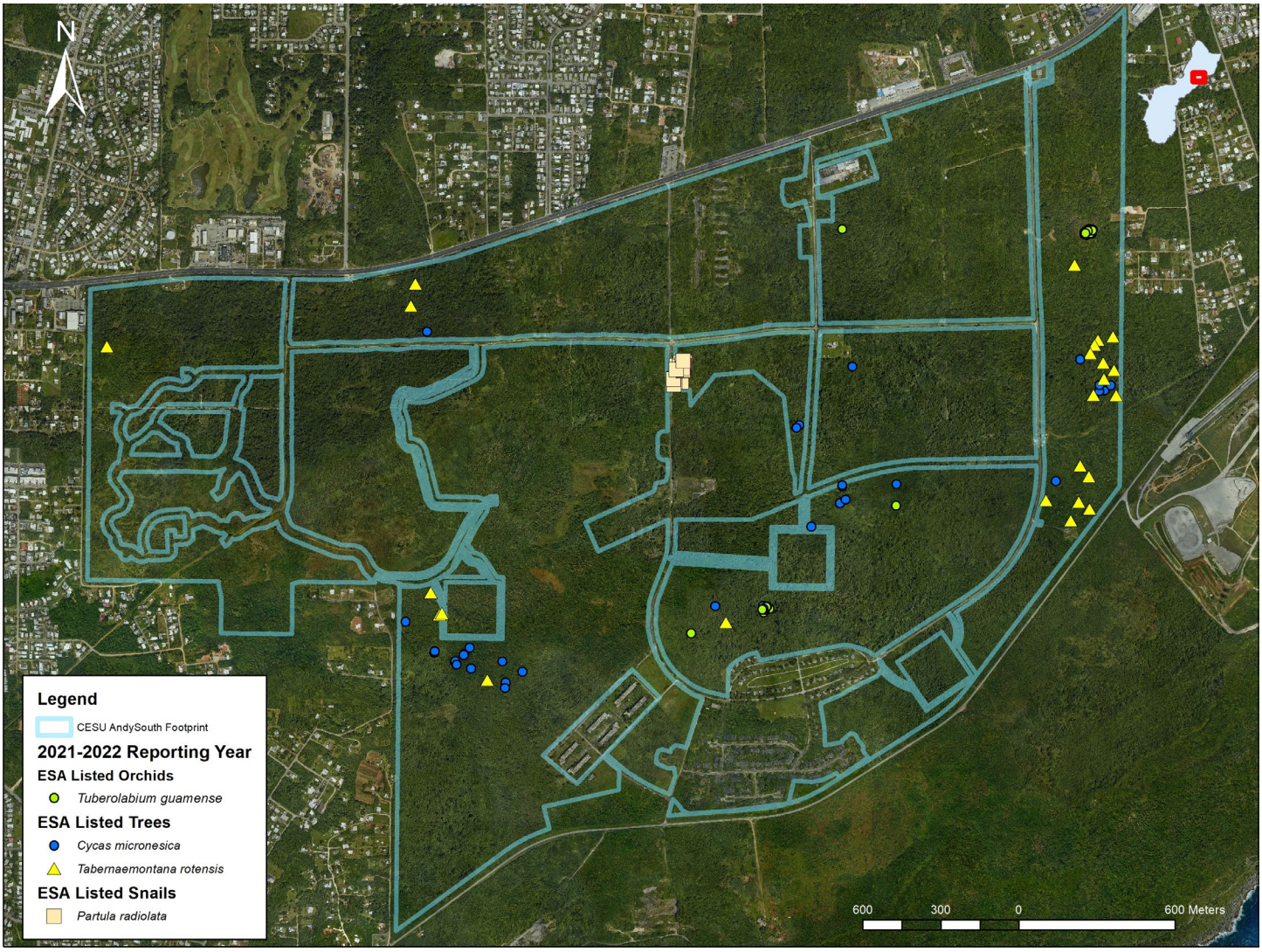
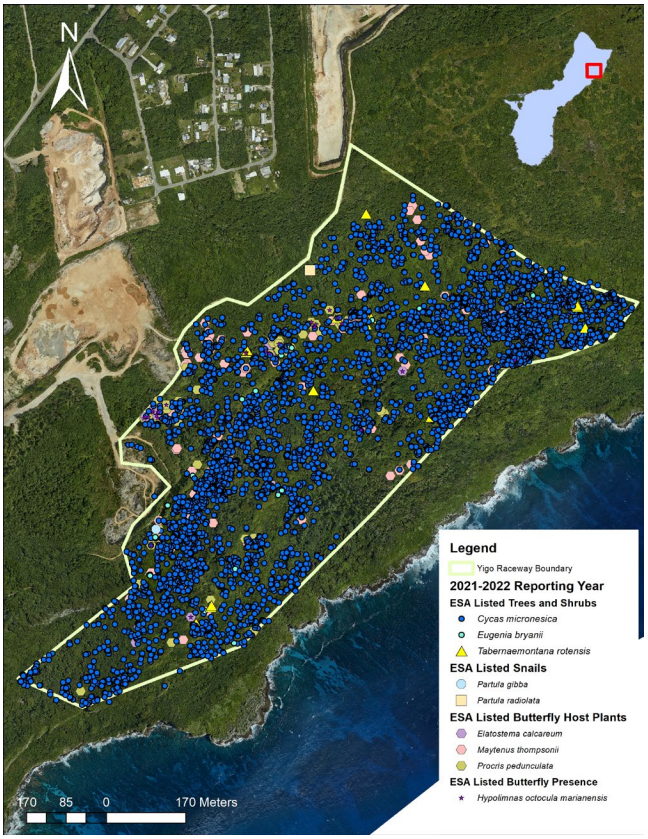
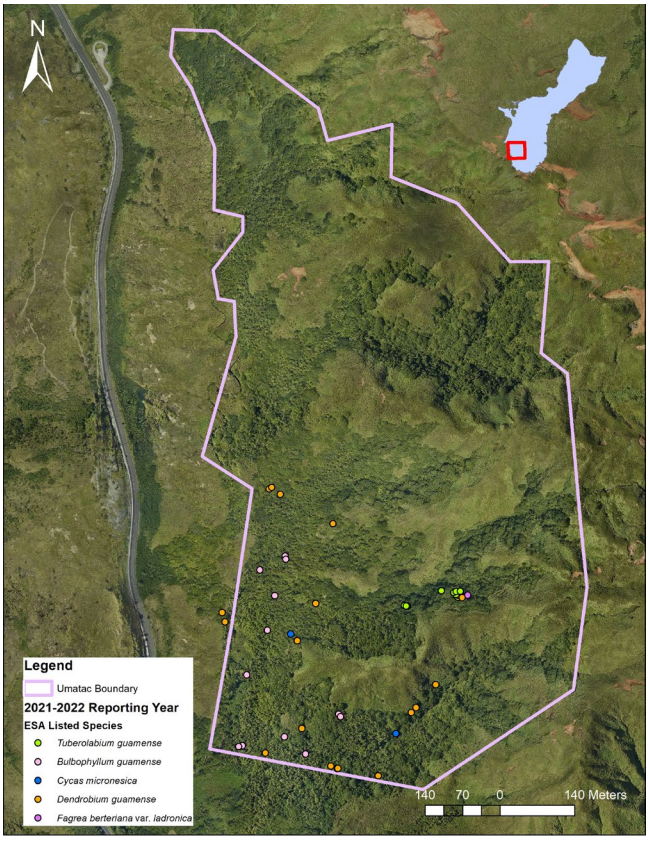
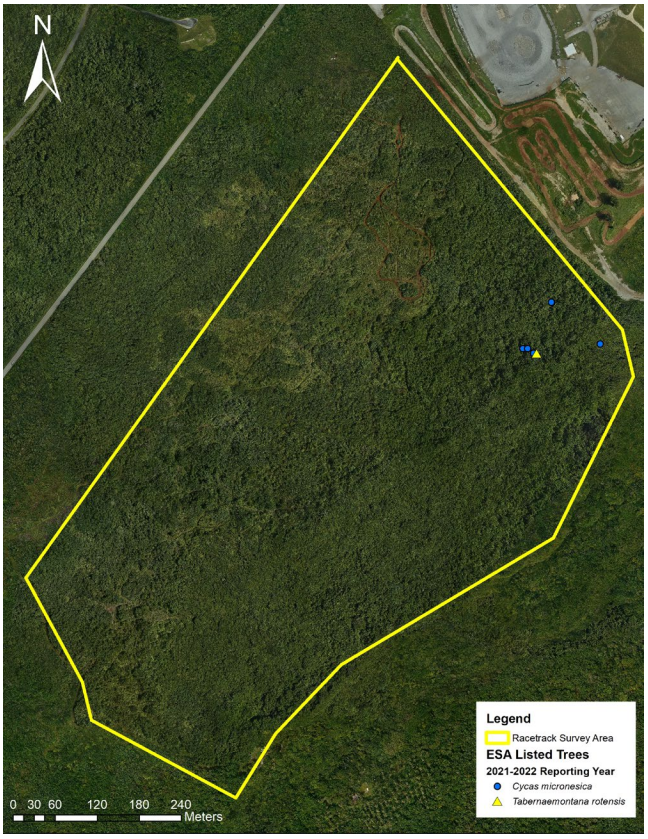
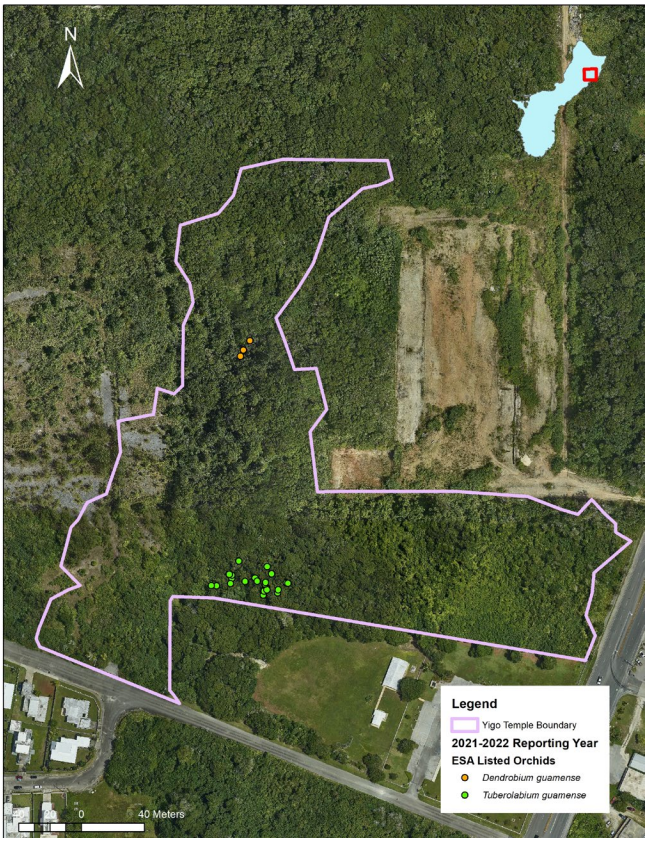


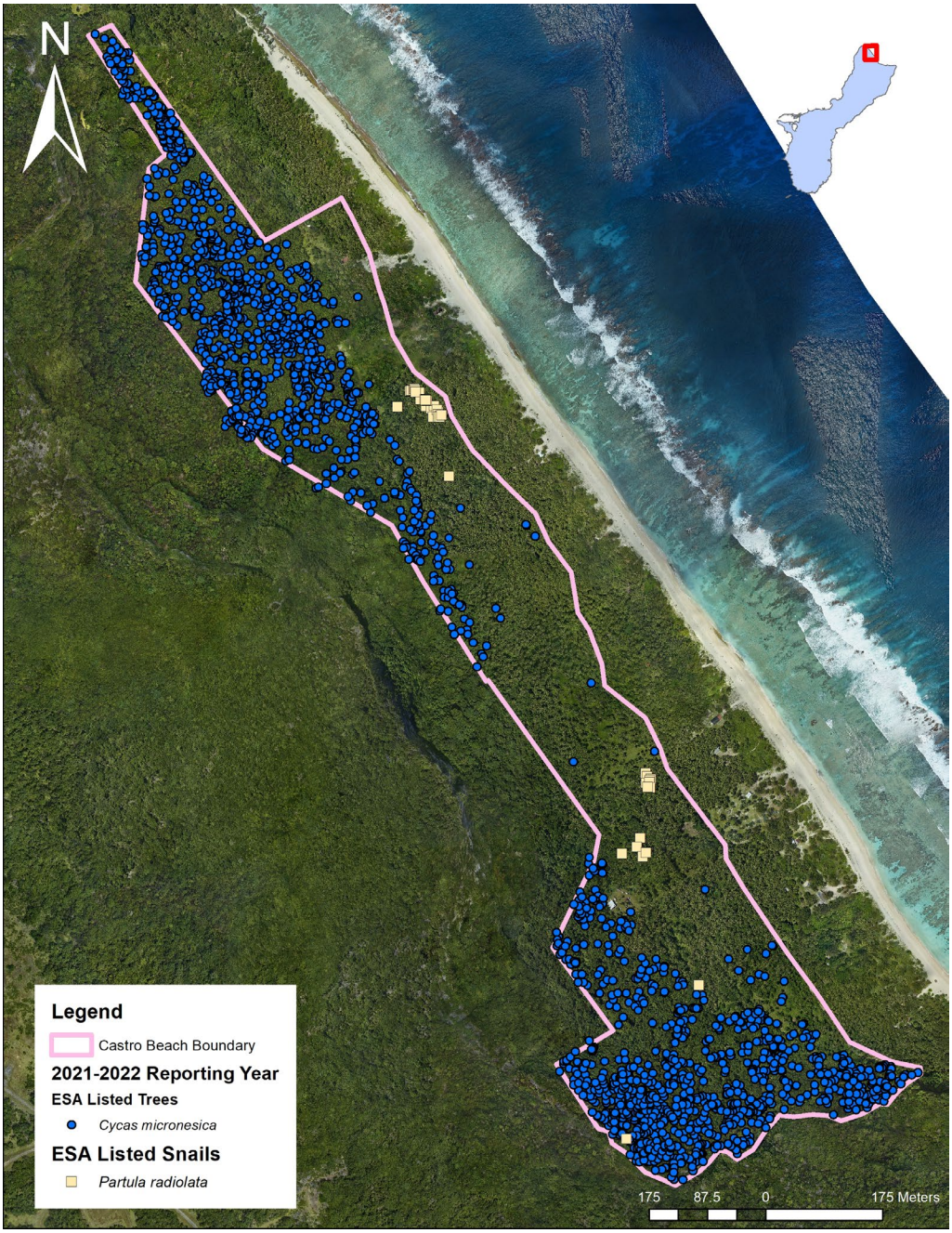
Figure 52. (Map) ESA-listed species found during surveys at Andy South


N
Legend
Yigo Raceway Boundary
2021-2022 Reporting Year
ESA Listed Trees and Shrubs
Cycas micronesica
Eugenia bryanii
Tabernaemontana rotensis
ESA Listed Snails
Partula gibba
Partula radiolata
ESA Listed Butterfly Host Plants
Elatostema calcareum
Maytenus thompsonii
Procris pedunculata
ESA Listed Butterfly Presence
Hypolimnas octocula marianensis
170 85 0 170 Meters


N
Legend
Umatac Boundary
2021-2022 Reporting Year
ESA Listed Species
Tuberolabium guamense
Bulbophyllum guamense
Cycas micronesica
Dendrobium guamense
Fagrea berteriana var. ladronica
140 70 0 140 Meters


N
Legend
Racetrack Survey Area
ESA Listed Trees
2021-2022 Reporting Year
Cycas micronesica
Tabernaemontana rotensis
0 30 60 120 180 240 Meters


N
Legend
Yigo Temple Boundary
2021-2022 Reporting Year
ESA Listed Orchids
Dendrobium guamense
Tuberolabium guamense
0 40 Meters



Figures 53 - 57. (Maps) ESA-listed species found during surveys Off DoD land

Listed Plant and Invertebrate Surveys 2

Location: NMS **Period of performance:** AUG2021 - Ongoing

Project Objective

To conduct surveys for ESA-listed plant and invertebrates. Information collected adds to the baseline data for each the species.

Conservation benefit

Identifying locations of ESA-listed plant and invertebrate species will allow for management actions to reduce habitat fragmentation, enhance and restore habitat, buffer protected areas, and implement new conservation strategies.

FY22 Status

- Surveys in NMS training areas (300 acres) and potential ungulate fence locations near swiftlet caves (425 acres)
- No invertebrates located
- Cycads, Tabernaemontana, 3 Epiphytic orchids, Phyllanthus
- Fruit bat ejecta

EPR: Listed plant surveys, Propagation, planting, and Establishment in the Wild; 61128NR209 and 1 S JRM AAFB - Monitoring and Surveys for Listed Tree Snails, Butterfly, Plants; M5240CN048

2019 JRM INRMP Reference: THM-2; 6-39

Table 7. Counts of ESA-listed species found during surveys between OCT 2021- JUL 2022

NBGNMS Northern Training Area

NOV 2021 - JUN 2022	
Species	**Total**
Bulbophyllum guamense	4687
Cycas micronesica	285
Dendrobium guamense	3208
Tabernaemontana rotensis	6
Tuberolabium guamense	4210

NBGNMS Northern Training Area

DEC 2021 - JUL 2022	
Species	**Total**
Bulbophyllum guamense	216
Cycas micronesica	41
Dendrobium guamense	60
Phyllanthus saffordii	47
Tuberolabium guamense	3

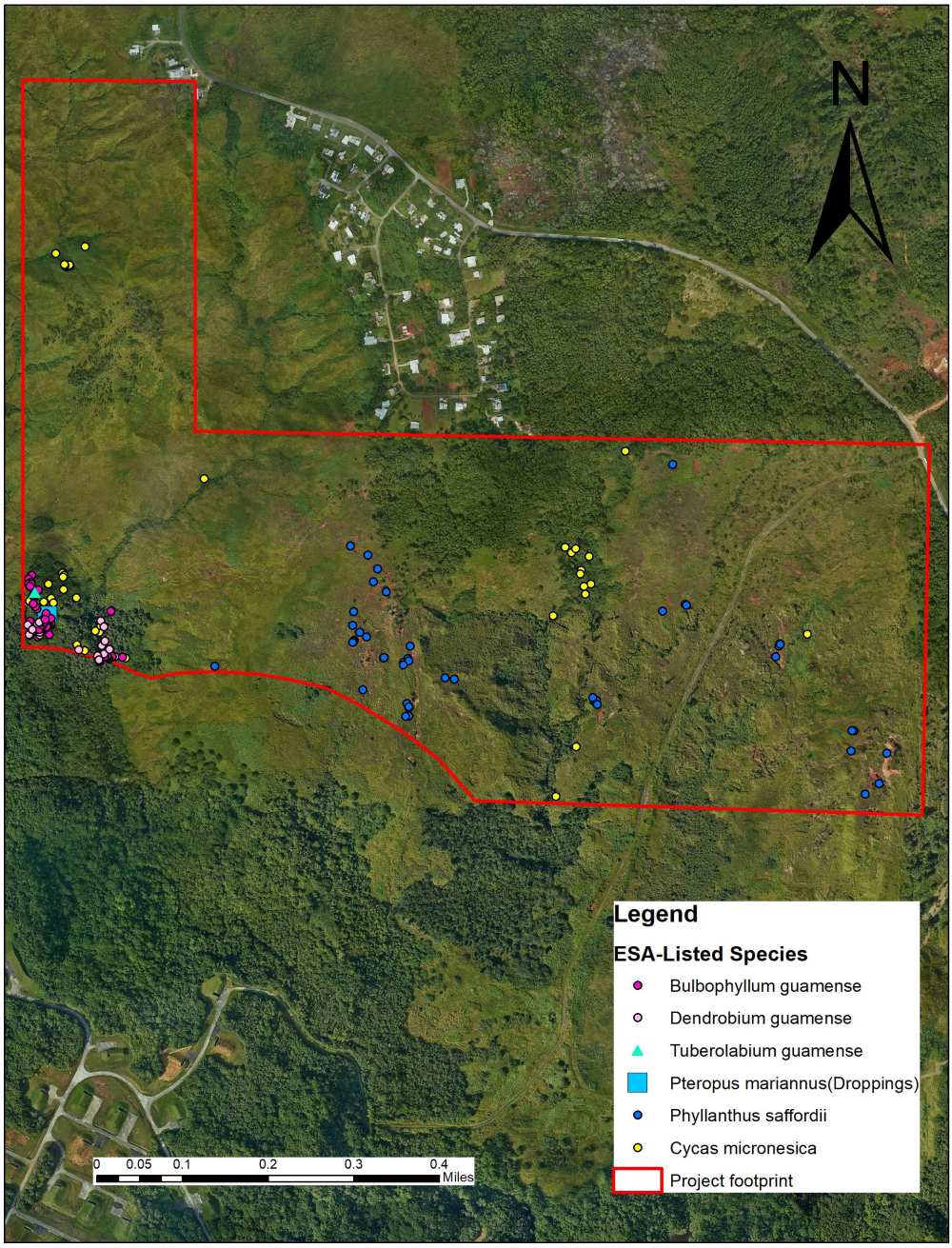


Figure 58. (Map) ESA-listed species found during surveys at NMS training area

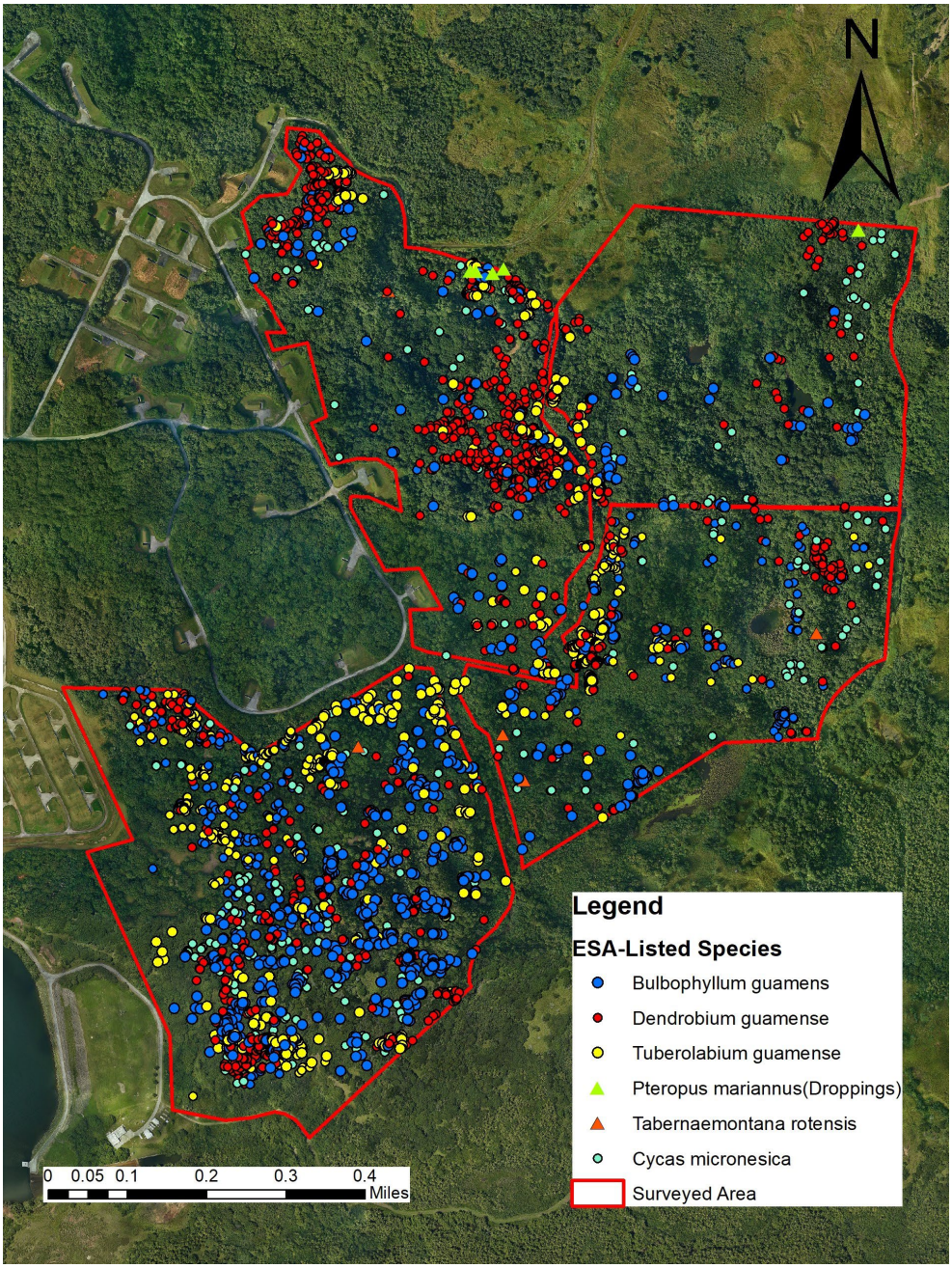


Figure 59. (Map) ESA-listed species found during surveys at NMS future ungulate fence sites8

Tree Density Study

Location: NMS **Period of performance:** JUL2020- MAR2022

Project Objective

Conduct forestry surveys to better understand tree density and diversity within select NMS study sites.

Conservation benefit

The conservation benefits of the project are (a) ensure self-sustaining, resilient populations to maintain and increase native species and diversity, and (b) ensure self-sustaining, resilient populations to include the use of novel techniques in the adaptive management of tree populations.

FY22 Status

- Study included 14 NMS survey locations
- Point quarter survey methodology
- 60 different tree species recorded
- 1,266 trees/ha/14 locations (95% CI)
- *Ficus prolixa* densest at 2 sites (43 individuals/ha)
- Undergoing data analysis

EPR: 1 S MAR NBG Endangered Species Monitoring; 61755NR142

2019 JRM INRMP Reference: THM-2; 6-39

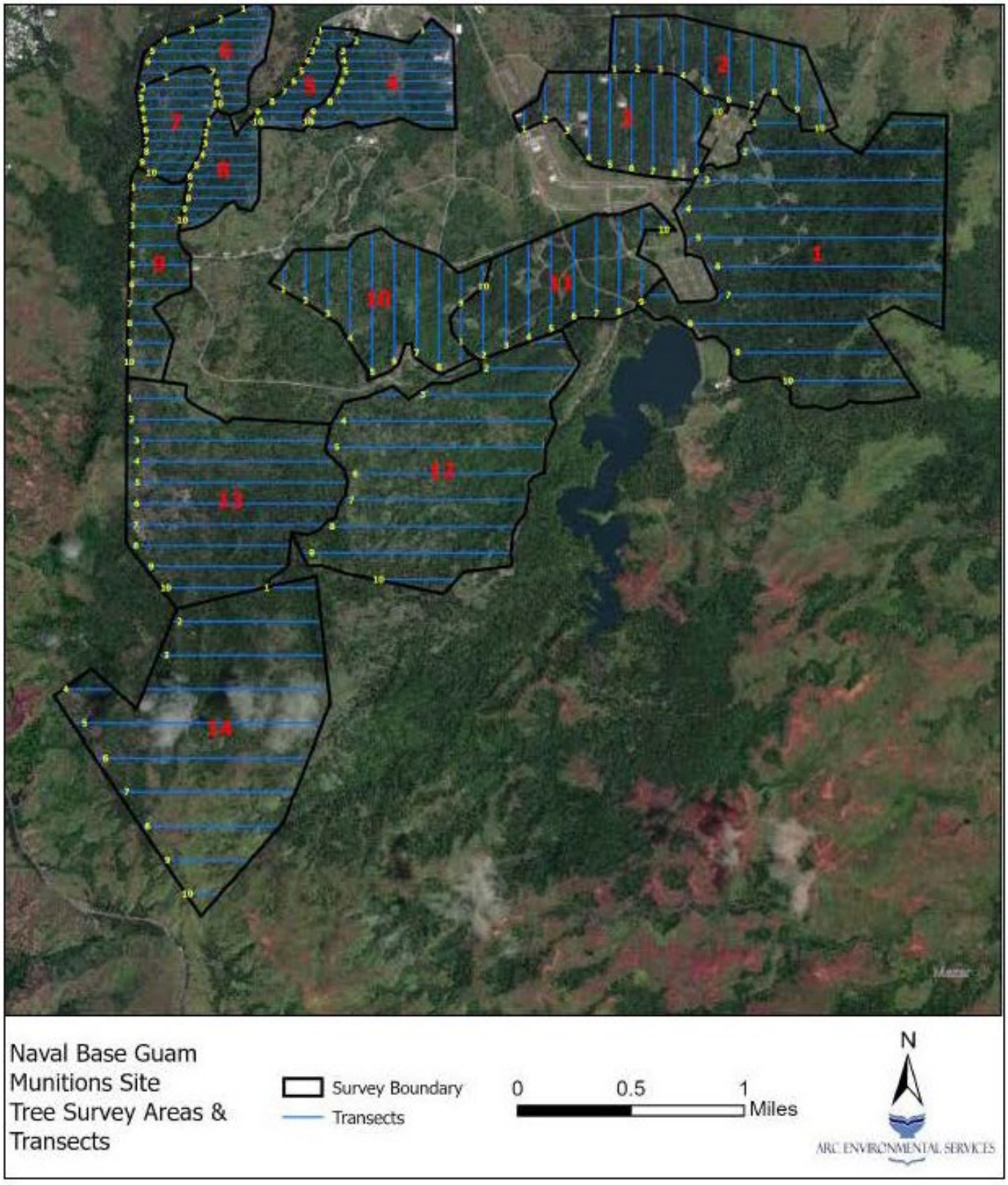


Figure 60. NMS tree monitoring locations in to determine density and diversity

Orchid Survivorship

Location: NMS **Period of performance:** JUL2020- MAR2022

Project Objective

Conduct re-occurring surveys of ESA-listed orchids to document life history data.

Conservation benefit

The conservation benefits of the project will ensure self-sustaining, resilient populations to include the use of novel monitoring techniques in the adaptive management of orchid populations.

FY22 Status

- Monitor orchids at 3 NMS survey locations
- 300 individual trees monitored
- Track individual fate/ life history data
- Ongoing data analysis/ comparisons
    - Wet season vs dry season
- Inside and outside fenced areas

EPR: 1 S MAR NBG Endangered Species Monitoring; 61755NR142

2019 JRM INRMP Reference: TPS-1; 6-46

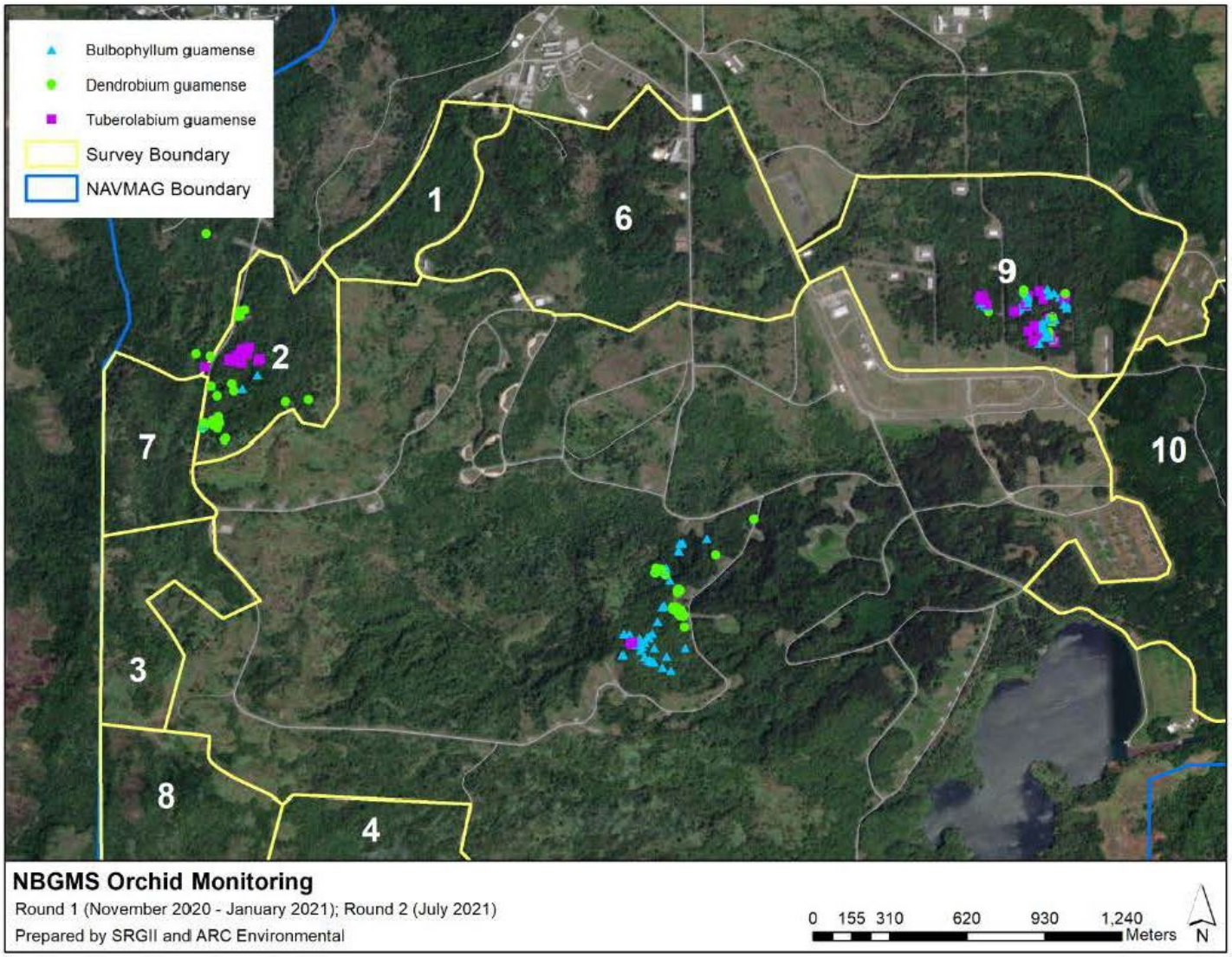


Figure 61. NMS orchid monitoring locations.

Forest Restoration Plan Implementation - NBG

Location: NMS **Period of Performance:** SEP2017 – DEC2022

Project Objective

Restore native forest ecosystems within fenced areas where feral pigs, deer and carabao have been removed on the NMS.

Conservation Benefit

The conservation benefits of the project will ensure self-sustaining, resilient populations to include the use of novel monitoring techniques in the adaptive management of forest resources.

FY22 Status

- Established monitoring plots inside and outside fenced areas
- Treat Vitex and monitor canopy light levels
- Propagate and outplant native species
- Establish experimental seeding plots

EPR: 1 S MAR NBG Endangered Species Monitoring; 61755NR142

2019 JRM INRMP Reference: THM-2; 6-39

Table 8. Survival rates of species found inside and outside fenced forest restoration unit

Location	Species	Survival
Inside	*G. mariannae*	Alive = 21 (70%)
		Dead = 9 (30%)
	I. bijuga	Alive = 18 (60%)
		Dead = 12 (40%)
	I. triantha	Alive = 23 (77%)
		Dead = 7 (23%)
	M. multiglandulosa	Alive = 13 (43%)
		Dead = 17 (57%)
	P. pedunculata	Alive = 0 (3%)
		Dead = 30 (97%)
Outside	*M. cylindrocarpa*	Alive = 1 (6%)
		Dead = 16 (94%)
	I. bijuga	Alive = 0 (0%)
		Dead = 30 (100%)
	I. triantha	Alive = 0 (0%)
		Dead = 30 (100%)
	M. multiglandulosa	Alive = 0 (0%)
		Dead = 30 (100%)
	P. pedunculata	Alive = 0 (0%)
		Dead = 30 (100%)

Forest Restoration Plan Implementation- Forest Restoration Unit (FRU) 2

Location: NMS **Period of Performance:** SEP2017 – DEC2022

Project Objective

To manage invasive species within the FRU 2 and restore native habitat.

Conservation Benefit

Increasing native forest habitats would improve native species survival, particularly threatened and endangered species, enhance native habitat for listed animals, increase the biodiversity of native species, and contributes to the connectivity with surrounding communities in ways that support improved ecosystem functionality. It also contributes to the goals of the Guam NWR as an overlay unit the NMS.

FY22 Status

- Monitoring plot locations and initial measurements
- Development of Biological Assessment to conduct Vitex removal ongoing

EPR: 61755NR856 SIKES MAR NBG Native Forest Habitat Restoration – Climate

2019 JRM INRMP Reference: THM-2; 6-39

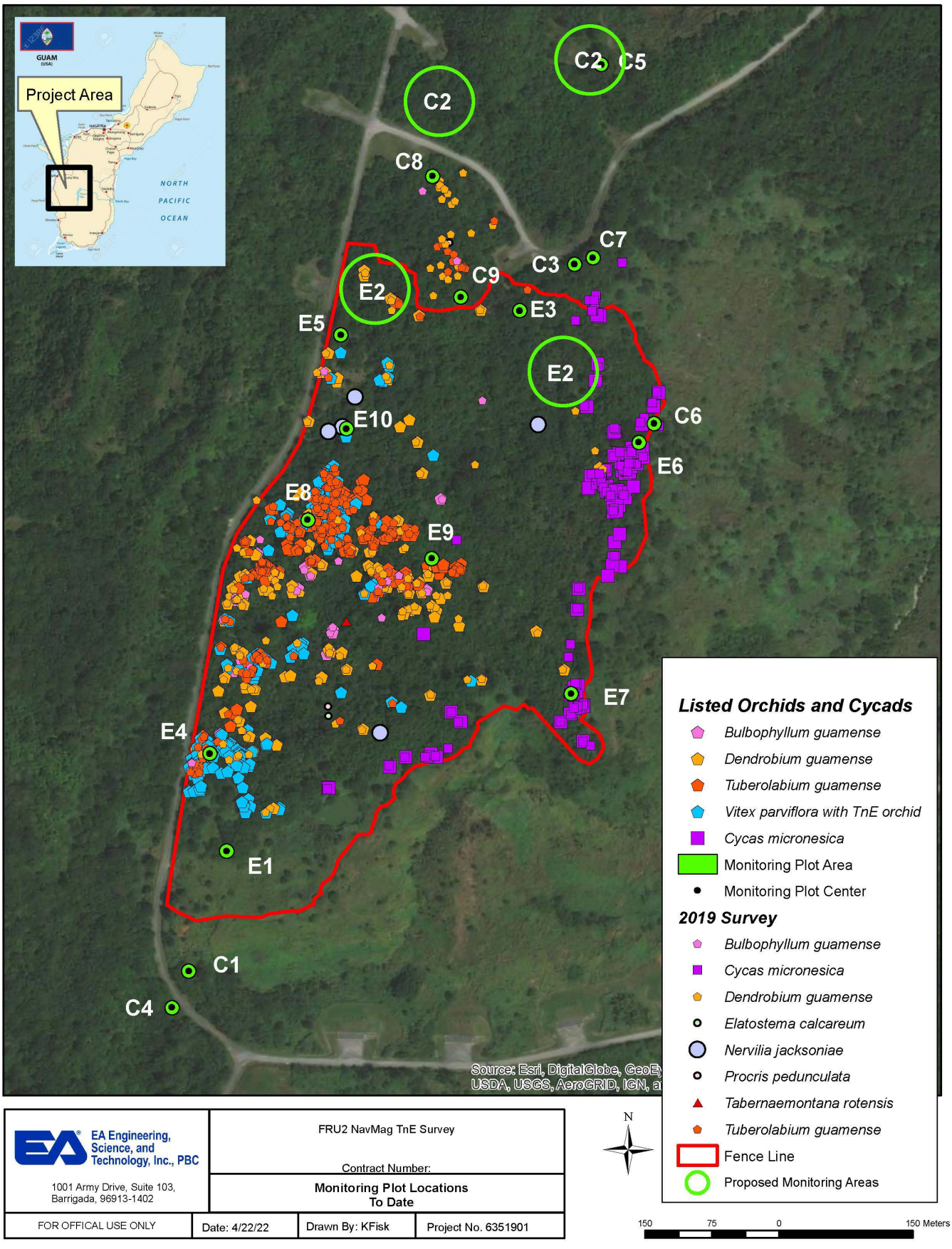


Figure 62. Monitoring plot locations

Forest Restoration at Achae Point

Location: AAFB **Period of Performance:** JUL2021 – Ongoing

Project Objective

Restore native vegetation component to limestone forest rehabilitation site.

Conservation Benefit

Enhance and restore habitats, reduce habitat fragmentation, increase populations of native species, and buffer protected areas.

FY22 Status

- 56 *Serianthes nelsonii* saplings outplanted to the Route 3A plot
- Protective cages are regularly repaired; winds frequently tear the protective screens and expose the trees to harmful pests
- Water for *S. nelsonii* saplings needs to be hauled in frequently and is very labor intensive
- Total of 1082 native plant species outplanted at the Route 3A plot as of July 2022
- Monitoring and maintenance of the 56 *S. nelsonii* saplings and future forest restoration work moved from *S. nelsonii* Cooperative Agreement to the Vegetation Restoration Cooperative Agreement

EPR: 1 CR MAR AFB Native Forest Habitat Restoration; M5240NR067

2021 JRM INRMP Reference: THM-1; 9-68



Figure 63. Serianthes nelsonii sapling outplanted at Route 3A

Vegetation Restoration for the Habitat Management Unit (HMU)

Location: AAFB **Period of Performance:** JUL2021 – JUL2022

Project Objective

Implement vegetation restoration within the Habitat Management Unit (HMU) utilizing the 2017 HMU Vegetation Restoration Plan.

Conservation Benefit

Enhance and restore habitat and maintain or increase populations of threatened and endangered species, including those extirpated from Guam and potentially reintroduced within the HMU.

FY22 Status

- Ongoing project with UOG CESU
- Experimental edge plots and 30m x 30m plots being monitored.
- Experimental 1 acre plot has begun and is successful
- Outplanted species will include species to increase habitat quality for Marianas fruit bats, e.g., *Artocarpus mariannensis* and *Ficus* sp.
- For the coming year will do 20-30, 1 acre plots
- Formal Section 7 consultation will be initiated
- Complete reforestation can be completed in 5-7 years

EPR: 1 CR MAR AAFB Native Forest Habitat Restoration; M5240NR067

2019 JRM INRMP Reference: THM-1; 9-68

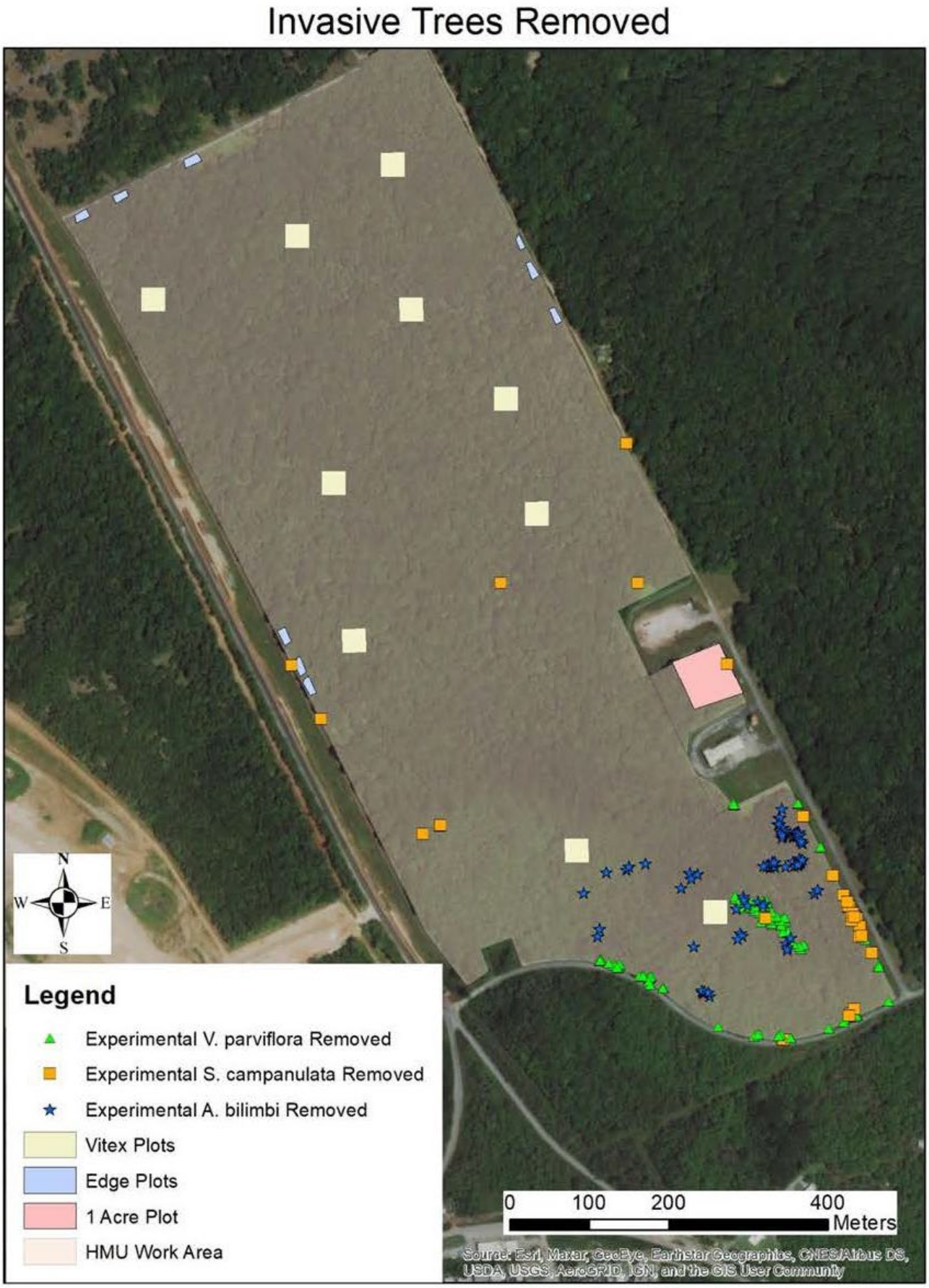


Figure 64. HMU experimental plots

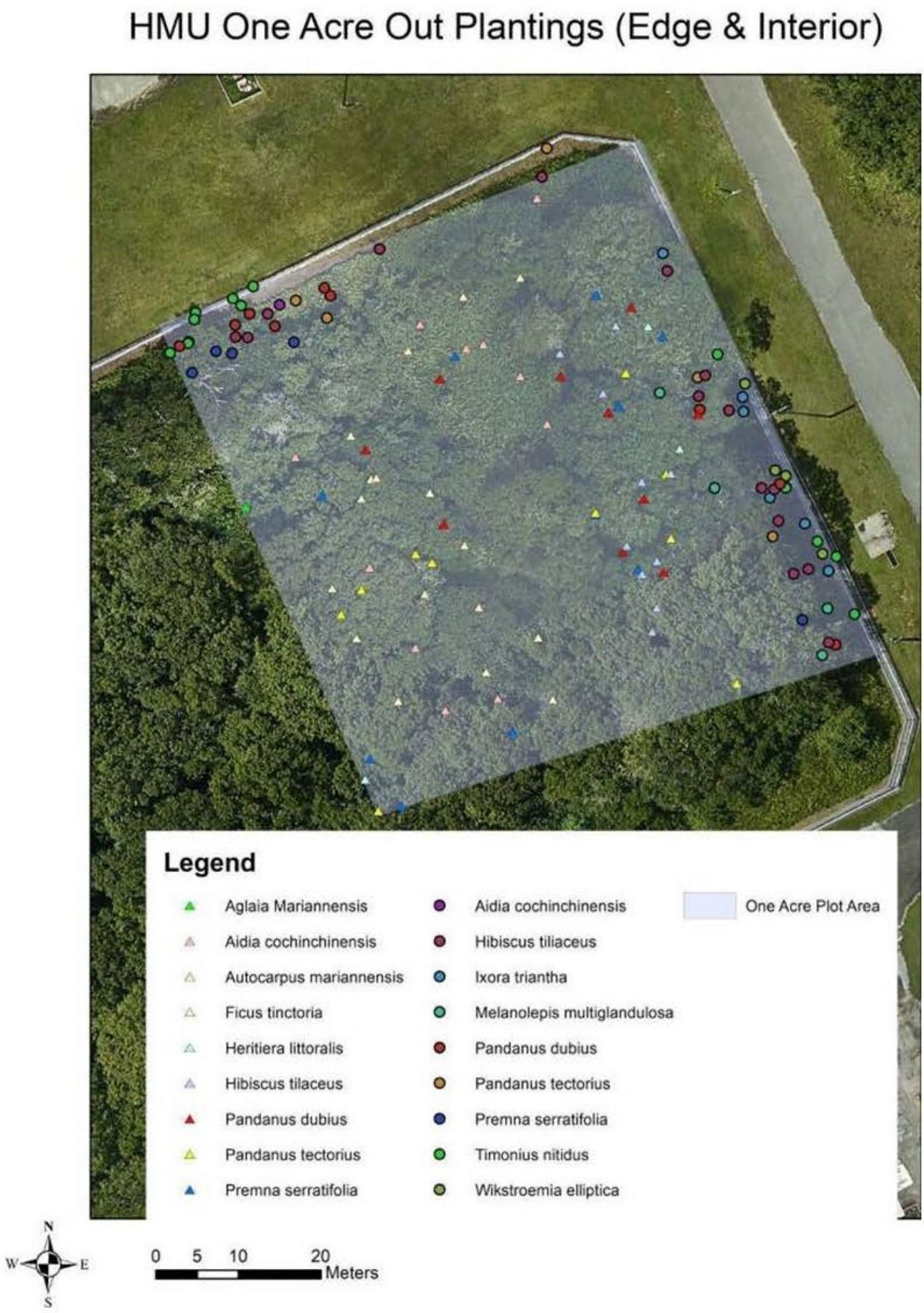


Figure 65. 1 acre plot outplantings

Implementation Plan for Caiguat Forest Enhancement Site

Location: MCBCB **Period of Performance**: JUL2019 – JAN2023

Project Objective

Develop site specific plans for the Caiguat FES Phase 1 and 2, as well as the Finegayan Forest Enhancement Site.

Conservation Benefit

The plan will streamline regulatory compliance, provide guidance on species selection and outplanting design, and develop invasive plant removal options that are applicable to future forest enhancement projects.

FY22 Status

- Phase 1 plan in review
- Phase 2 plan in development
- Planning efforts for Finegayan FES began in FY2022

DPRI: Marine Corps Relocation 2017/2018 amendment to 2015 BO, Conservation Measures to Contribute to the Recovery of Listed Species

Reference: Guam Relocation Biological Opinion

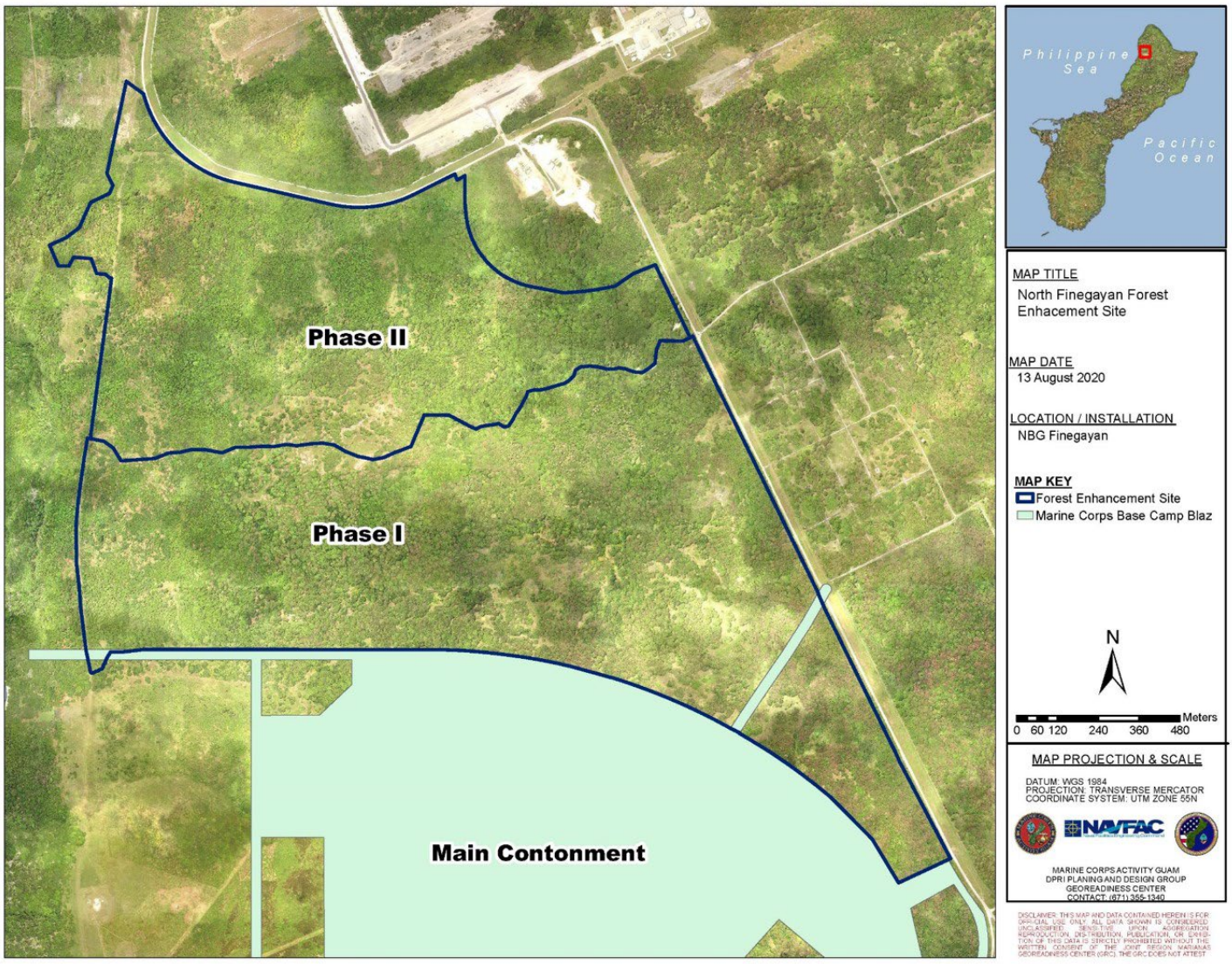


Figure 66. The North Finegayan Forest Enhancement Site (FES) has been renamed the Caiguat FES to reflect place names from historic maps.

Irrigation and access for Caiguat Forest Enhancement Site

Location: MCBCB **Period of Performance**: SEP2021 – MAR2023

Project Objective

Complete full surveys for listed species within Caiguat FES, and create access pathways and irrigation backbones for future outplanting work in the site.

Conservation Benefit

The Caiguat FES will have large-scale invasive plant removal and native plant outplanting. This project will facilitate future work in the site by providing access and water to support maintenance and monitoring.

FY22 Status

- Surveys for federally listed plants, snails and butterflies completed for Caiguat FES Phase 1
- Surveys for Phase 2 are planned to begin 2023
- Irrigation and access path plans for Phase 1 are under review, with installation expected to begin in September 2022
- Design and installation of Phase 1 access and irrigation anticipated to begin in 2Q FY23

DPRI: Marine Corps Relocation 2017/2018 amendment to 2015 BO, Conservation Measures to Contribute to the Recovery of Listed Species

Reference: Guam Relocation Biological Opinion

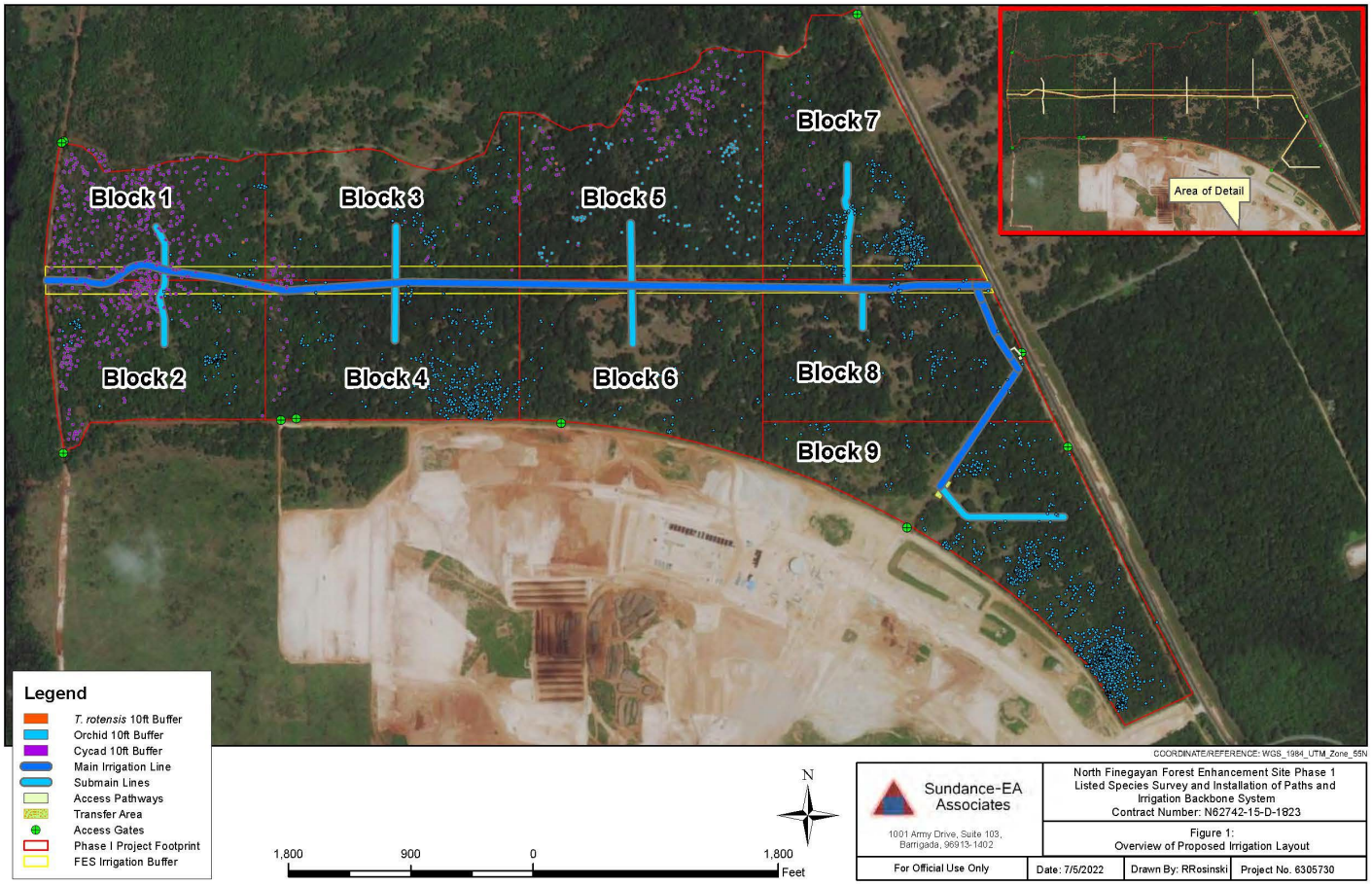


Figure 67. Proposed layout for irrigation and access paths in Caiguat FES Phase 1

Cetti Bay Watershed Terrestrial Monitoring

Location: NMS **Period of Performance**: MAR2022 - MAR2024

Project Objective

Annual survivorship and growth rate monitoring of acacia plantings and to document soil runoff and stream turbidity within the Cetti Bay Watershed.

Conservation Benefit

Monitoring will facilitate understanding of the effectiveness of the ridge to reef concept. The effort will detail how effective the acacia tree plantings are in improving Cetti Bay watershed and, ultimately the health of marine resources, given the environment and site history of annual fires.

FY22 Status

- UoG completed a 3-year study in 2022
- Average area of *Acacia* basal increased
- 58.8% (or, 2,313 m) forested area.
- -0.5 mm average erosion (n=4 sites)
- FY22 monitoring contract awarded

EPR: USACE Permit, NBG Reforestation Site, Cetti Bay; 61755NR896

2019 JRM INRMP Reference: THM-2; 6-39

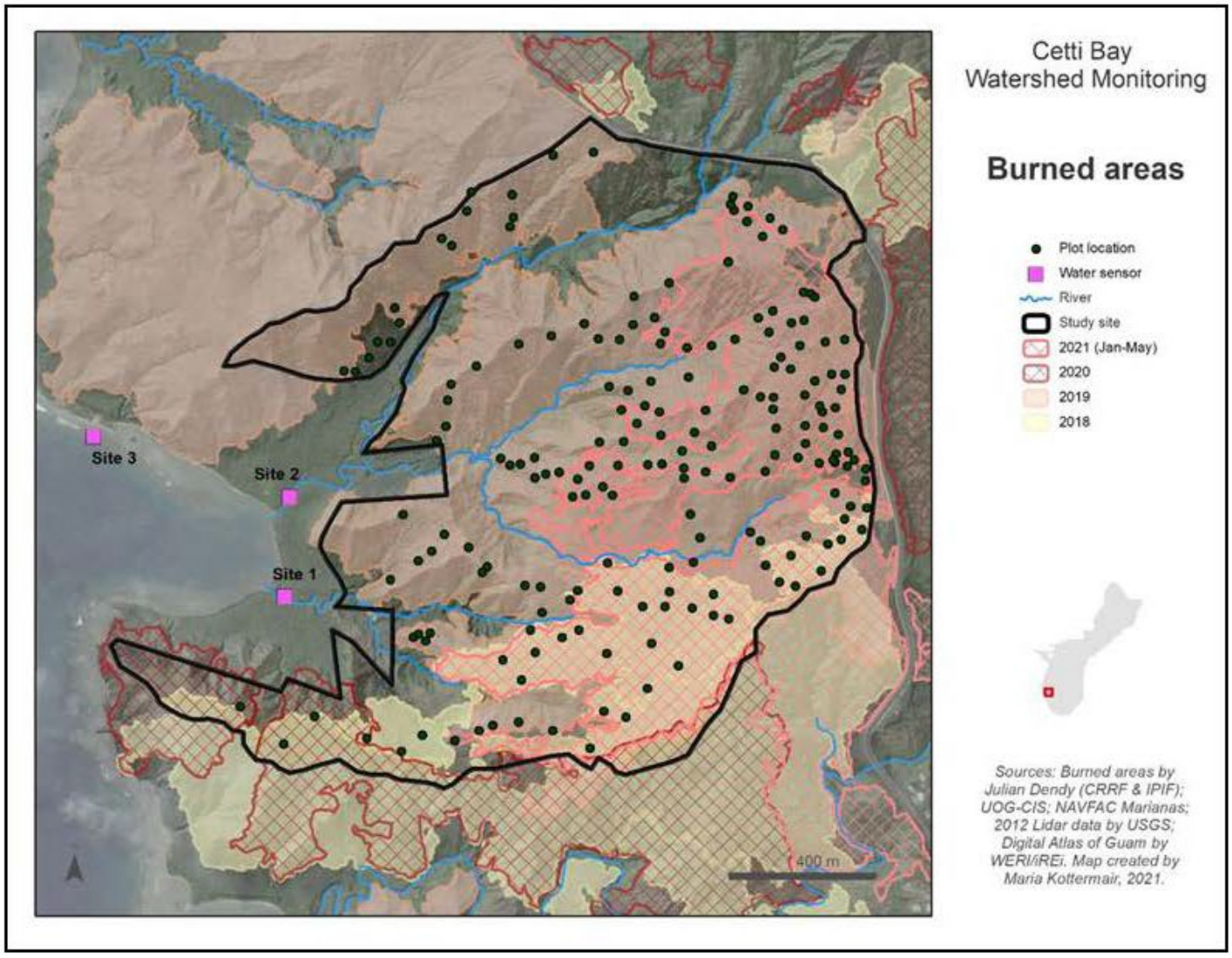


Figure 68. A map of the tree monitoring plots and burned areas in the Cetti watershed each year.

Fire Management Plan Implementation - NBG

Location: NMS **Period of Performance**: SEP 2021 – SEP2022

Project Objective

Protect natural resources on NMS by reducing habitat degradation (*i.e.* soil erosion and vulnerability to invasive plant establishment) resulting from wildland fires.

Conservation Benefit

Controlling fuels (*i.e.* swordgrass) in strategic locations creates buffers/ fuel breaks and protects sensitive natural resource areas and enhances existing conservation areas.

FY22 Status

- 5 acre fuel treatment parcel was identified for management, adjacent to NMS Fire Break 5 and Cotal Forest Reserve in eastern NMS. The site is part of Fire Management Unit #1.
- Treatment of fuels include initial, mechanical removal of flammable grasses followed by chemical treatment (herbicide applications) to limit re-sprouting.
- Future use of site may support *Acacia* or other native savannah out-plantings.

EPR: 1 RP MAR NBG Wildland Fire Management Plan (2015) Implementation through Habitat Management; 61755NR857

2019 JRM INRMP Reference: THM-3; 6-41



Figure 69. Project location for implementing NBG Fire Management Plan fuels reduction. Swordgrass targeted for control is hashed area; small patches are orange dots.

Soil and Water Conservation - NBG

Location: NMS **Period of Performance**: AUG 2020 – SEP2023

Project Objective

Maintain, protect, and enhance water quality and contain/minimize runoff into watersheds and ultimately marine waters.

Conservation Benefit

Stabilization of soils in erosion prone areas reduces sediment runoff into watersheds and benefits supports a ridge-to-reef ecosystem approach. Identification and stabilization of areas with high erosion rates will ultimately reduce sediment loads that drain to coastal waters and minimize potential impacts to coral reefs.

FY22 Status

- Outplantings focus on south of Fena Reservoir
- 62% success rate (n=72,000 shrubs planted)
- Successful taxa include *Pandanus* spp., and *Calophyllum inophyllum.*
- *Hibiscus tiliaceus*, *Morinda citrifolia*, and *Scavola taccada* are heavily browsed, driving low success rates
- 86% success rate of *Vetiveria zizanoides* (n>10,000 plugs)
- Project constraints
    - Available planting area
    - Browse pressure
    - Mobilization

EPR: CHS JRM NBG Soil and Water Conservation: stabilization of eroding streambanks and cliff/ravine; 61755NR832

2019 JRM INRMP Reference: THM-1; 6-39

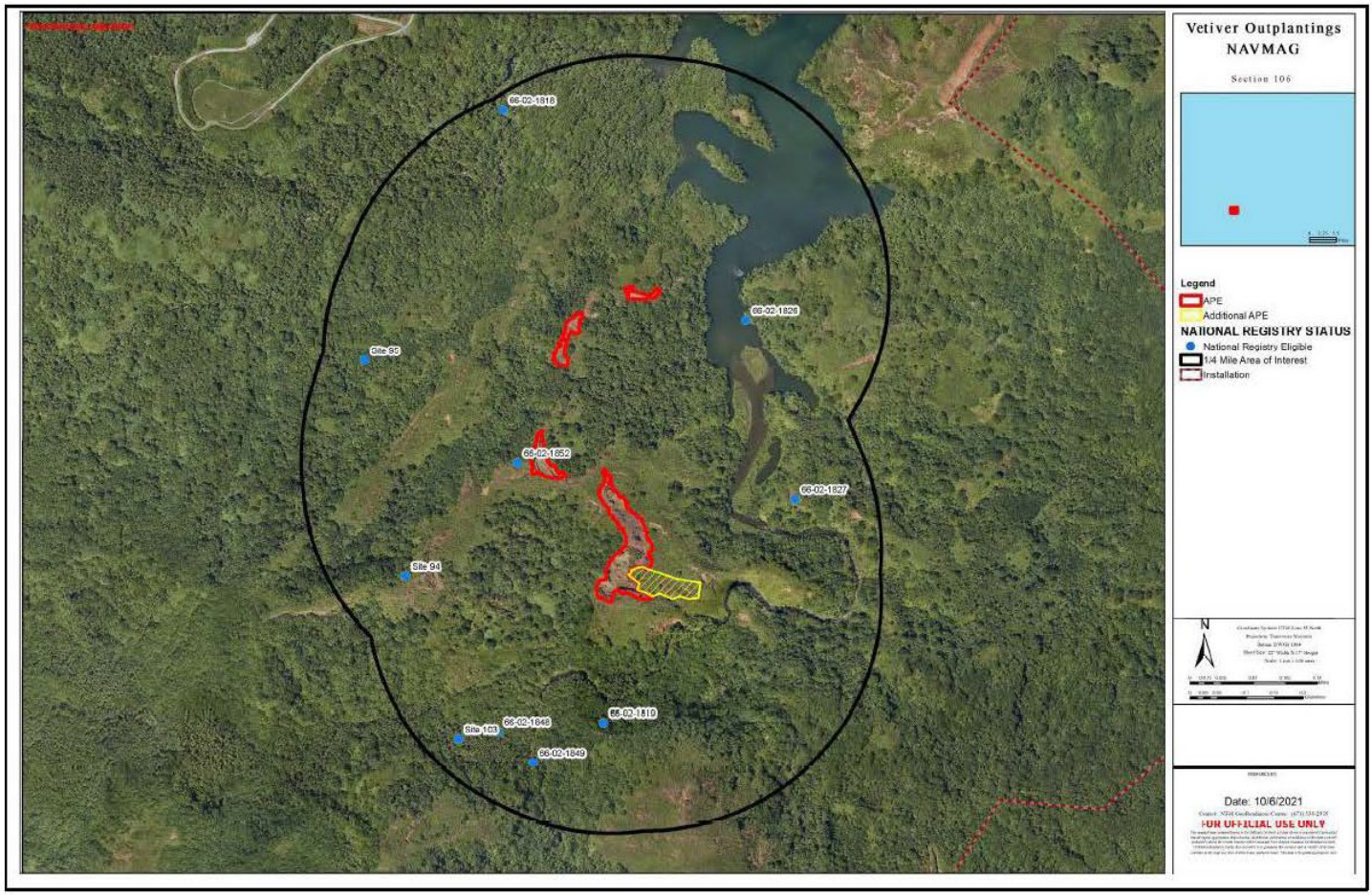


Figure 70. NMS location of project, south of Fena Reservoir above Imong River.



Figure 71. Example of vetiver grass plantings in project location.

Range Fire Management Plan for Marine Corps Ranges on Guam

Location: MCBCB **Period of Performance**: SEP2017 – SEP2021

Project Objective

Develop a range fire management plan to reduce wildfire potential to protect natural and cultural resources, integrate applicable permit and reporting requirements, and implement ecosystem management goals, sustainable training, and objectives already supported on existing Marine Corps installations.

Conservation Benefit

The fire management plan provides operational and management guidance to minimize the risk of fire to limestone forest habitats and the species that depend upon them.

FY22 Status

- Draft document was submitted to FWS for review
- DON is currently addressing FWS comments

DPRI: Marine Corps Relocation 2017/2018 amendment to 2015 BO, Conservation Measures to Contribute to the Recovery of Listed Species

Reference: Guam Relocation Biological Opinion



Figure 72. Mushroom found on site.

Fuels Management at Mason Live Fire Training Range Complex

Location: MCBCB **Period of Performance**: Pre-award

Project Objective

Eliminate tall grasses and similar non-native vegetation to reduce the risk of fire spreading in the range complex.

Conservation Benefit

Control of invasive grasses will reduce the risk of fire impacting limestone forest areas of the range complex. Removal of these grasses also will allow native limestone forest species to re-establish in areas that have become dominated by grasses.

FY22 Status

- Pending award; target award date is September 2022

DPRI: Marine Corps Relocation 2017/2018 amendment to 2015 BO, Conservation Measures to Contribute to the Recovery of Listed Species

2019 JRM INRMP Reference: THM-3; 6-41, THM-1; 9-68



Figure 73. MCBCB Biosecurity Manager Jerome Perez inspects the range complex for invasive grasses.

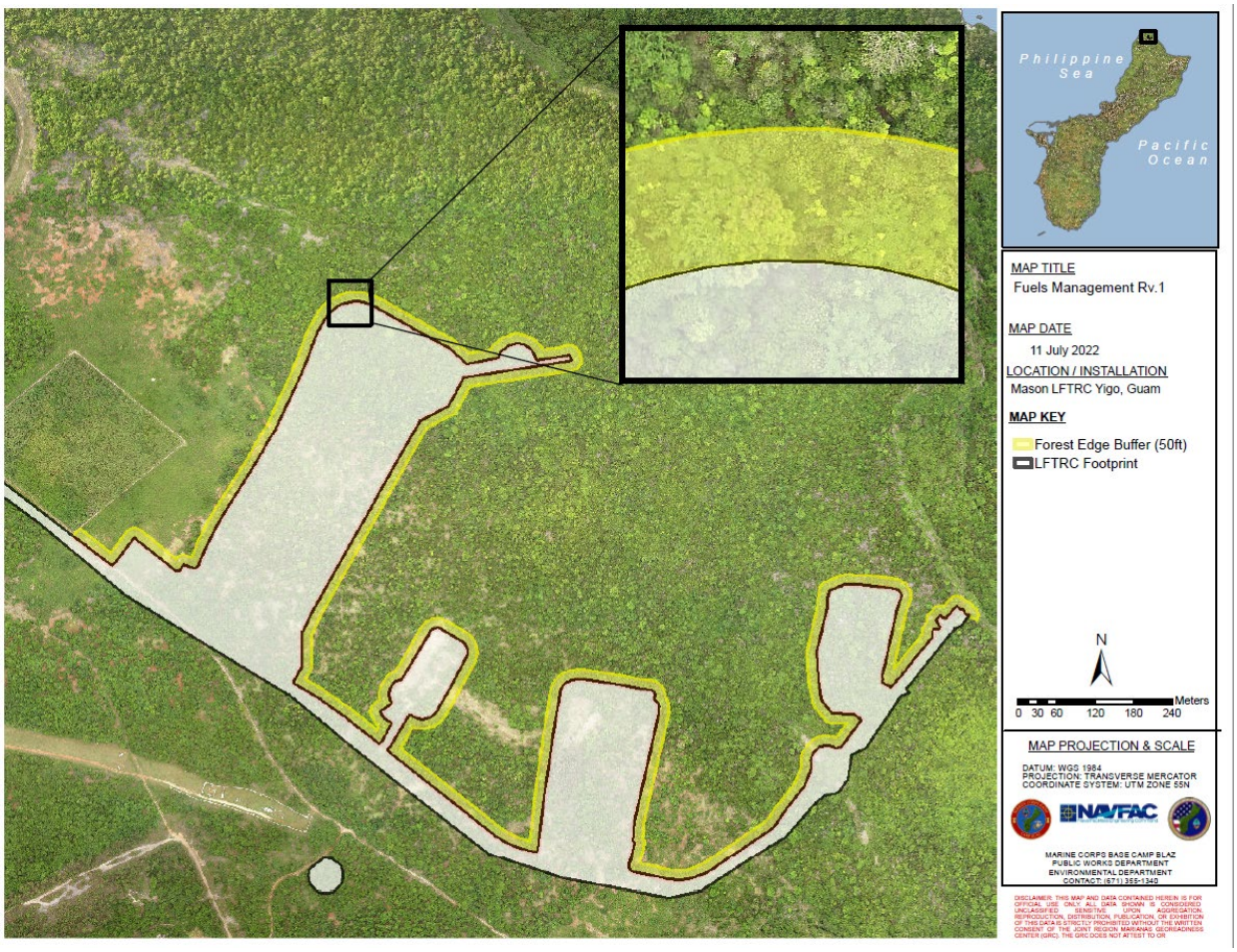


Figure 74. Map depicting fuels management areas within the Mason LFTRC.

Ungulate Fencing on NBG - NMS

Location: NMS **Period of performance:** SEP2021 - Ongoing

Project Objective

The objective is to protect and manage sufficient habitats by securing and managing unprotected areas or rare or unique habitats.

Conservation benefit

The installation effort facilitates the revitalization of native habitats that support viable populations of native and ESA-listed species, increases biodiversity, and promotes ecosystem health. Ungulate fence construction is the first step of the applied ecosystem approach to resource management, as defined in the INRMP.

FY22 Status

- NMS ungulate fence #4 construction underway
    - Enclosed area approximately 70 acres
- Quarterly monitoring of NMS ungulate fence CEMML
- Ungulate monitoring and removal, as needed (e.g. breaches)
- 455 acres constructed and contracted

EPR: 1 RP MAR NBG Ungulate Fencing; 61755NR894

2019 JRM INRMP Reference: THM-2; 6-39

Table 9. NMS ungulate fence status overview

FY	NMS Region	Name	Hectares/Acres	Status
FY17	Alifan Ridge	Alifan Conservation Fence #1	32/80	Constructed and ungulate free
FY18	East of High Road	NMS Conservation Fence #2	29/71	Constructed, and ungulate free November 2021
FY19	Alifan Ridge South	Alifan South Conservation Fence #3	30/73	Construction TBD
FY21	Central NMS	Parsons Road Conservation Fence #4	28/70	Construction underway
FY22	Central NMS	Parsons Road North Conservation Fence #5	62/155	Contract FY23 Q1
FY23-24	Eastern NMS	TBD/ Maemong River Fence	TBD	TBD

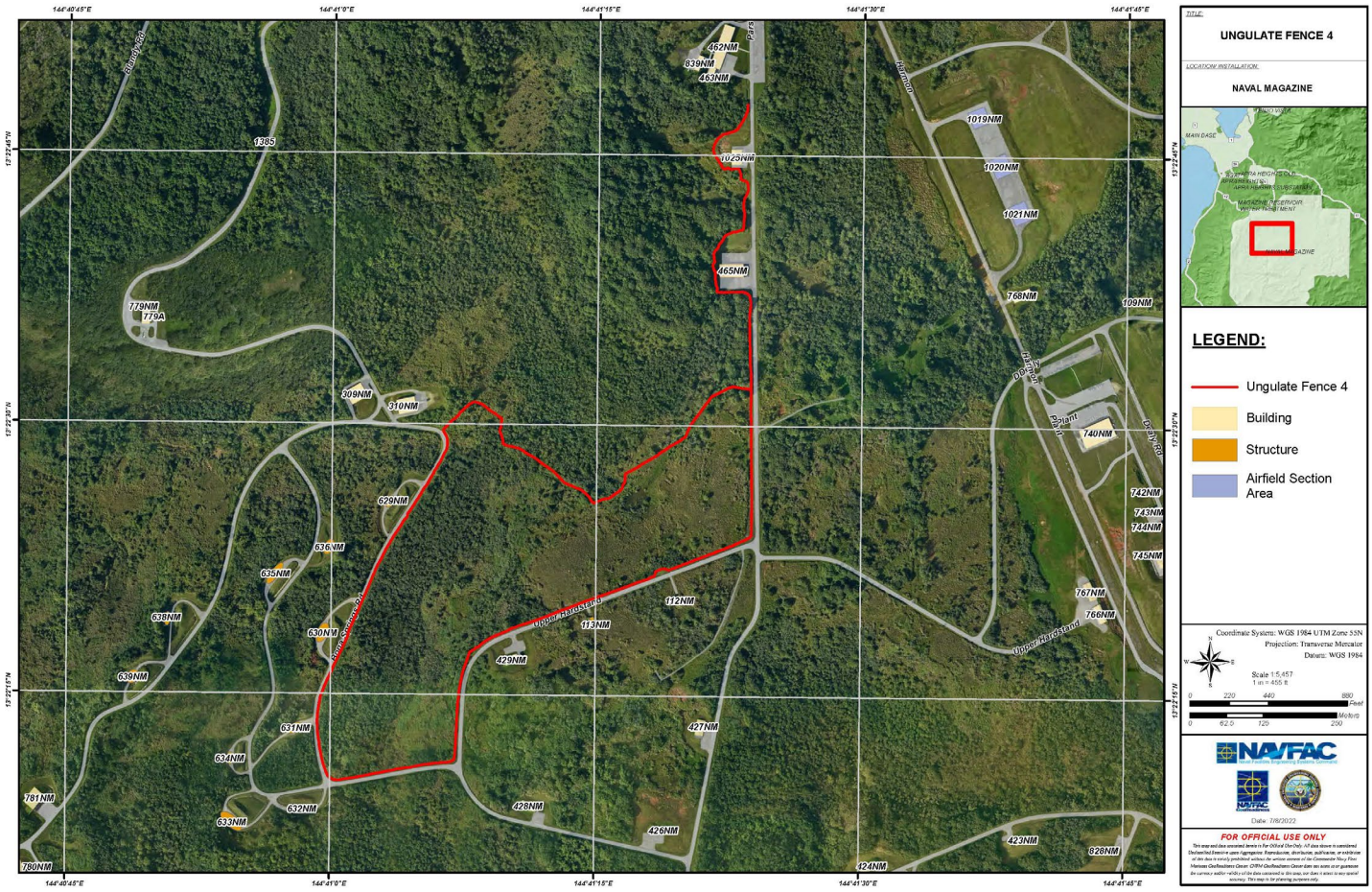


Figure 75. NMS ungulate fence #4 location

Ungulate Control and Eradication on NBG-Administered Lands

Location: NBG; NMS **Period of performance:** SEP2021 - Ongoing

Project Objective

Maintain or enhance ecological function and diversity through control and eradication of established invasive species, particularly ungulates.

Conservation benefit

To allow for multiple INRMP projects to commence, reducing a primary stressor from multiple habitats and ESA-listed species.

FY22 Status

- Pig trapping
  - Removed 34 on NBG Camp Covington
  - Removed 36 removed on PP
- Canine detection dogs and net partition
  - Removed 3 pigs NMS Alifan CF #1 (breach)
  - Removed 41 deer on NBG CF #2
- Sterilization of 6 carabao (n=76)

Table 10. Ungulate control density estimates on NBG.

	Alifan Conservation Fence #1	NMS Conservation Fence #2	Naval Base Guam	Polaris Point
Number of Days	8	15	4	3
Acres	78	64	346	47
Deer Removed	0	41	0	0
Deer Density	0/ac.	0.64/ac.	0/ac.	0/ac.
Pigs Removed	3	0	34	36
Pig Density	0.04/ac.	0.64/ac.	0.10/ac.	0.77/ac.
Ungulate Density	0.04/ac.	0.64/ac.	0.10/ac.	0.77/ac.

EPR: 1 RP MAR NBG Ungulate Management Population Control; 61755NR807

2019 JRM INRMP Reference: TIS-2, TIS-3; 5-85, 6-43



(Yellow = Alifan Conservation Fence #1; Orange = NMS Conservation Fence #2; Blue = Carabao Capture Area; Red = Naval Base Guam; Green = Polaris Point)

Figure 76. FY21 Ungulate control and eradication locations on NBG.

Ungulate Fencing – AAFB

Location: AAFB **Period of Performance:** SEP2019 – AUG2020

Project Objective

Construct ungulate fencing on AAFB to facilitate eradication of feral pigs (*Sus scrofa*) and Philippine deer (*Rusa marianna*) as well as prevent immigration of ungulates within fenced areas.

Conservation Benefit

Supports ungulate eradication goals within fenced areas (Figure 76). Ungulate eradication facilitates the revitalization of native habitat that supports viable populations of native species, increases the biodiversity of native species, and contributes to the connectivity with surrounding communities in ways that support improved ecosystem functionality. Contributes to the goals of the Guam NWR as an overlay unit on AAFB.

FY22 Status

- Notice to Proceed for Tarague Basin Conservation Area II fence received July 2022
- Shall enclose approximately 74 acres (30 hectares) of conservation area
- Plans in FY23 includes (1) complete the construction by June 2023
- (2) Initiate ungulate eradication will upon completion (3) FY23 funds for constructing second Tarague Basin Conservation Area II fence

EPR: 1 RP MAR AAFB Ungulate Fencing; M5240NR043

2019 JRM INRMP Reference: THM-1; 9-68

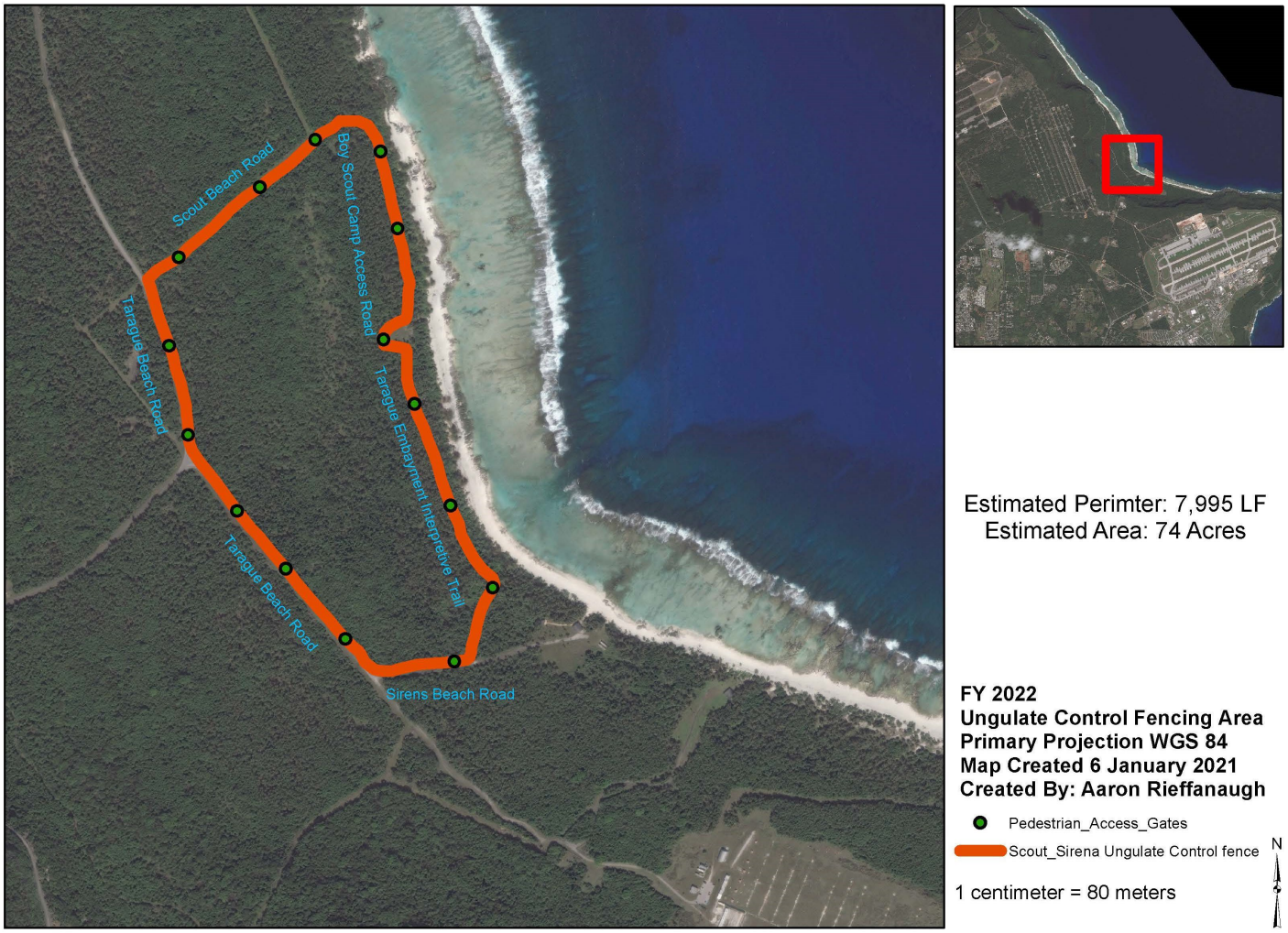


Figure 77. Taragüe Basin Conservation Area Fence II.

Maintenance of Ungulate Exclosures

Location: AAFB **Period of Performance:** AUG2021 – JUL2022

Project Objective

Maintain a three foot buffer, clear of vegetation, on each side of the fence to reduce the possibility of damage. Conduct inspections quarterly and immediately after any high wind events (≥39 mph or ≥34 knots wind speed) on foot or via vehicle where applicable. Perform minor maintenance and repairs to prevent ingress of fence as needed.

Conservation Benefit

The routine maintenance and repair of ungulate exclosures will enhance the longevity of the ungulate barrier. Regular fence monitoring and repair also has the benefit of early detection to any possible immigration of ungulates into fenced eradicated areas. Monitoring, maintenance and repair all support the purpose of facilitating ungulate-free areas to enhance native forest ecosystem regeneration.

FY22 Status

- Cooperative agreement for clearing, monitoring and maintenance of ungulate fence at Tarague Basin Conservation Area awarded July 2022
- Vegetation has been removed within the three foot buffer along the fence-line
- All minor repairs have been completed
- No major damages have been reported as yet
- Plans in FY23 include (1) continue status quo for maintenance and monitoring (2) add the FY22 fence to the maintenance/monitoring cooperative agreement

EPR: 2 BO MAR AAFB Maintenance of Ungulate Exclosure; M5240NR045

2019 JRM INRMP Reference: THM-1; 9-68



Map Created 23 Jan 2019
Primary Projection: WGS 1984

Tarague Ungualte Fence Perimeter

Pedestrian Gate

N

Approximate Fence Length
West Side: 4593ft.
East Side: 4082ft.
South Side: 1210ft.
Total Estimated Fence Lenth: 9985ft.
Total Acres: 81.08 Total Hectares: 32.81

0 0.045 0.09 0.18 0.27 0.36
Miles

Figure 78. Tarague Basin Conservation Area Fence I

Monitor Ungulate Populations with Trail Camera Distance Sampling

Location: AAFB **Period of Performance:** OCT2021 – SEP2022

Project Objective

Develop an efficient monitoring method utilizing trail cameras to capture data and analyze using distance sampling methodology in order to estimate ungulate densities and monitor the populations on AAFB.

Conservation Benefit

This will allow the assessment of the efficacy of ungulate control programs; what percentage of the population is being removed on an annual basis and assess recolonization rates after ungulate control in unfenced areas. Frequency and intensity of ungulate control in unfenced areas can then be decided upon.

FY22 Status

- Method development performed by Pacific Islands Ecosystems Research Center
- Data collected and undergoing analysis at present

EPR: 1 CP MAR AAFB Ungulate Eradication and Control; M5240NR069

2021 JRM INRMP Reference: THM-1; 9-68



Figure 79. Trail camera photo showing distance marking flags and deer. The deer is between 2m and 3m from the camera.

Ungulate Eradication and Control

Location: AAFB **Period of Performance:** AUG2021 – JUL2022

Project Objective

To remove feral pigs (*Sus scrofa*) and Philippine deer (*Rusa marianna*) from AAFB to reduce risk to mission activities, human safety, protection of government property and natural resources conservation with a focus on the DoD mission.

Conservation Benefit

Enhance and restore habitats to increase populations of native species, particularly threatened and endangered species, as well as promote biodiversity of native plants. Reduce ground disturbance from ungulates to improve soil stabilization and reduce suitability of invasive plant species.

FY22 Status

- Ungulate Management Program removed a total of 1,658 deer and 318 pigs from Main A/B, MSA 1, NWF, Tarague and Upi (Figure 79)
- Volunteer Conservation Officer program and other Depredation teams removed 1284 deer and 107 pigs
- White Buffalo, Inc. removed 374 deer and 171 pigs from Main A/B, NWF and Tarague Basin
- Pig trapping by USDA Wildlife Services removed 40 pigs from August – December 2021
- Plans in FY23 includes (1) continue status quo for ungulate removal (2) work with the Command to reopen recreational hunting on base to eligible personnel

EPR: 1 CP MAR AAFB Ungulate Eradication and Control; M5240NR069

2019 JRM INRMP Reference: THM-1; 8-69

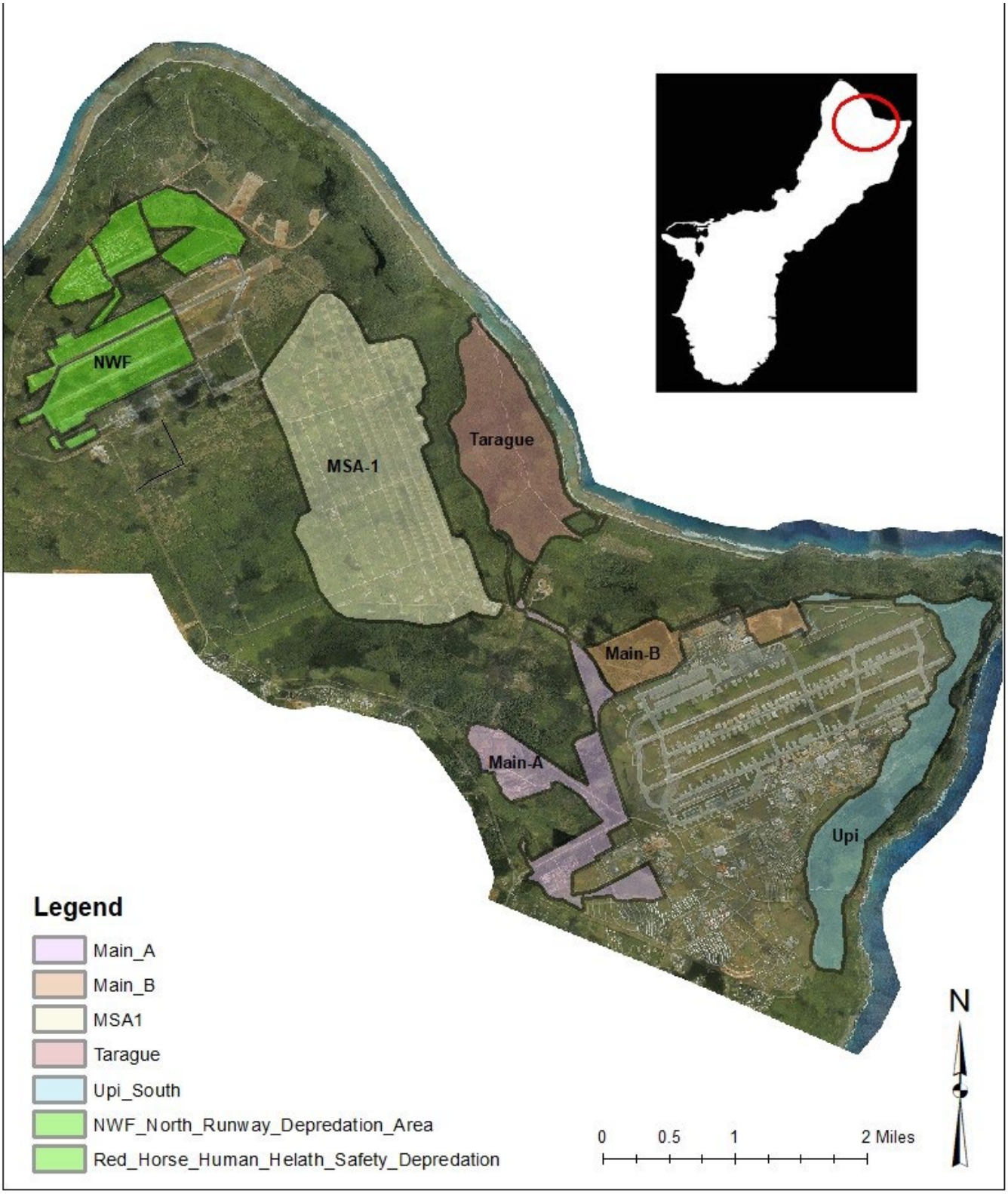


Figure 80. Map of Current AAFB Depredation Areas.

Maintenance of BTS Barrier at the HMU

Location: AAFB **Period of Performance:** AUG2021 – JUL2022

Project Objective

Monitoring and maintenance of the Brown Tree Snake Barrier in order to maintain its efficacy. Project includes: 1) Inspections, via walking or driving, weekly and immediately after any high wind events (≥39 mph or ≥ 34 knots wind speed). 2) Maintaining three-foot vegetation buffer on each side of the fence. 3) Removing any type of objects (praying mantis egg cases, mud wasp nests, dried slugs, crabs, chunks of mud, vines, etc.) that have adhered to the exterior of the barrier wall. 4) Conducting minor maintenance and repairs as needed. 5) Conducting barrier wall replacement and painting of vertical (lower) and upper (bulge) mesh sections due to damage or corrosion and pressure-wash sections of the mesh and concrete base. (Figure 80)

Conservation Benefit

The routine maintenance and repair of the BTS barrier shall enhance the longevity of its efficacy. Monitoring, maintenance and repair all support the purpose of facilitating BTS-free areas to protect Mariana fruit bat (*Pteropus mariannus*) pups and possible future reintroduction of other endangered bird species.

FY22 Status

- Vegetation has been removed within the three foot buffer along the fence-line
- All foreign objects that were attached to the barrier wall were removed
- All minor repairs have been completed, no major damages have been reported as yet
- Approximately 1,237 lf of the barrier wall was replaced/painted (blue line), 142 lf of the upper bulge section was replaced/painted (yellow line), and 2,800 lf of the barrier wall was power-washed (red line)

- Plans in FY23 include (1) continue status quo for maintenance and monitoring; (2) scope maintenance of vegetation above 20 ft.; (3) scope more fence to power-wash and/or replace

EPR: 1 CR MAR AAFB BTS Barrier Maintenance in HMU; M52401000

2021 JRM INRMP Reference: THM-1; 9-68

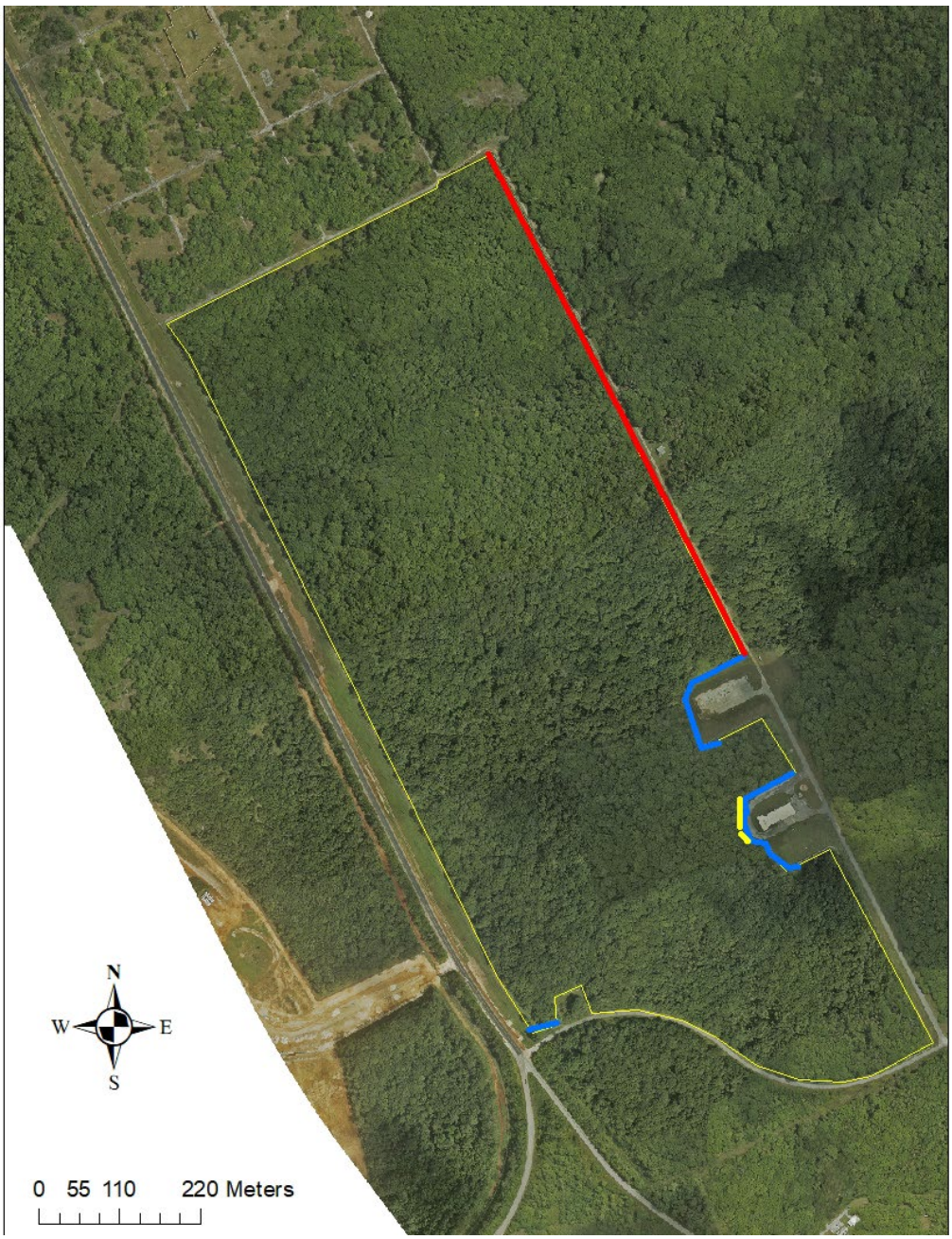


Figure 81. HMU fence replacement and power-washing

Haputo Ecological Reserve Area Ungulate Fencing and Eradication

Location: MCBCB **Period of Performance**: AUG2019 – Ongoing

Project Objective

Eradicate pigs and deer from the 280-acre Haputo ERA.

Conservation Benefit

Pigs and deer dramatically change Guam's native vegetation and damage habitats needed for federally listed species as well as other native species. Ungulate-proof fencing and eradication of pigs and deer will promote forest regrowth, promote biodiversity, and protect limestone forest habitat important to many native species.

FY22 Status

- Southern Haputo ERA fence completed in FY2022, while northern section fence is ongoing
- Southern fence open on the northern end so animals are not fully enclosed during preparation for eradication
- Eradication expected to begin after protective measures to safeguard listed snail and butterfly populations are installed; target date is Sept 2022

EPR: Guam Micronesia Kingfisher MOA

2019 JRM INRMP Reference: THM-2; 8-48



Figure 82. Fencing ties into natural karst barriers at the southern edge of the Haputo Ecological Reserve Area.



Figure 83. All ungulate control teams must be trained to identify snails like this partulid, as well as listed plant species and bats, before they can work in the Haputo ERA.

Mason Live Fire Training Range Complex Ungulate Control Area Fencing and Eradication

Location: MCBCB **Period of Performance**: JUL2020 – Ongoing

Project Objective

Eradicate pigs and deer from the 600 acre Mason LFTRC at Northwest Field after ungulate-proof fencing is installed.

Conservation Benefit

Pigs and deer dramatically change Guam's native vegetation and damage habitats needed for federally listed species as well as other native species. Ungulate-proof fencing and eradication of pigs and deer will promote forest regrowth, promote biodiversity, and protect limestone forest habitat important to many native species.

FY22 Status

- 4.1 miles of fence completed in March 2022
- Population studies within the LFTRC are ongoing with another round of pig collaring completed in July 2022
- Active removals are ongoing with 6 pigs and 158 deer removed as of July 2022

DPRI: Marine Corps Relocation 2017/2018 amendment to 2015 BO, Conservation Measures to Contribute to the Recovery of Listed Species

Reference: Guam Relocation Biological Opinion



Figure 84. Vegetation at the LFTRC is showing signs of recovery after decades of heavy ungulate pressure.



Figure 85. USDA is conducting a study using collared feral pigs to understand the way pigs use the forest and adjacent spaces.

Caiguat Forest Enhancement Site Ungulate Eradication

Location: MCBCB **Period of Performance**: MAR2020 – OCT2021

Project Objective

Eradicate pigs and deer from the 670-acre Caiguat Forest Enhancement Site.

Conservation Benefit

Pigs and deer dramatically change Guam's native vegetation and damage habitats needed for federally listed species as well as other native species. Ungulate-proof fencing and eradication of pigs and deer will promote forest regrowth, promote biodiversity, and protect limestone forest habitat important to many native species.

FY22 Status

- Caiguat FES is split into a roughly 400-acre southern section and 270-acre northern area
- Pig and deer eradication for the 270-acre section was completed in October 2021 with 331 deer and 46 pigs removed from the site

DPRI: Marine Corps Relocation 2017/2018 amendment to 2015 BO, Conservation Measures to Contribute to the Recovery of Listed Species

Reference: Guam Relocation Biological Opinion



Figure 86. Ifit seedlings are recruiting in the Caiguat Forest Enhancement Site now that ungulates have been removed.

Multi-Species Barrier Construction at Finegayan Forest Enhancement Site

Location: MCBCB **Period of Performance**: Ongoing

Project Objective

Facilitate control of brown tree snakes, rats and cats for the 180-acre northern Finegayan Forest Enhancement Site. The project is currently in final design stages.

Conservation Benefit

BTS are recognized as the major obstacle to re-introduction of native bird species that have been extirpated from Guam. Control of BTS and other predators such as rats and cats is a critical step in efforts to reintroduce these birds to the island's forests.

FY22 Status

- Engineers working with natural resource specialists to finalize design for the barrier
- Some site preparation work, including listed species surveys within the barrier footprint and geotech work, completed in FY22

DPRI: Marine Corps Relocation 2017/2018 amendment to 2015 BO, Conservation Measures to Contribute to the Recovery of Listed Species

Reference: Guam Relocation Biological Opinion



Figure 87. The multispecies barrier project is intended to control predators including the brown tree snake, cats, and rats.

Seed Collection from *Heritiera longipetiolata* and *Tabernaemontana rotensis*

Location: AAFB **Period of Performance**: OCT2018 - 2021

Project Objective

To collect seeds from federally endangered *Heritiera longipetiolata* and threatened *Tabernaemontana rotensis* identified within project footprints associated with the Guam Relocation.

Conservation Benefit

To minimize impacts of military construction activities to native ecosystems by collecting the seeds from as many mature individuals as possible and preserving the genetic diversity of the species.

FY21 Status

- 54 seeds have been collected from 3 of 5 mature *Heritiera longipetiolata* located within AAFB project footprints.
- 15 *Heritiera longipetiolata* seeds have germinated.
- 1,396 seeds have been collected from 19 of 136 mature *Tabernaemontana rotensis* located within AAFB project footprints.
- 945 *Tabernaemontana rotensis* seeds have germinated.

DPRI: Marine Corps Relocation 2017/2018 amendment to 2015 BO, Conservation Measures to Contribute to the Recovery of Listed Species

Reference: Guam Relocation Biological Opinion

Guam Relocation BO Implementation, J-001B T&E Salvage and Transplantation

Location: MCBCB **Period of Performance**: JUN2017 – Ongoing

Project Objective

To determine the number of federally listed plants present within the J-001B Area F project footprint, salvage the specimens deemed healthy and suitable for salvage, translocate those specimens to the FES (either directly or after a period of care in a nursery), and ensure the survival of at least 50% of the genetic diversity of the individuals of each species salvaged.

Conservation Benefit

Protection of genetic diversity of the *Tuberolabium guamense*, *Dendrobium guamense*, and *Bulbophyllum guamense*, which are the federally listed species that were located within J-001B Area F project footprint.

FY22 Status

- Ongoing CTO on NR MAC
- Orchids
    - *Tuberolabium guamense*, *Dendrobium guamense*, and *Bulbophyllum guamense* that were transplanted to the FES the previous fiscal year were maintained and monitored from August 2021 through July 2022.
    - Contractor currently meeting survival criteria of >50% of genetic specimens.

DPRI: Marine Corps Relocation 2017/2018 amendment to 2015 BO, Conservation Measures to Contribute to the Recovery of Listed Species

Reference: Guam Relocation Biological Opinion

Guam Relocation BO Implementation, P-103 T&E Salvage and Transplantation

Location: AAFB **Period of Performance**: JUN2020 – Ongoing

Project Objective

To determine the number of federally listed plants present within the P-103 project footprint, salvage the specimens deemed healthy and suitable for salvage, translocate those specimens to the FES (either directly or after a period of care in a nursery), and ensure the survival of at least 50% of the genetic diversity of the individuals of each species salvaged.

Conservation Benefit

Protection of genetic diversity of *Cycas micronesica*, *Tuberolabium guamense*, *Dendrobium guamense*, and *Bulbophyllum guamense*, which are the federally listed species that were located within the P-103 project footprint.

FY22 Status

- Ongoing CTO on NR MAC
- Cycads
    - 62 apical stems and pups salvaged from 28 genetically unique individuals in October 2021.
    - Stems and pups were monitored and maintained in a nursery through July 2022.
    - Contractor currently meeting survival criteria of >50% of genetic specimens.
- Orchids
    - 2,450 *Tuberolabium guamense*, 3 *Dendrobium guamense*, and 101 *Bulbophyllum guamense* were salvaged and translocated to the FES between October and December 2021.
    - Orchids were maintained and monitored through July 2022.

- Contractor currently meeting survival criteria of >50% of genetic specimens.

DPRI: Marine Corps Relocation 2017/2018 amendment to 2015 BO, Conservation Measures to Contribute to the Recovery of Listed Species

Reference: Guam Relocation Biological Opinion

Guam Relocation BO Implementation, P-290 T&E Salvage and Transplantation

Location: AAFB **Period of Performance**: APR2021 – Ongoing

Project Objective

To determine the number of federally listed plants present within the P-290 project footprint, salvage the specimens deemed healthy and suitable for salvage, transplant those specimens to the FES, and ensure the survival of at least 50% of the genetic diversity of the individuals of each species salvaged.

Conservation Benefit

Protection of genetic diversity of *Cycas micronesica* and *Tuberolabium guamense*, which are the federally listed species that were located within the P-290 project footprint.

FY22 Status

- Ongoing CTO on NR MAC
- Cycads
    - 12 apical stems and pups salvaged from 5 genetically unique individuals in August 2021.
    - Stems and pups were monitored and maintained in a nursery through July 2022.
    - Contractor currently meeting survival criteria of >50% of genetic specimens.
- Orchids
    - 85 *Tuberolabium guamense* were salvaged and transplanted to the FES in August 2021.
    - Orchids were maintained and monitored through July 2022.
    - Contractor currently meeting survival criteria of >50% of genetic specimens.

DPRI: Marine Corps Relocation 2017/2018 amendment to 2015 BO, Conservation Measures to Contribute to the Recovery of Listed Species

Reference: Guam Relocation Biological Opinion

Guam Relocation BO Implementation, P-296 T&E Salvage and Transplantation

Location: AAFB **Period of Performance**: MAR2021 – Ongoing

Project Objective

To determine the number of *Cycas micronesica* within the P-296 project footprint that were healthy and suitable for salvage, salvage the specimens, transplant them to containers and care for them for 12 months in a nursery, and ensure the survival of at least 50% of the genetic diversity of the individuals salvaged.

Conservation Benefit

Protection of genetic diversity of *Cycas micronesica*, which is the federally listed species that was located within the P-296 project footprint.

FY22 Status

- Completed CTO on NR MAC
- Cycads
    - 3 pups salvaged from 2 genetically unique individuals were maintained and monitored in a nursery and transferred to Government custody in March 2022.
    - Contractor met survival criteria of >50% of genetic specimens.

DPRI: Marine Corps Relocation 2017/2018 amendment to 2015 BO, Conservation Measures to Contribute to the Recovery of Listed Species

2019 JRM INRMP Reference: n/a, Guam Relocation BO Requirement.

Guam Relocation BO Implementation, P-735 T&E Salvage and Transplantation

Location: AAFB **Period of Performance**: OCT2017 – Ongoing

Project Objective

To determine the number of federally listed plants present within the P-735 project footprint, salvage the specimens deemed healthy and suitable for salvage, transplant those specimens to the FES, and ensure the survival of at least 50% of the genetic diversity of the individuals of each species salvaged.

Conservation Benefit

Protection of genetic diversity of *Heritiera longipetiolata*, *Tabernaemontana rotensis*, *Tuberolabium guamense*, *Dendrobium guamense*, and *Bulbophyllum guamense*, which are the federally listed species that were located within the P-735 project footprint.

FY22 Status

- Ongoing CTO on NR MAC
- Orchids
    - 190 *Tuberolabium guamense* and 18 *Dendrobium guamense* were salvaged and transplanted to the FES in August and September 2021.
    - Orchids were maintained and monitored through July 2022.
    - Contractor currently meeting survival criteria of >50% of genetic specimens.
- Seed Collection
    - 68 *Tabernaemontana rotensis* monitored for seed production; 212 seeds collected in FY22.
    - 6 *Heritiera longipetiolata* monitored for seed production; 24 seeds collected in FY22.
    - All trees were cleared from project footprint in May 2022; this work element is complete.

DPRI: Marine Corps Relocation 2017/2018 amendment to 2015 BO, Conservation Measures to Contribute to the Recovery of Listed Species

Reference: Guam Relocation Biological Opinion

Listed plant species salvage and transplantation

Location: MCBCB **Period of Performance**: JUN2017 – Ongoing (multiple awards)

Project Objective

Identify federally listed plants present within buildup construction footprints, salvage healthy individuals suitable for translocation, and move these individuals to long-term conservation areas.

Conservation Benefit

The project protects the genetic diversity of federally listed plant populations with individuals that occurred in construction sites. The long-term conservation areas that received these individuals also support many other listed and native plants and animals.

FY22 Status

- All projects currently meeting survival criterion of >50% survival of genetic specimens
- J-001B: *Tuberolabium guamense*, *Dendrobium guamense*, and *Bulbophyllum guamense* were transplanted in the Forest Enhancement Site in FY21 and have been monitored through July 2022
- P-735: 190 *Tuberolabium guamense* and 18 *Dendrobium guamense* were transplanted in the Forest Enhancement Site in August and September 2021 and monitored through July 2022
- P-735: 68 *Tabernaemontana rotensis* monitored for seed production, with 212 seeds collected in FY22
- P-735: 6 *Heritiera longipetiolata* monitored for seeds, with 24 seeds collected in FY22
- P-103: 62 apical stems and pups salvaged from 28 genetically unique *Cycas micronesica* individuals in October 2021 and monitored in nursery through July 2022

- P-103: 2,450 *Tuberolabium guamense*, 3 *Dendrobium guamense*, and 101 *Bulbophyllum guamense* translocated to the FES between October and December 2021, with maintenance and monitoring through July 2022
- P-296: 3 *Cycas micronesica* pups from 2 genetically unique individuals maintained and monitored in nursery and transferred to Government custody in March 2022
- P-290: 12 apical stems and pups from 5 genetically unique *Cycas micronesica* individuals salvage in August 2021, with monitoring and maintenance in nursery through July 2022
- P-290: 85 *Tuberolabium guamense* salvaged and transplanted in the FES in August 2021, with maintenance and monitoring ongoing through July 2022

DPRI: Marine Corps Relocation 2017/2018 amendment to 2015 BO, Conservation Measures to Contribute to the Recovery of Listed Species

Reference: Guam Relocation Biological Opinion



Figure 88. The success rate for translocated Dendrobium guamenseplants is 100 percent.

Salvage and Transplantation of *Cycas micronesica* – MSA-1 Igloo Project (P-3105, Phase 3)

Location: MSA-1, AAFB **Period of Performance:** DEC2020 - TBD

Project Objective

Objective is to meet the special conditions and success criteria stated in the USFWS Biological Opinion Ref: 01EPIF00-2019-F-0012. To salvage, propagate, and out plant the federally threatened *Cycas micronesica* and *Tabernaemontanae rotensis* identified within the construction footprint of the Munitions Storage Area (MSA-1) Igloo Project, P-3105 Phase 3.

Conservation Benefit

To minimize impacts of military construction activities to native ecosystems by salvaging as many individuals of *C. micronesica* and *T. rotensis* as possible and preserving the genetic diversity of the species.

FY22 Status

- Second consecutive Annual Report submitted to US Fish & Wildlife Service on July 2022, in compliance with the Biological Opinion
- Daily monitoring for the Marianas fruit bat conducted prior to start of every work day
- Environmental protection measures installed around the construction site also inspected every work day
- 238 *Cycas micronesica* and 16 *Tabernaemontana rotensis* at Contractor's plan nursery as of July 2022
- Anticipated date of outplanting – June 2023
- Five sites on AAFB and one on Naval Magazine assessed as potential outplanting sites: Route 3A, Achae, Tarague Traingle, Tarague Basin, Golf Course, and Fence #4.

EPR: Biological Opinion for MSA-1 Igloo, P-3105 Phase 3 (Ref # 01EPIF00-2019-F-0012)

2019 JRM INRMP Reference: THM-3; 8-49



Figure 89. Currently 238 C. micronesica and 16 Tabernaemontana are growing at the Contractor's plant nursery.

TERRESTRIAL PROTECTED SPECIES MANAGEMENT

Biomonitor Support for Natural Resource Management at JRM Area of Responsibility

Location: MCBCB **Period of Performance**: JUL2020 – JUN2023

Project Objective

Provide biomonitor support to assist the Department of the Navy in natural resource management across lands under Joint Region Marianas AOR.

Conservation Benefit

Biomonitors conduct surveys for federally listed species, culturally valuable plants, rare plants, and non-native/invasive species. Activities support the GMKMOA (2015) and the Biological Opinion for the Department of the Navy's Relocation of the U.S. Marine Corps from Okinawa to Guam and associated activities.

FY22 Status

- Biomonitors provided support for biosecurity projects, forest enhancement, ungulate eradication, and outplanting projects

DPRI: Marine Corps Relocation 2017/2018 amendment to 2015 BO, Conservation Measures to Contribute to the Recovery of Listed Species

Reference: Guam Relocation Biological Opinion



Figure 90. University of Guam biomonitor Ami Shull checks a project's demarcation lines.

Monitoring of Tree Snails

Location: NBG; NMS **Period of Performance:** SEP2019 - Ongoing

Project Objective

Conduct photo mark recapture (PMR) studies of partulids to determine population estimates

Conservation Benefit

The conservation benefits of the project will ensure self-sustaining, resilient populations to include the use of novel monitoring techniques in the adaptive management of forest resources.

FY22 Status

- Development of PMR capacity and protocol
- Monitoring sites:
    - Haputo (now MCBCB)
    - Pugua Point
    - San Luis
    - NMS
    - Sasa Valley
- Wet season and dry season monitoring
- Up to 5 “capture” events

EPR: 1 S MAR NBG Endangered Species Monitoring; 61755NR142

2019 JRM INRMP Reference: TPS-1; 5-88, TPS-1; 6-46, TPS-2; 6-46, TPS-1; 7-55

Table 11. Population estimates of ESA-listed partulids by season

Species	Site	Dry	Wet	Dry vs Wet
Partula radiolata	Haputo	293.71	319.87	
	Sasa Valley	0.00	227.55	
	San Luis	60.65	160.68	
	NMS	62.10	62.15	
	Pugua Point	51.46	38.33	
P. gibba	Haputo	11.00	-	
Samoana fragilis	Sasa Valley	45.04	86.49	
	Pugua Point	40.07	41.06	

ESA-Listed Snail Survey and Monitoring

Location: NMS; MCBCB **Period of Performance:** AUG2022 – 2023

Project Objective

To delineate and monitor known ESA-listed snail colonies at one site in NBGNMS (*Samoana fragilis)* and one at MCBCB (*Partula gibba*).

Conservation Benefit

Delineation and counts help make management decisions in the areas where the snails occur. Data collected during monitoring efforts will enhance what is known for each of the species and aid in tracking population changes.

FY22 Status

- Contract awarded in August 2022
- Initial survey and follow on monitoring

EPR: 61128NR203 CP JRM Conservation Management of ESA-listed Invertebrates

2019 JRM INRMP Reference: TPS-1; 6-46, TPS-2, 6-46; TPS-1, 8-54, TPS-2; 8-54



Figure 91. Monitoring locations for P. gibba.



Figure 92. Monitoring locations for S. fragilis.

Monitoring Salvaged and Translocated ESA-listed Plants and Invertebrates on JRM Lands on Guam

Location: MCBCB **Period of Performance:** SEP 2020-2022

Project Objective

Monitor and maintain salvaged and translocated plants and invertebrate species listed under the Endangered Species Act (ESA) (16 USC 1531 et seq.) located at the Forest Enhancement Area, Northwest Field, and the Haputo Ecological Reserve Area at Marine Corps Base Camp Blaz (MCBCB).

Conservation Benefit

Monitoring to allow for management actions to enhance and restore habitat, reduce habitat fragmentation, buffer protected areas, and implement new conservation strategies.

FY22 Status

- Epiphytic Orchids: quarterly monitoring, about 30% reproducing, new seedlings
- Cycads: monthly monitoring of 30 trees, coning events, seeds
- 8-Spot Butterfly: quarterly monitoring, all life stages observed
- *Partula radiolata*: quarterly monitoring, juveniles and adults observed (ranging from 37-100 and 64-329 individuals at two sites), many empty shells (range 0-71), *P. gibba* also observed in one site (up to 95 individuals)

EPR: Listed plant surveys, Propagation, planting, and Establishment in the Wild; 61128NR209

2019 JRM INRMP Reference: THM-2; 6-39, TPS-5; 9-77



Figure 93. Cycad megasporophyll



Figure 94. Cycad seed



Figure 95. Partula radiolata



Figure 96. Hypolimnas octocula mariannensis

Native Plant Seed Collection, Salvage, Storage, and Nursery Propagation for Forest Enhancement

Location: MCBCB **Period of Performance**: OCT2017 – APR2023

Project Objective

Collect native plant material to propagate for use in limestone forest enhancement projects.

Conservation Benefit

More than 30 species of rare, high value, native, and listed species have been raised in the nursery, providing additional information about these species and developing methods to successfully grow these plants for outplanting.

FY22 Status

- Nursery contractor is working closely with outplanting contractors to move plants into Caiguat Forest Enhancement Site
- Project extended until April 2023

DPRI: Marine Corps Relocation 2017/2018 amendment to 2015 BO, Conservation Measures to Contribute to the Recovery of Listed Species

Reference: Guam Relocation Biological Opinion



Figure 97. Plants are propagated and maintained in the native plant nursery until they are ready for outplanting.

Monitoring of Butterfly Host Plant Sites and Tarague Snail Colony

Location: AAFB **Period of Performance:** AUG2020 – AUG2022

Project Objective

Monitor populations of the listed snail *Partula radiolata* and the Marianas eight-spot butterfly (*Hypolimnas octocula marianensis*).

Conservation Benefit

Collect baseline data on population abundances for snails and the numbers of eggs, larva, chrysalids and adults for butterflies.

FY22 Status

- Ongoing project with UOG CESU
- Population abundances estimated for snails on 4 mark recapture plots in rainy and dry seasons
- Monitor 3 plots for: butterfly egg, larvae, chrysalids, and adults; performed twice a month for a little over a year
- Trail cams monitored butterfly plots for herbivory; however, no herbivory documented
- Snail numbers declined in wet season
- Butterfly eggs appear to be parasitized in high numbers
- Does not appear to be a distinct breeding season for butterflies; each site is unique

EPR: Monitoring and Surveys for Listed Tree Snails, Butterflies, and Plants; M5240CN048

2019 JRM INRMP Reference: TPS-1; 7-5

Table 12. Snail photo mark recapture plot results, wet vs dry season

Plot	season	# capture events	capture probability	# captured	captures + recaptures	pop estimate	lower limit	upper limit
1	dry	5	0.21	115	173	165.16	134.22	196.1
	wet	5	0.06	57	64	174.52	17.67	331.37
2	dry	5	0.2	110	165	183.45	76.48	290.41
	wet	5	0.09	73	88	86.92	25.63	148.21
3	dry	5	0.1	52	63	126.41	44.78	208.04
	wet	5	0.06	16	18	60.94	0	135.71
4	dry	5	0.05	145	160	631.47	344.09	918.84
	wet	5	0.1	27	33	46.29	3.8	88.78

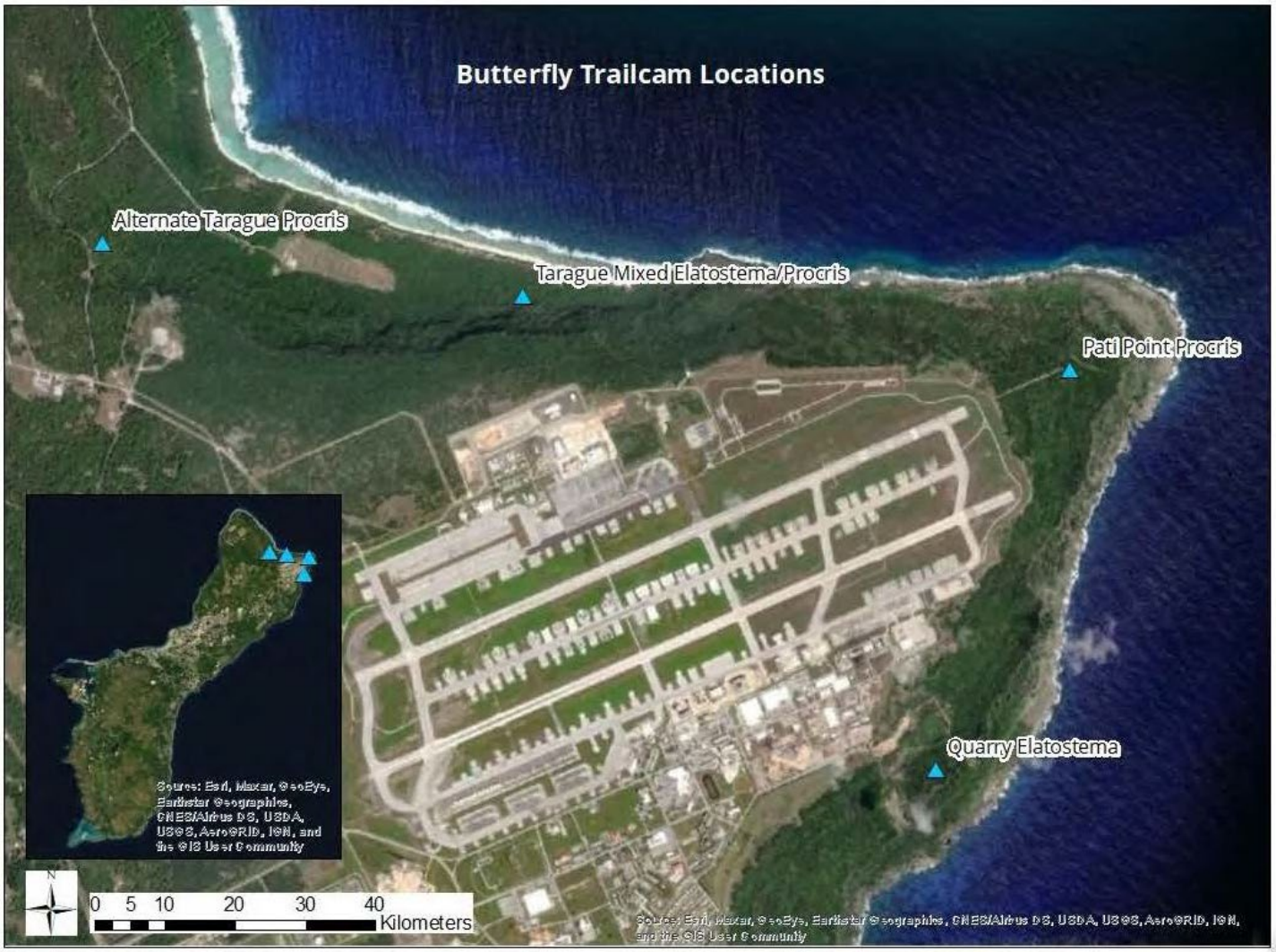


Figure 98. Butterfly monitoring plot locations

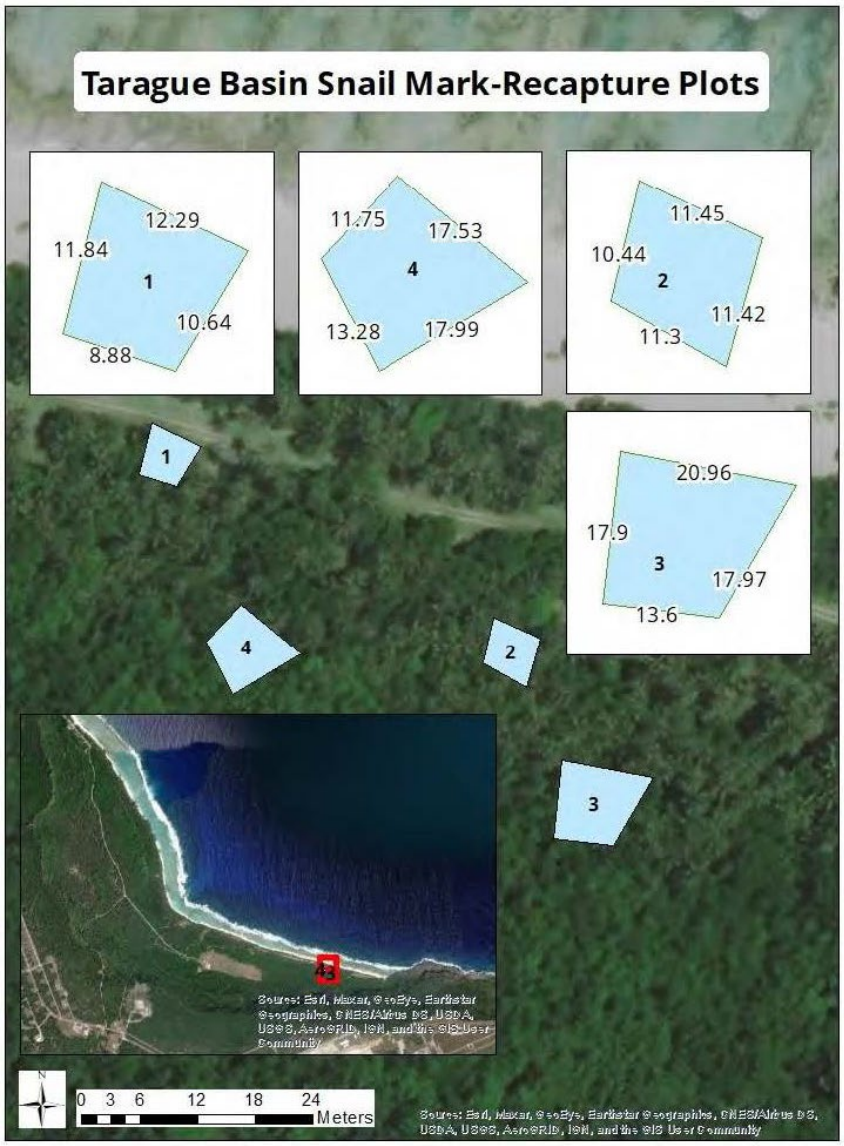


Figure 99. Location of snail colony and photo mark recapture plots

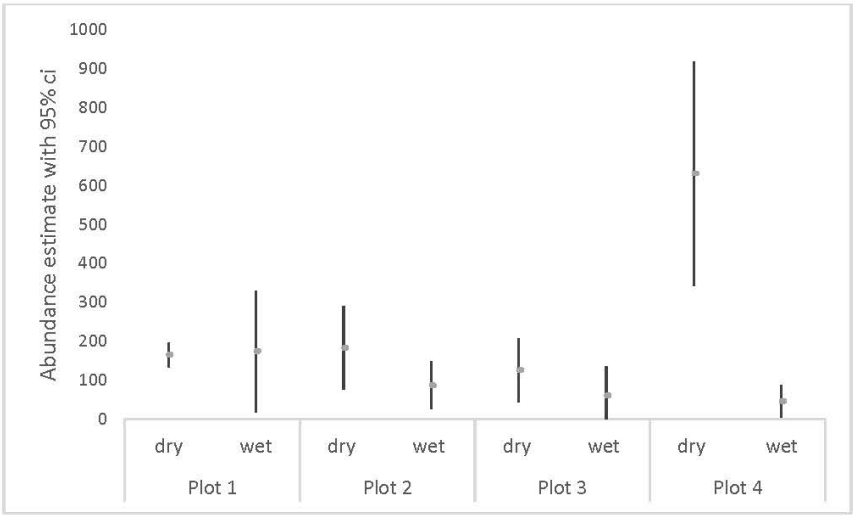


Figure 100. Taragues snail photo mark recapture plots, wet vs dry season

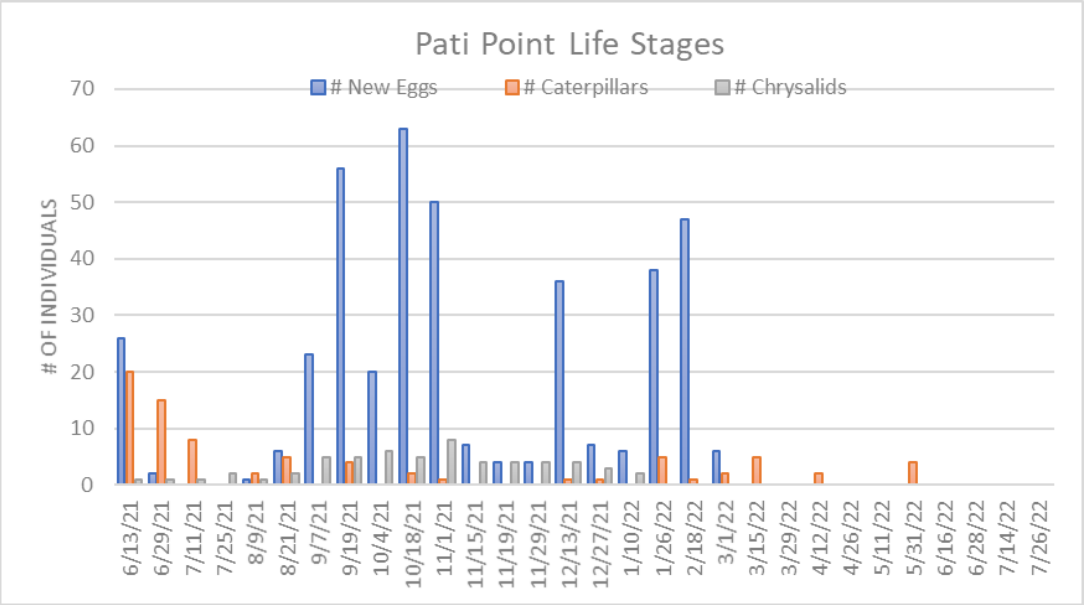


Figure 101. Butterfly life stages at Pati Point plot

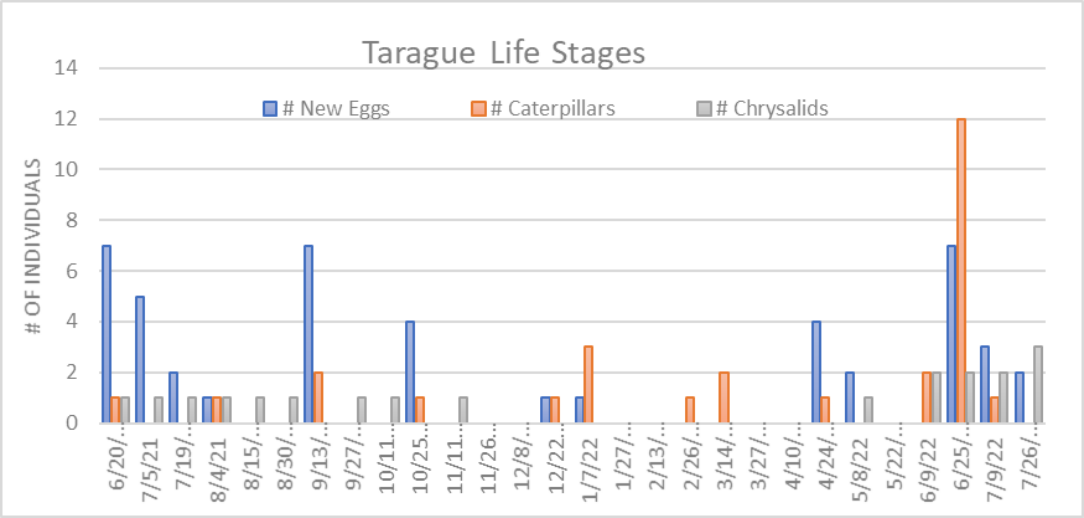


Figure 102. Butterfly life stages at Taragüe plot

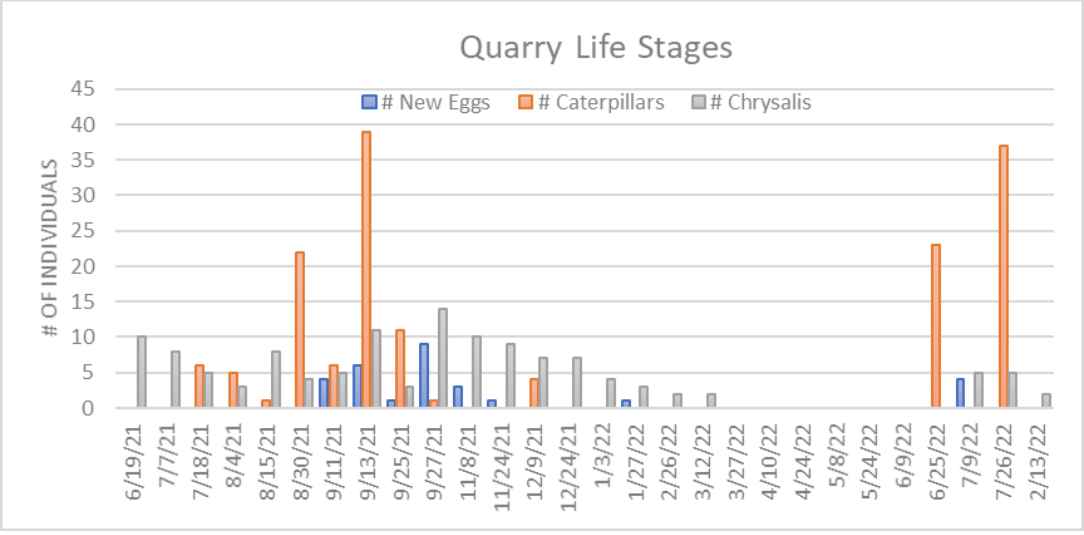


Figure 103. Butterfly life stages at Quarry plot

Transplantation of Federally Listed Species at the Forest Enhancement Area

Location: MCBCB **Period of Performance**: SEP2020 – SEP2022

Project Objective

Transplantation and maintenance *Cycas micronesica*, *Tabernaemontana rotensis*, *Heritiera longipetiolata*, and *Bulbophyllum guamense* into the FES. Revegetate and maintain berms at Northwest Field with Mariana 8-spot butterfly host plants, *Procris pedunculata* and *Elatostema calcareum*.

Conservation Benefit

Transplantation of *T. rotensis, H. longipetiolata, B. guamense* will help increase their abundance and distribution. The planting of butterfly host plants at berms within NWF will increase the number of host plants available and improve habitat connectivity.

FY22 Status

- Over 900 *Tabernaemontana rotensis* and 15 *Heritiera longipetiolata* trees have been transplanted in the FES.
- Planning efforts for the transplantation of *Cycas micronesica* began in Q4 FY22 and anticipated outplanting is Q2 FY23.

DPRI: Marine Corps Relocation 2017/2018 amendment to 2015 BO, Conservation Measures to Contribute to the Recovery of Listed Species

Reference: Guam Relocation Biological Opinion



Figure 104. Contractors prepare a Tabernaemontana rotensis sapling for transplant into the Caiguat Forest Enhancement Site.

JRM *Serianthes nelsonii* Propagation, Outplanting, and Maintenance

Location: AAFB **Period of Performance**: JUL2021-2023

Project Objective

This project is to propagate, outplant, and maintain subpopulations of the federally endangered *Serianthes nelsonii* (tree) on Joint Region Marianas (JRM) managed lands.

Conservation Benefit

Increasing the number of *Serianthes* trees would improve species survival, enhance native habitat, increase the biodiversity of native species, and contributes to the connectivity with surrounding communities in ways that support improved ecosystem functionality.

FY22 Status

- 60 seedlings propagated
- Outplanting planned for AAFB

EPR: 1 RP MAR JRM *Serianthes nelsonii* Propagation, Outplanting, and Maintenance; 61128NRSNI

2019 JRM INRMP Reference: TPS-5; 9-77



Figure 105. Serianthes seedlings





Figure 106 - 107. Serianthes nursery structure

Serianthes nelsonii Monitoring, Outplanting and Management - AAFB

Location: AAFB **Period of Performance:** JUL2020 - Ongoing

Project Objective

Maintenance and monitoring of mature *Serianthes nelsonii* tree in Northwest Field at Ritidian point, including in situ seedlings and fence maintenance, monitoring and maintenance of outplanted seedlings, and nursery propagation and maintenance of seedlings.

Conservation Benefit

Implementation of recovery actions such as increasing populations, insuring against catastrophic events, and testing and implementing new conservation strategies.

FY22 Status

- *S. nelsonii* mature tree at Ritidian Point remains stable; visited on a weekly basis for monitoring and maintenance
- 98 seedlings and saplings naturally growing under the mature tree
- A total of 56 *S. nelsonii* saplings maintained at Route 3A
- 84 total seedlings and saplings being prepared for eventual outplanting
- Approximately 459 seeds collecting from mature tree
- 2,795 total seeds in storage by University of Guam
- 149 seeds distributed to Marine Corps Base Camp Blaz

EPR: 2 LC MAR AAFB *Serianthes nelsonii* Monitoring and Management; M5240CN039

2019 JRM INRMP Reference: TPS-5; 9-77



Figure 108. Serianthes nelsonii sapling growing in the vicinity of the mature tree



Figure 109. Serianthes nelsonii seedlings at the GPEPP nursery



Figure 110. Serianthes nelsonii sapling at the GPEPP nursery

Serianthes nelsonii Propagation, Outplanting, and maintenance at Forest Enhancement

Location: MCBCB **Period of Performance:** AUG2022 – AUG2026

Project Objective

Propagate, outplant, and maintain 100 seedlings of the endangered tree species *Serianthes nelsonii* (*S. nelsonii*) from seed previously collected from the mature *S. nelsonii* tree located on AAFB.

Conservation Benefit

While no critical habitat has been designated for this species, the current population estimate is less than forty mature trees on Rota and one mature tree on Andersen Air Force Base (AAFB). The propagation and outplanting of *S. nelsonii* is particularly important for maintaining the genetic diversity within this species.

FY22 Status

- To date, 131 seeds obtained from UOG *S. nelsonii* storage lab (13 seedlings underdeveloped growth, 10 seedlings died, 2 no germination)
- Planning efforts to begin outplanting seedlings into the Forest Enhancement began in Q4 FY22. Anticipated outplanting start is Q1 FY23.

DPRI: Marine Corps Relocation 2017/2018 amendment to 2015 BO, Conservation Measures to Contribute to the Recovery of Listed Species

Reference: Guam Relocation Biological Opinion

Cycas micronesica Conservation

Location: AAFB **Period of Performance:** MAY2021 - Ongoing

Project Objective

Maintenance and monitoring of six, 1-acre, permanent fenced cycad (*Cycas micronesica*) plots (Achae Point, Ritidian, Tarague Basin, Golf Course, Tarague North, and Tarague South).

Conservation Benefit

Research and monitoring on management actions that directly benefit *Cycas micronesica*. The intent is to identify which management actions most benefit the plant and if possible, implement on a broader scale.

FY22 Status

- All trees in managed plots continue to be treated with Merit
- Potential sites for future cycad plots investigated in 2022; healthy cycad trees observed growing in an un-fenced area at Tarague Beach
- Approximately 139 seedlings growing at the three Andersen cycad plots (Ritidian, Tarague Basin, and Golf Course) as of May 2022.
- 217 total seedlings stored at University of Guam
- USFWS and Dr. Cave looking into potential biocontrol for the cycad scale; coordinated with Toni Mizerek from USFWS and hosted Dr. Ronald Cave on a visit to cycad plots at AAFB

EPR: 3 SAR JRM, AAFB – *Cycas micronesica* Management for Conservation; M5240NR061

2019 JRM INRMP Reference: TPS-5; 9-77

Table 13. Cycad plot seedling health assessment

Seedlings	Established Roots		Seed attached		Flush of new leaves	
	Poor	Well	Yes	No	Yes	No
Ritidian	2	3	4	1	1	4
Tarague	27	103	78	50	8	120
Golf Course	1	3	2	2	0	4



Figure 111. March 2022 Field Visit to the Andersen Cycad plots with Dr. Ronald Cave

Green and Hawksbill Sea Turtle Nesting Habitat

Location: NBG **Period of performance:** AUG2021 – AUG2022

Project Objective

In an effort to protect and enhance sea turtle nesting population on NBG, suitable habitats are monitored and protected throughout the year. Data collected through regular surveys determine hatching success, emergence success and effectiveness of predator control measures, as well as identify threats to nests (e.g. tidal inundation, roots of invasive vegetation; and marine debris). Understanding the spatial and temporal distribution of sea turtle activity ensures their nesting habitat is maintained.

Conservation Benefit

The conservation benefits of project are to (a) sustain and enhance the sea turtle population; (b) maintain sea turtle species range and distribution; and (c) increase the use of adaptive management techniques for sea turtles.

FY22 Status

- 49 surveys between SEP 2021 to AUG 2022
- 31 nests at SS; 3 nests at Dadi
- Clutch size range: $\tilde{x}$ = 83; range (43-106)
- Hatching success: $\tilde{x}$ = 86
- Emergence success: $\tilde{x}$ = 76
- 100% of nests protected with screens
- Removed greater amount of invasive vines (60 lbs)
- Increased number of beach clean-ups (3)

EPR: 1 RP MAR NBG Green and Hawksbill Sea Turtle Nesting Habitat – Invasive Plant and Predator Control; 61755NR808

2019 JRM INRMP Reference: TPS-2; 5-89



Figure 112. Live hatchlings released into Apra Harbor; nest activity at Spanish Steps beach on 11 JUN 2022.

Table 14. Turtle activity observances during the FY20, FY21, and FY22 reporting periods.

	Turtle Encounters	
Survey Year	Observerd + Captured	Satellite-Tagged
2015	90	16
2016	25	4
2017	75	22
2019	69	12
2020	IAA Extension due to COVID pandemic	
2021	IAA Extension due to COVID pandemic	
2022	98	11
All Years	**357**	**65**

Sea Turtle Monitoring, Protection, and Educational Outreach - AAFB

Location: AAFB **Period of Performance:** JUL2018 - Ongoing

Project Objective

To implement management techniques and methodologies to monitor nesting sea turtles on AAFB. These methodologies include but are not limited to: collection of consistent data to determine population demographics, reduce mortality and increase natural survivorship, increase sea turtle awareness of AAFB units and beach stakeholders, and create/maintain a robust database for long-term monitoring data that can support future research and detect trends.

Conservation Benefit

Implement recovery actions by conducting long-term monitoring to determine population estimates and abundance; provide protection of sea turtles and their nesting habitats; and conducting outreach and education to the public on sea turtles and their habitats.

FY22 Status

- Nests recorded on all AAFB beaches including Tarague, Scout, Sirena, Pati, and EOD
- Total 158 emergences from August 2021 to present; 132 nests and 36 false crawls
- 4 nesting turtles Passive Transponder (PIT) tagged, none satellite tagged; few tagged during early morning survey work after being discovered sleeping on the beach
- Clutch data collected on previously marked nests located successfully after 70 days incubation; hatching and emergence success 88% and 86.1% respectively
- New activities include installation of trail cameras on EOD Beach to capture female nesting activity and hatchling emergence footage

- Outreach events: January 2022 beach clean-up in preparation for nesting season, from Taragüe to EOD Beach; presentations to various local public schools and community events; in-briefs with key stakeholders such as EOD, Outdoor Rec, Security Forces, and Marine Patrol
- Other outreach activities: installation of new full color “No Vehicle Driving on the Beach” at the entrance to EOD beach, one of our busiest nesting beaches.
- Project Final Report due December 2022

EPR: 1 LC MAR AAFB Sea Turtle Monitoring; M5240CN037

2019 JRM INRMP Reference: TPS-1; 9-75

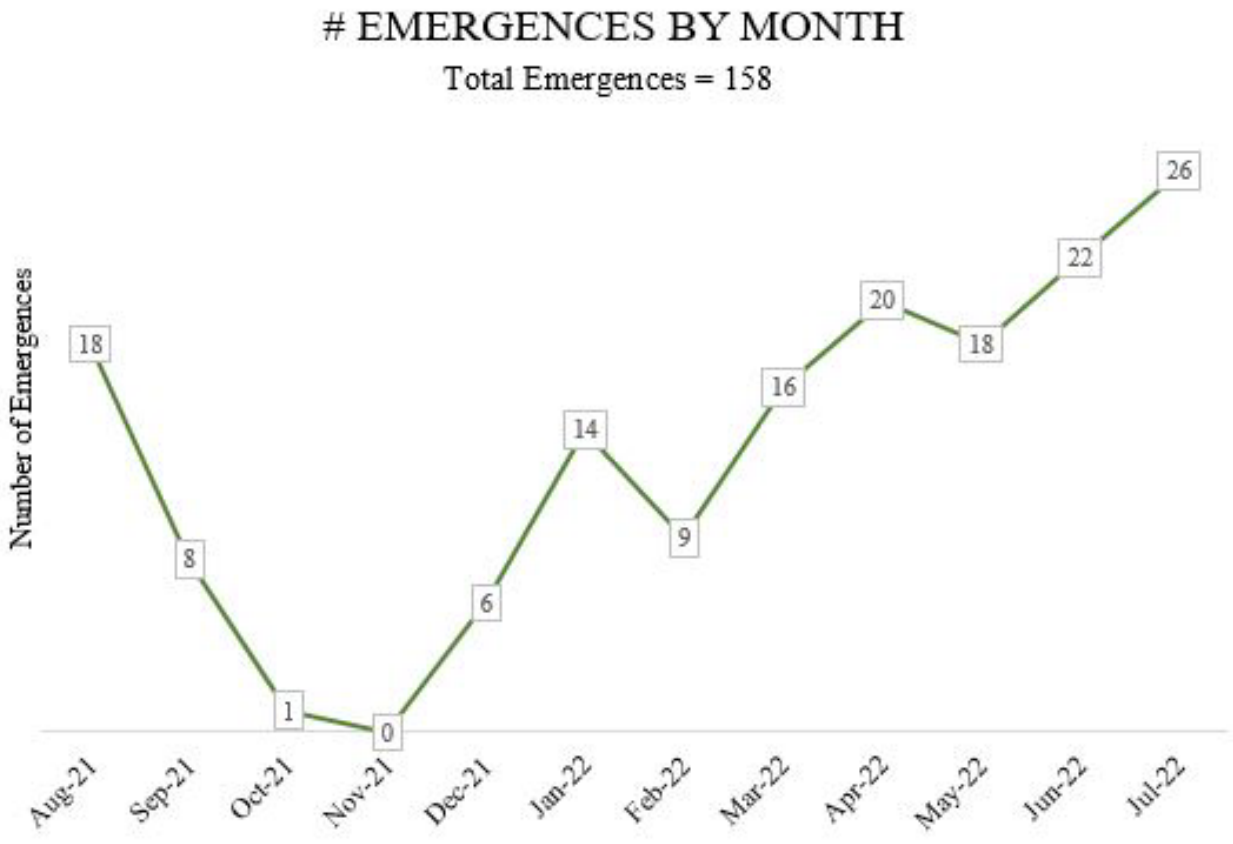


Figure 113. Total number of emergences by month from August 2021–July 2022, with a total of 158 emergences



Figure 114. Nesting Female Daytime Encounter



Figure 115. Trail Camera Behind Nest on EOD Beach



Figure 116. No Vehicle Driving on the Beach Sign

Sea Turtle Nesting Monitoring at MCB Camp Blaz

Location: NBG **Period of Performance:** PRE-AWARD

Project Objective

Conduct regular monitoring for sea turtle nests at Haputo Beach.

Conservation Benefit

Monitoring for nests will minimize impacts to nesting turtles from and provide information about turtle nesting success.

FY22 Status

- Pending award

EPR: 1 CP MAR NBG Sea Turtle Distribution and Habitat Use; 61755NR815

2019 JRM INRMP Reference: TPS-1; 9-75; MPS-2 (5-103)

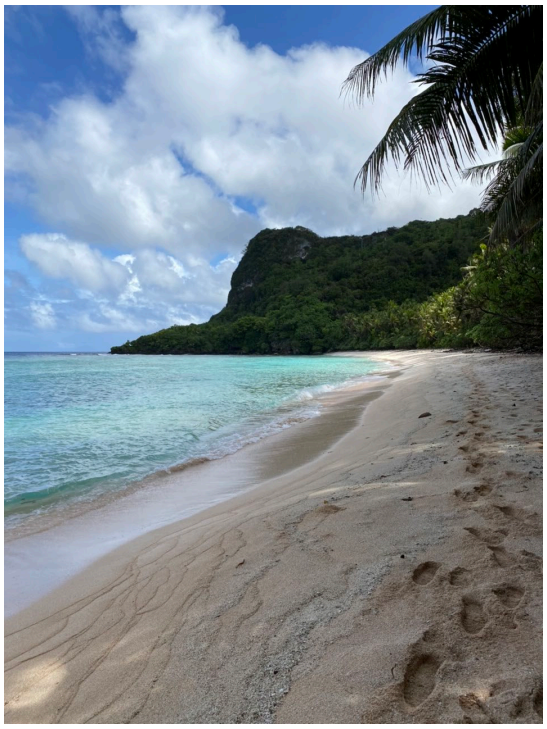


Figure 117. Biologists will begin a new contract to monitor Haputo Beach for turtle nests in September 2022.

Monitoring of Mariana Swiftlets

Location: NMS **Period of Performance:** AUG2021 - Ongoing

Project Objective

Monitor population trends of Mariana swiftlets (*Aerodramus bartschi*) at three caves on NMS: (Maemong, Mahlac, and Fachi).

Conservation Benefit

The conservation benefits will ensure self-sustaining, resilient populations of native species and prohibit loss of current species range.

FY22 Status

- Quarterly counts conducted (Table 14)
- Removed vegetation from Mahlac cave entrance

EPR: 1 S MAR NBG Endangered Species Monitoring; 61755NR142

2019 JRM INRMP Reference: TPS-4; 6-47

Table 15. Quarterly counts for all occupied caves on NMS.

Cave	Dates surveyed	Total Count	Notes
Mahlac	10/26/2021	615	
	3/31/2021	647	
	6/23/2021	NA	Not enough staff
Maemong	10/26/2021	128	
	3/31/2021	214	Late start
	6/23/2021	165	
Fachi	10/26/2021	10	no in cave count due to water
	3/31/2021	53	
	6/23/2021	44	

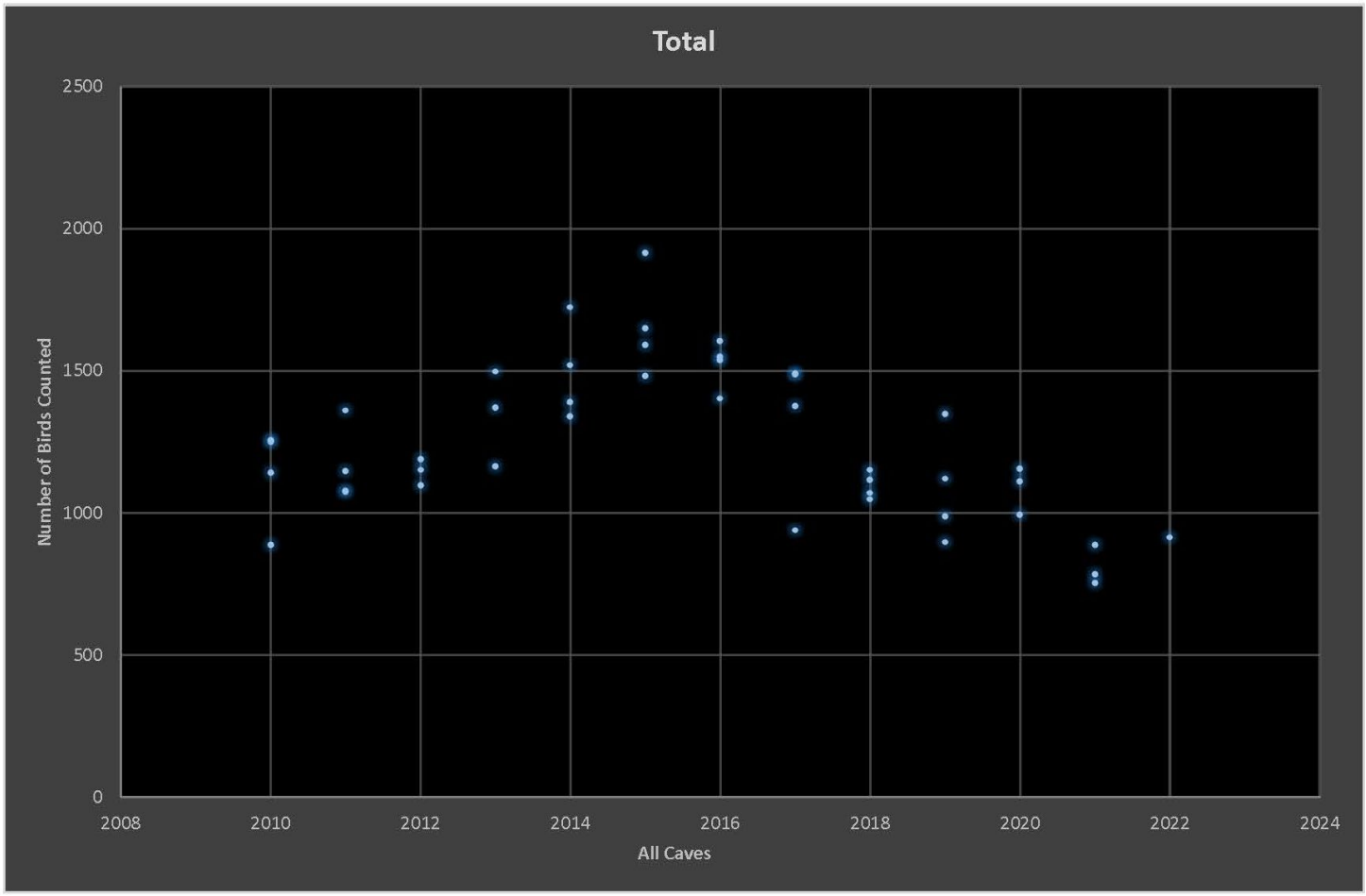


Figure 118. Quarterly swiftlet count results, all occupied NMS caves

Mariana Swiftlet Recovery and Habitat Use

Location: NMS **Period of Performance:** MAR2022 – MAR2024

Project Objective

To provide an understanding of Mariana swiftlet (*Aerodramus bartschi*) habitat use, movement, reproductive success, and breeding site selection to inform management actions and meet specific objectives identified in the USFWS Recovery Plan for the Mariana Swiftlet.

Conservation Benefit

To ensure self-sustaining, resilient populations of native species and prohibit loss of current species range.

FY22 Status

- MAR2022 and AUG2022 field visits conducted for the collection of data via:
    - Thermal camera system to visualize, map, and monitor roosting and nesting
    - Visual cave entrance count of individuals
    - Radio tracking of adult swiftlets at caves and surrounding landscape
        - 10 individuals MAR2022
        - 20 individuals AUG2022
    - Deployment of AudioMoth acoustic loggers to detect prospecting of unoccupied caves
    - Deployment of AudioMoth acoustic loggers at two entrances of Fachi cave to determine preference of use
- Project Extension to SEP2024 with additional funding
- Cave entrance vegetation survey ongoing

EPR: 1 RP MAR NBG Mariana Swiftlet Habitat Use; 61755NR303

2019 INRMP References: TPS-4; 6-47

Monitoring Survival and Demography of Micronesian Starlings

Location: AAFB **Period of Performance:** JUL2019 – JAN2021

Project Objective

To monitor and analyze for Micronesian starling (*Aplonis opaca* [Sali]) nest success and fledgling survival using telemetry, nest monitoring, and survey methods in relation to BTS control efforts. Through monitoring fledging survival and population recruitment efficacy of BTS control techniques can be assessed. This project is one of four projects that will, collectively, further develop information on BTS behaviors related to predation and movement in the presence of abundant avian species

Conservation Benefit

The Micronesian starling is a useful proxy for understanding Guam forest bird ecology in the presence in of BTS. Behavior, survivorship, and population demographics could be useful for supporting future avian restoration projects and controlling BTS in low density with competing food sources in the presence of control regimes.

FY22 Status

- 455 Micronesian starling fledglings tagged during project period of performance
- 47% of fledgling suffered mortality: BTS/cats/other causes
- 22% fledgling survived 2019-2022
- Larger than average BTS (M&F) consuming Micronesian starlings in housing areas
- Project renewed (final year): MAR2022 – FEB2023

EPR: 1 RP JRM Brown Tree Snake Eradication and Control to Support Recovery of ESA-Listed Birds; 61128NR202

2019 JRM INRMP Reference: TIS-2; 5-85, TIS-3; 5-85, TIS-2; 6-43, TIS-3; 6-43, TIS-2; 7-52, TIS-3; 7-52, TIS-2; 8-50, TIS-3; 8-51, TIS-2; 9-71, TIS-3; 9-71

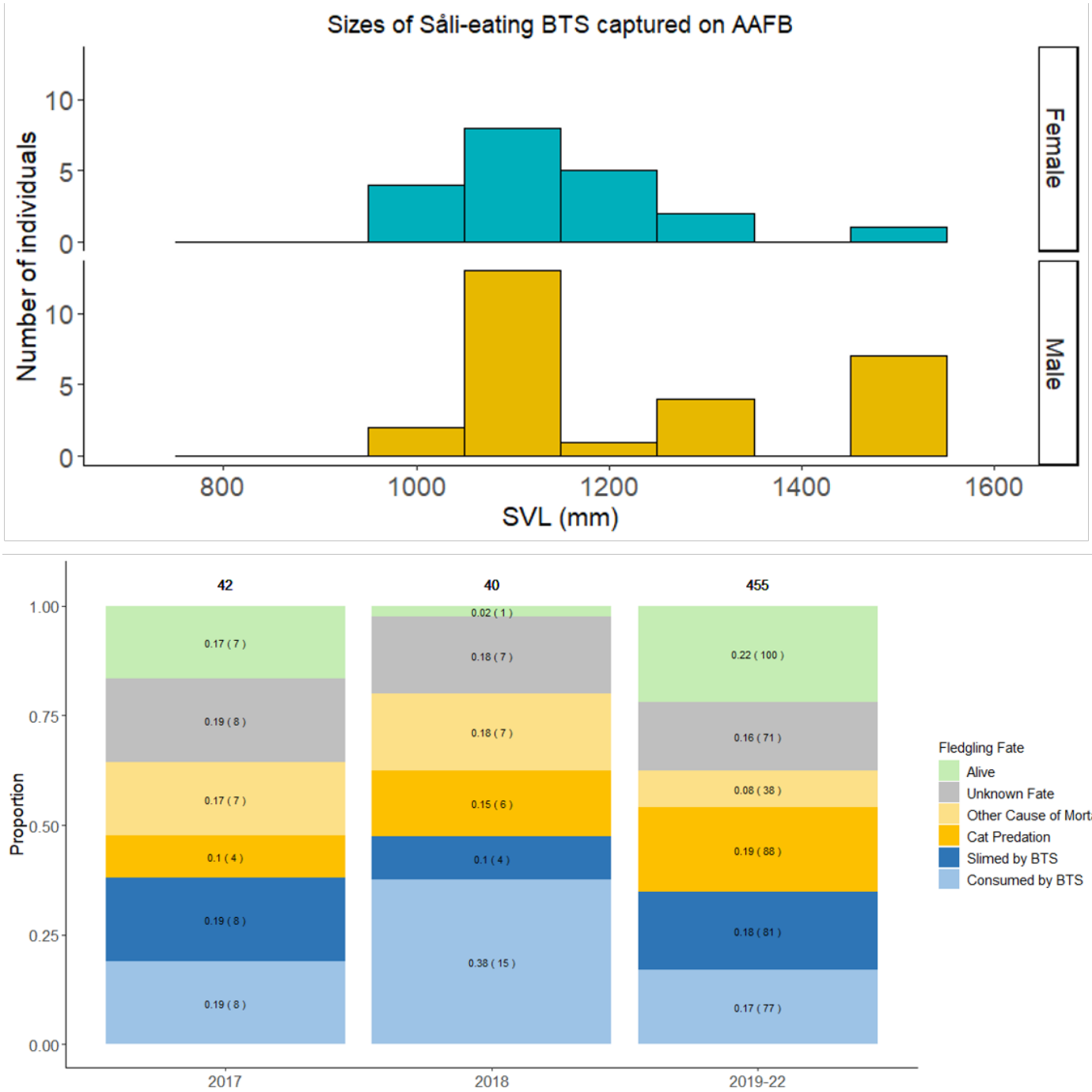


Figure 119. a) Size classes of male (teal) and female (yellow) brown treesnakes confirmed consuming Micronesian Starlings on Andersen, AFB. Source: Iowa State University. b) Micronesian Starling fledgling causes of mortality by proportion of causes, 2017, 2018, 2019-2022. Source: Iowa State University.

Mariana Fruit Bat Monitoring - AAFB

Location: AAFB **Period of Performance:** JAN2021 – Ongoing

Project Objective

Conduct surveys for Mariana fruit bats (*Pteropus mariannus mariannus*) at AAFB as part of long-term population monitoring and to provide analysis on the effects of aircraft overflights and behavior of Mariana fruit bats at Pati Point.

Conservation Benefit

Monitoring will allow for management actions to enhance and restore habitat and increase efforts to recover Mariana fruit bat populations in Guam.

FY22 Status

- Addresses three of the recovery criteria in the 2009 US Fish and Wildlife Service (USFWS) Draft Revised Recovery Plan for the Mariana Fruit Bat or Fanihi by implementing seven of the Recovery Actions outlined in the Draft Plan
- 9th Annual Base-wide Count on 1 July, 2022; data presently being analyzed
- Data shows increasing trend
- Consistent flyway and roost area identified
- Pati Point surveys continue on quarterly basis; no sign of fruit bats present at the historic site
- Large temporary population increases document in last 2 years; assumption that these are migrants from Rota
- Population increase of approx. 200 bats in 2021, approx. 1300 bats in 2022
- Increases happened January/February time frame; numbers went down again in March/April
- Distinct possibility that this is a frequent occurrence not noticed in the past

EPR: 2 BO MAR AAFB Fruit Bat Monitoring; M5240CN041

2019 JRM INRMP Reference: TPS-2; 9-75

Table 16. AAFB Bat count results

Year	# Bats Counted	AAFB Fanihi Estimate: (flight – area)	Area Sampled acres (% of AAFB habitat)
2021	64	108-123	8635 (59%)
2020	33	69 - 92	5269 (36%)
2019	46	79 - 98	7307 (47%)
2018	32	57 - 76	6233 (41%)
2017	32	57 - 68	6125 (34%)
2016	25	45 - 64	5068 (28%)
2015	13	24 - 32	5245 (29.3%)
2014	8	14 - 20	5200 (29.3%)

***2022 Base-wide survey data analysis pending final results.**

***2021 count had more stations near the known flyway.**

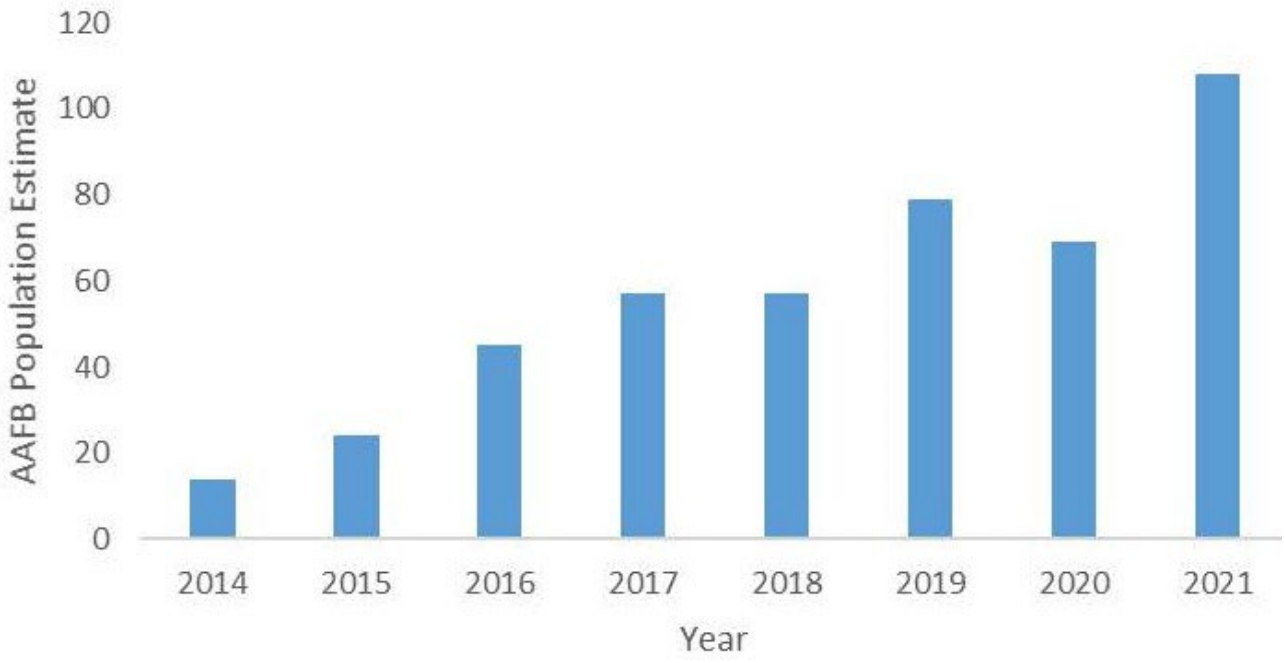


Figure 120. AAFB Bat Population Estimates

Survey and Monitoring of Mariana Fruit Bats on Marine Corps Base Camp Blaz

Location: MCBCB **Period of Performance**: Pre-award

Project Objective

Implement systematic searches for Mariana fruit bat colonies, on a semi-annual basis, in all areas of suitable habitat within MCBCB Mason Live Fire Training Range Complex.

Conservation Benefit

Surveys will help minimize impacts and monitor for potential Mariana fruit bat at the MCBCB Mason LFTRC.

FY22 Status

- Pending award

DPRI: Marine Corps Relocation 2017/2018 amendment to 2015 BO, Conservation Measures to Contribute to the Recovery of Listed Species

Reference: Guam Relocation Biological Opinion

Mariana Fruit Bat Monitoring – NMS and Tinian MLA

Location: NMS; MLA **Period of Performance:** AUG2021 - JUL2022

Project Objective

Conduct annual surveys for Mariana fruit Bats (*Pteropus mariannus marianuus*) on NMS and Tinian MLA. Search for fruit bat aggregating locations. If aggregations or new colony locations are detected, roost counts will commence in accordance with established survey protocols. If changes in roost locations, colony size, or movement are detected, investigate potential threats or stressors that may be causing disturbance.

Conservation Benefit

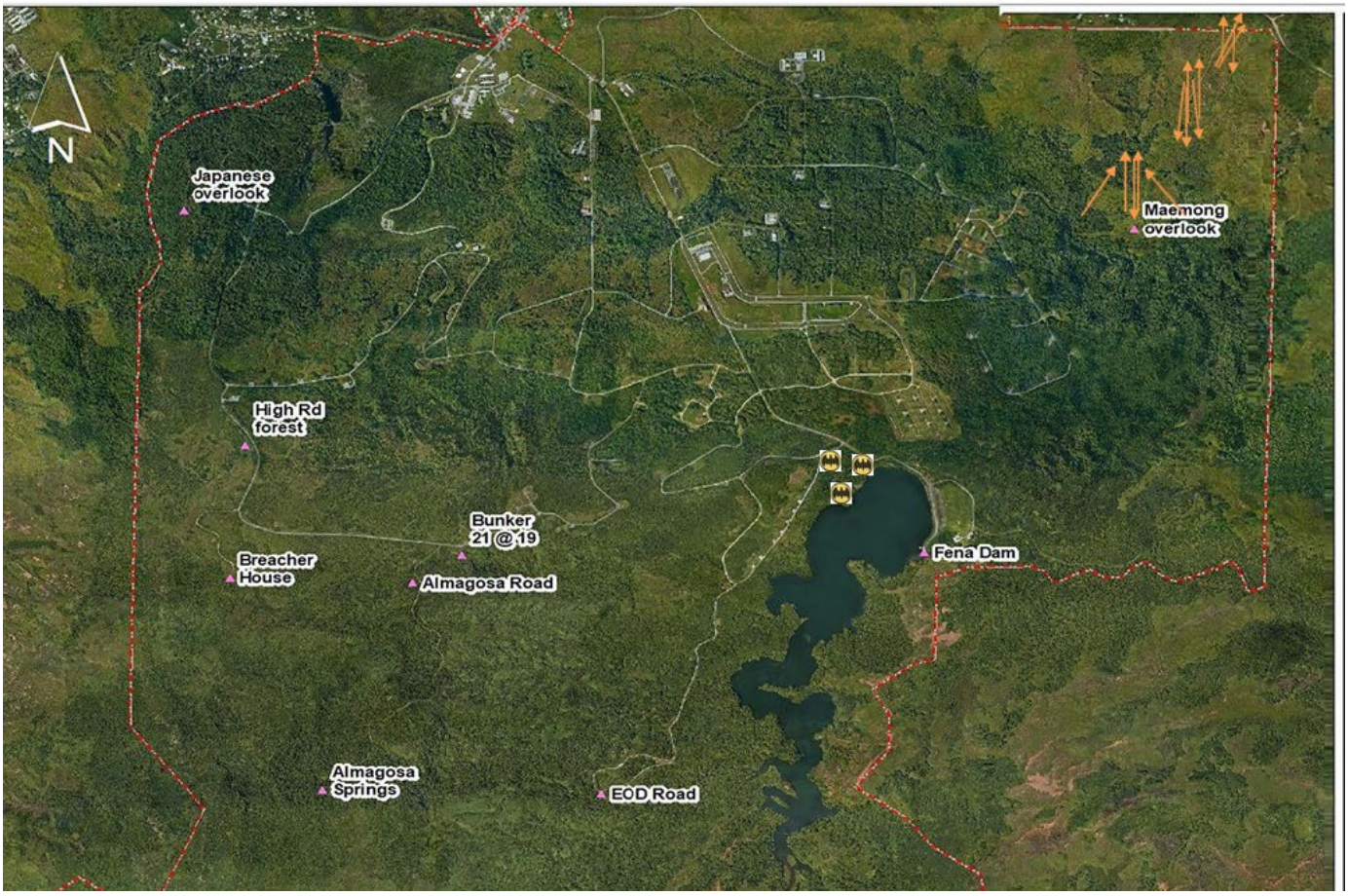
Management strategies and actions of the INRMP to protect and conserve Mariana fruit bats include protection and enhancement of their forested habitats, control and suppression of BTS, continued monitoring of bat populations, and control of wildland fires and ungulates. Monitoring allows for management actions to enhance and restore habitat, reduce habitat fragmentation, buffer protected areas, implement new conservation strategies, and avoid and minimize impacts to fruit bats.

FY22 Status

- Naval Munitions Site Survey conducted Aug 6, 2021
- Last known counts on NMS was during the island wide bat count in 2019
- Tinian MLA surveys conducted July 28, 2022. No fruit bat observed.

EPR: 1 RP MAR JRM Mariana Fruit Bat Monitoring: 61128NRFBM

2019 JRM INRMP Reference: TPS-7; 6-48, TPS-7; 11-67



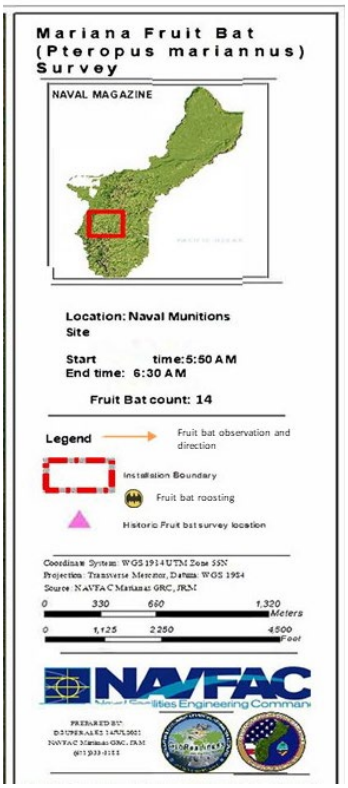


Figure 121. Naval Munitions Site Survey.



Rufus Fantail (*Rhipidura rufifrons saipanensis*) nest
Photo: Jill Liske-Clark

Joint Region Marianas Integrated Natural Resources Management Plan Summary of 2022 Projects

CNMI REPORT

NAVFAC
Naval Facilities Engineering Systems Command
NAVFAC Marianas

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ACRONYMS AND ABBREVIATIONS

ACRONYM	DESCRIPTION
AAFB	Andersen Air Force Base
ADS	Automated Delivery System
AFPMB	Armed Forces Pest Management Board
AOR	Area of Responsibility
BO	Biological Opinion
BTS	Brown Treesnake
CESU	Cooperative Ecosystem Studies Units Network
CEMML	Center for Environmental Management of Military Land
CGAPS	Coordinating Group on Alien Pest Species
CIS	Center for Island Sustainability
CNMI	Commonwealth of the Northern Mariana Islands
COMPACFLT	Commander, U.S. Pacific Fleet
COTS	Crown-of-thorns Seastar
CP	Closed Population
CRB	Coconut Rhinoceros Beetle
CRU	Cooperative Research Unit
CSU	Colorado State University
DAWR	Division of Aquatic and Wildlife Resources
DFW	Division of Fish and Wildlife
DLNR	Department of Lands and Natural Resources
DNM	Dead Neonatal Mice
DoD	Department of Defense
DON	Department of the Navy
EOD	Explosive Ordnance Disposal
ERA	Ecological Reserve Area
ESA	Endangered Species Act
FDM	Farallon de Medinilla

Ft	foot/feet
FY	Fiscal Year
GIS	Geographic Information System
GISAC	Guam Invasive Species Advisory Committee
GISC	Guam Invasive Species Council
GMK	Guam Micronesian Kingfisher
GNWR	Guam National Wildlife Refuge
GPEPP	Guam Plant Extinction and Prevention Program
GDOAg	Guam Department of Agriculture
ha	hectare(s)
HACCP	Hazard Analysis and Critical Control Points
HMU	Habitat Management Unit
ISU	Iowa State University
INRMP	Integrated Natural Resources Management Plan
IRP	Installation Restoration Program
JRM	Joint Region Marianas
LFA	Little fire ant
LFTRC	Live Fire Training Range Complex
M	meter(s)
MEDU	Marine Natural Resources Educational Outreach
MCBCB	Marine Corps Base Camp Blaz
MGIS	Marine GIS and Data Management
MHM	Marine Habitat Management
MIG	Marine Bird Management
MIRC	Mariana Islands Range Complex
MIS	Marine Invasive Species Management
MISMP	Marine Invasive Species Management Plan
MITT	Mariana Islands Training and Testing
MLA	Military Lease Area
MLAW	Marine Natural Resources Law Enforcement

MOA	Memorandum of Agreement
MPS	Marine Protected Species Management
MSA	Munitions Storage Area
NAVFAC	Naval Facilities Engineering Systems Command
NBG	Naval Base Guam
NBGTS	Naval Base Guam Telecommunications Site
NMFS	National Marine Fisheries Service
NMS	Naval Base Guam Naval Munitions Site
NNE	Non-Nesting Emergence
NOAA	National Oceanic and Atmospheric Administration
NWF	Northwest Field
NWRC	National Wildlife Research Center
PACOM	Pacific Command
PIERC	Pacific Island Ecosystems Research Center
QA/QC	Quality Assurance/Quality Control
SOP	Standard Operating Procedure
TEDU	Terrestrial Natural Resources Educational Outreach
TGIS	Terrestrial GIS and Data Management
THM	Terrestrial Habitat Management
TIS	Terrestrial Exotic and Invasive Species Management
TLAW	Terrestrial Natural Resources Law Enforcement
TPS	Terrestrial Protected Species Management
RBP	Regional Biosecurity Plan for Micronesia and Hawaii
RFMP	Range Fire Management Plan
RISC	Micronesian Regional Invasive Species Council
UOG	University of Guam
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey

USDA-WS	United States Department of Agriculture- Wildlife Services
WERI	Water and Environmental Research Institute

MARINE HABITAT MANAGEMENT

JRM Marine Invasive Species Management Plan (JRM MISMP)

Location: JRM AOR **Period of Performance:** AUG 2022 – OCT 2023

Project Objectives

To develop standard operating procedures (SOP) and protocols to avoid and minimize: (1) the spread of new marine invasive species (MIS) into the Department of Defense (DoD) submerged lands within the JRM Area of Responsibility (AOR), and (2) the transfer of any MIS from DoD submerged lands within the JRM AOR to the Pacific region.

Conservation Benefit

The development of SOPs and protocols for a MISMP shall support natural resource managers to monitor, detect, respond, control, eradicate, and prevent the risk of MIS incursions into, out of, and within the JRM AOR, thus maintaining marine biodiversity and ecosystem functions within JRM's AOR.

FY22 Status

- Awarded August 22, 2022

EPR: 61128NR168: Ecosystem Monitoring and Coral Reef Indicators

2019 JRM INRMP Reference: MIS-1; 5-102, MIS-2; 5-102, MIS-1; 8-64, MIS-2: 8-65, MIS-1; 9-88, MIS-2; 9-88, MIS-1; 11-75, MIS-2; 11-75

Water Quality Monitoring on JRM Submerged Lands

Location: JRM AOR **Period of Performance:** JUN2021 – Ongoing

Project Objectives

To quantify the conductivity, temperature, depth, pH, chlorophyll A, dissolved oxygen, nitrate, and phosphate concentrations in shallow reef systems. In 2014, several SeaBird water quality sensors (model 19plus V2) were deployed and installed on a (stainless steel) mounting frame in Apra Harbor, Guam (A = Anchor Reef; B = Middle Shoals; C = Orote Point). For this proposed action, the same methodology will be employed.

Conservation Benefit

These quantitative data will assist in determining the parameters associated with climate change that may be impacting coral reefs in order to avoid, minimize or mitigate potential adverse effects to the marine resources within these areas, especially marine protected species.

FY22 Status

- Ongoing project with the UOG WERI
- Fieldwork was delayed due to COVID-19
- Sensor deployment is ongoing for Guam and will be completed by SEP 2022
- Sensor deployment on the Tinian MLA submerged lands is planned for OCT 2022
    - The mounting frame will be installed on the benthic to be easily retrieved for data acquisition and servicing, as well as preventing physical contact with the benthic substrate.

EPR: CHS MAR JRM Monitoring and Control of Acute Impacts on Coral Reefs; 61128CN222

2019 JRM INRMP Reference: MIS-2; 8-65, MHM-1; 8-62, MHM-2; 8-63, MHM-3; 8-63, MGIS-1; 8-68, MHM-1; 11-73, MHM-2; 11-74, MHM-3; 11-74, MIS-2; 11-75, MPS-1; 11-76

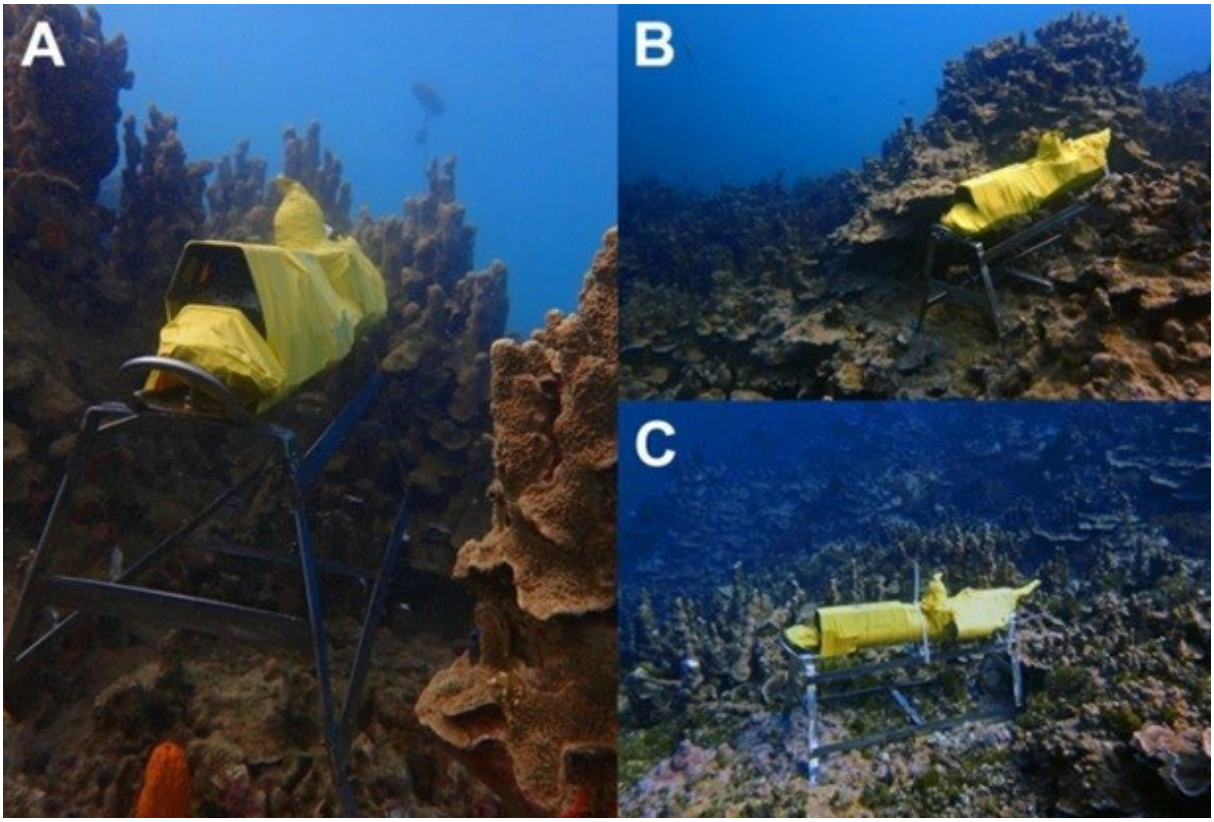

Figure 1. Intalled SeaBird water quality sensors (model 19plus V2)



Figure 2. A CTD sensor mounted on a stainless steel frame.

Coral Bleaching and Crown of Thorns Seastar (COTS) Monitoring on JRM Submerged Lands

Location: JRM AOR **Period of Performance:** JUN2021 – Ongoing

Project Objective

To quantify the coral bleaching and abundance distribution of COTS, and if necessary conduct COTS culling.

Conservation Benefit

These quantitative data will assist in determining the parameters associated with coral bleaching and COTS outbreak events that may be impacting coral reefs in order to avoid, minimize or mitigate potential adverse effects to the marine resources within these areas, especially marine protected species.

FY22 Status

- Ongoing project with the UOG Sea Grant Office
- Fieldwork was delayed due to COVID-19; fieldwork is ongoing for Tinian
- COTS workshop hosted on March 21-22, 2022; consisted on classroom and in-water training; participants from state, federal, and NGO participants

EPR: CHS MAR JRM Monitoring and Control of Acute Impacts on Coral Reefs; 61128CN222

2019 JRM INRMP Reference: MIS-2; 8-65, MHM-1; 8-62, MHM-2; 8-63, MHM-3; 8-63, MGIS-1; 8-68, MHM-1; 11-73, MHM-2; 11-74, MHM-3; 11-74, MIS-2; 11-75, MPS-1; 11-76

MARINE PROTECTED SPECIES MANAGEMENT

Sea Turtle Aerial Surveys in Farallon de Medinilla (FDM)

Nearshore Waters

Location: FDM CNMI **Period of Performance**: SEP 2020 – Ongoing

Project Objective

To identify, locate, and quantify the abundance distributions of sea turtles and marine mammals in FDM nearshore waters.

Conservation Benefit

The identification, location, and population data of the marine megafauna will help identify the spatial and temporal trends associated with these populations, which will inform military training and testing, as well as the consultations with regulatory agencies, in order to avoid, minimize or mitigate potential adverse effects to the marine resources within these areas, especially marine protected species.

FY22 Status

- Ongoing project with the UOG Sea Grant Office
- Fieldwork was delayed due to COVID-19 and scheduling is continuing to be challenging due to aircraft availability.
- Last survey completed on June 30, 2021

EPR: CHS MAR JRM Monitoring and Control of Acute Impacts on Coral Reefs; 61128CN222

2019 JRM INRMP Reference: MPS1 (12-41); MGIS 1 (12-43)

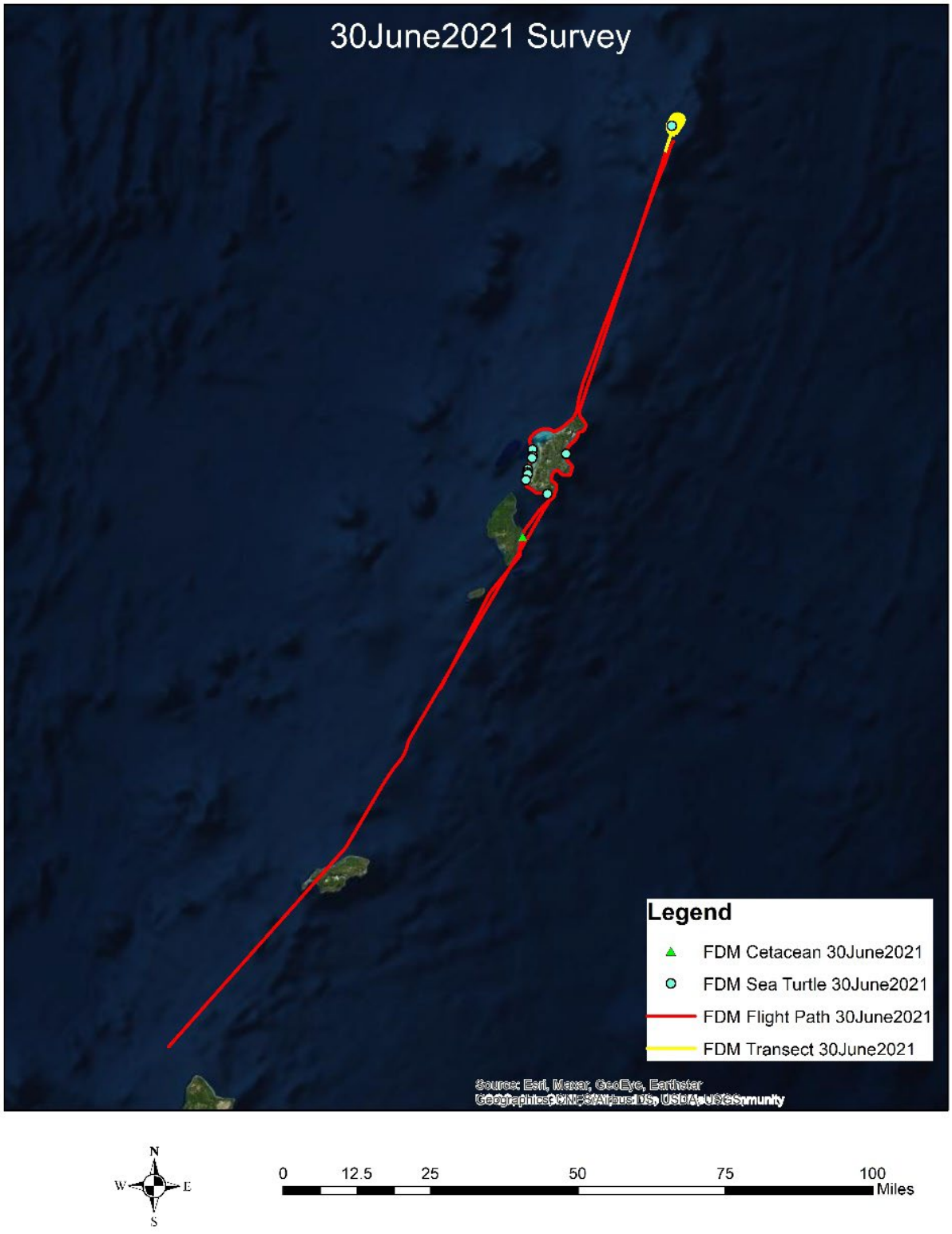

Figure 3. The flight path of the aircraft during the survey on June June 30, 2021. Sea turtles were identified in FDM and Saipan nearshore waters.

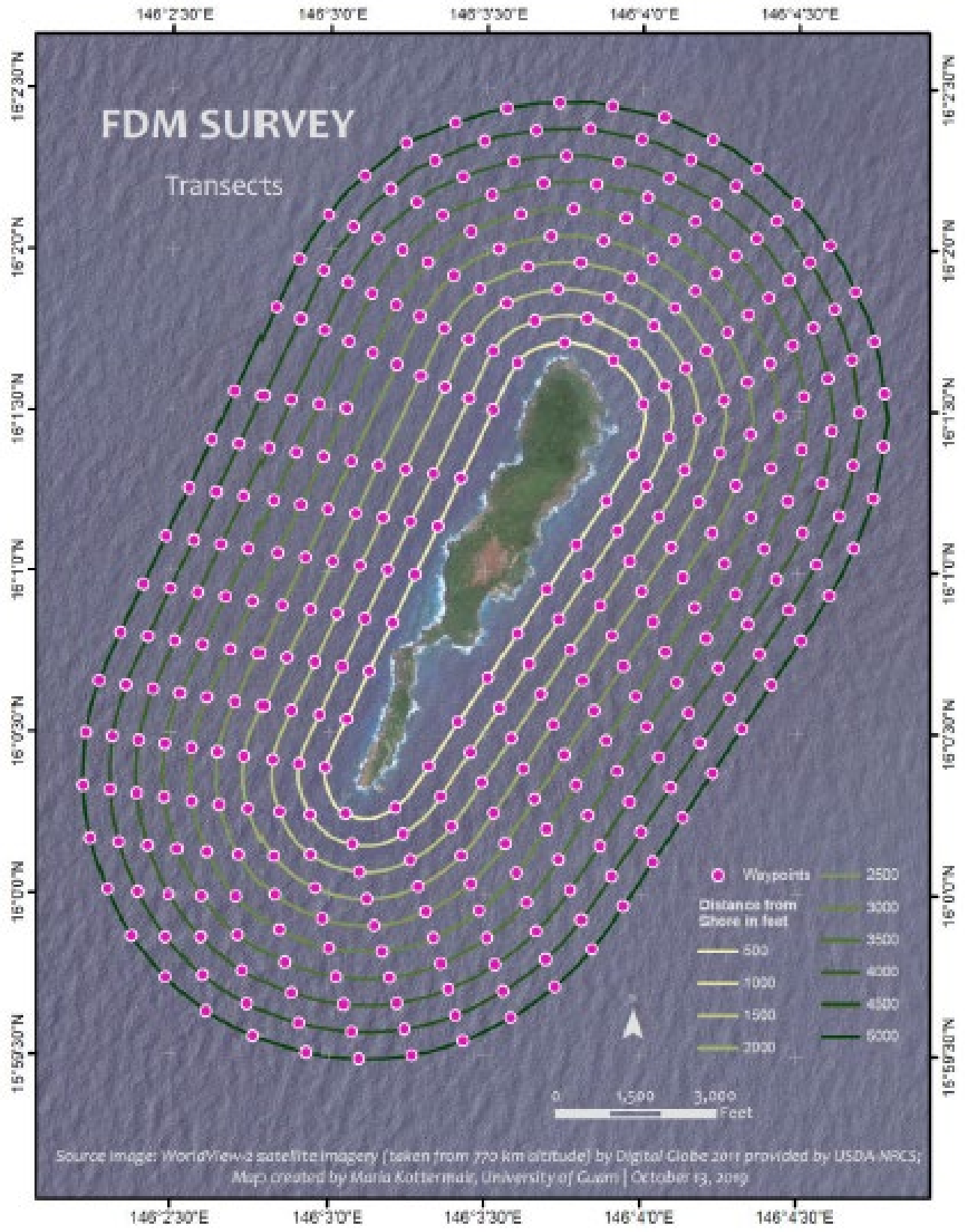

Figure 4. The geo-referenced transected created for the FM aerial surveys, which were entered into the aircraft instruments for accuracy.

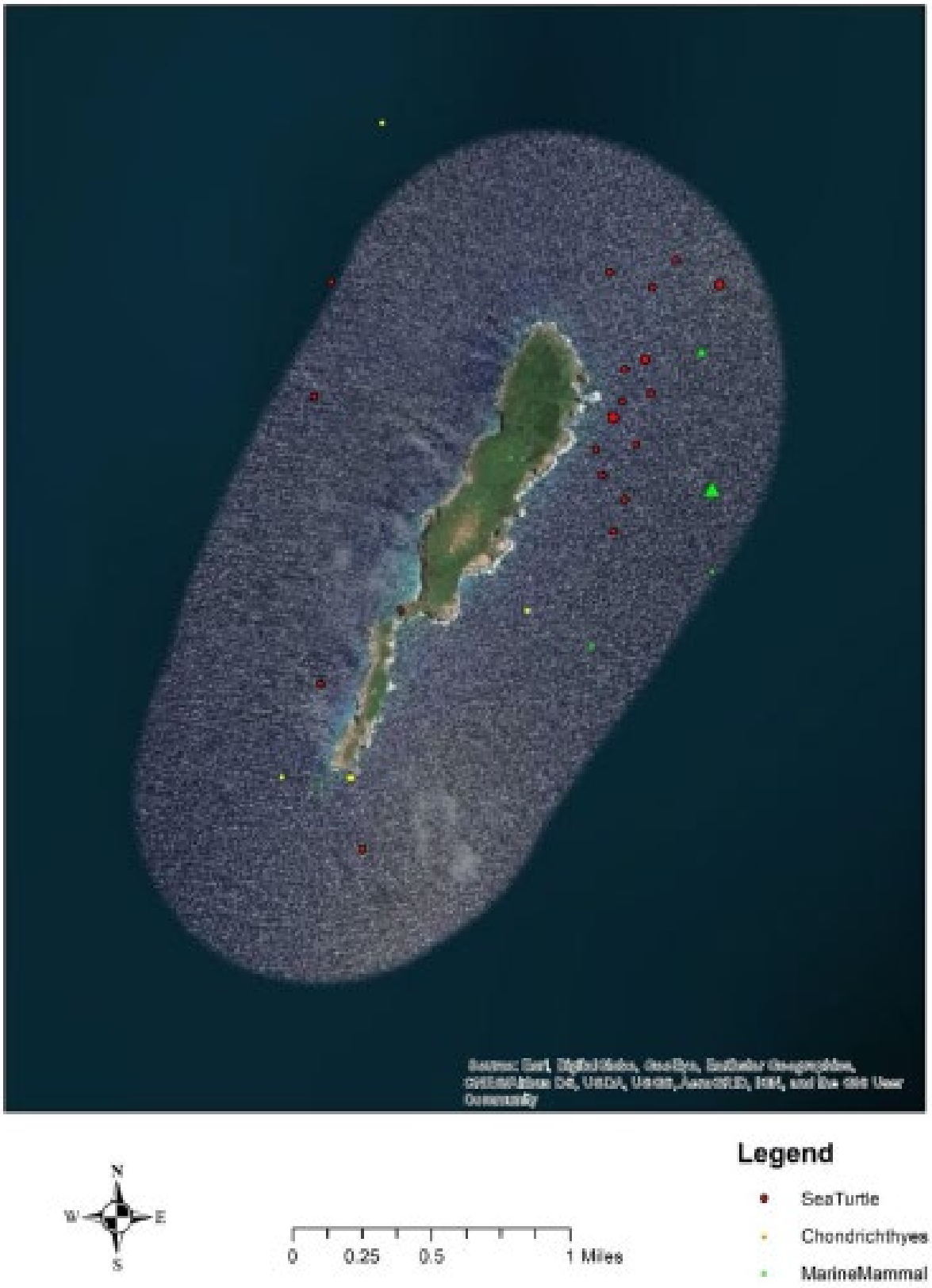

Figure 5. In 2018, marine megafuna were identified in FDM nearshore waters (NAVFAC 2020).

TERRESTRIAL EXOTIC AND INVASIVE SPECIES MANAGEMENT

Implementation of the Regional Biosecurity Plan of Micronesia and Hawaii (RBP) – CNMI

Location: JRM **Period of Performance:** AUG2021-Ongoing

Project Objective

Implement priority actions from the RBP aimed at: 1) Preventing the spread of invasive species within and in/out of JRM Area of Responsibility (AOR); 2) Foster regional coordination and collaboration; 3) Invasive species management and control; and 4) Strengthening capacity for biosecurity.

Conservation Benefit

Protection of native species, particularly those that are threatened and endangered, from the threat of invasive species within the JRM AOR.

FY22 Status

- Implement arrival and/or pre-departure biosecurity inspections of non-training military equipment and cargo movements to and from the CNMI to ensure Armed Forces Pest Management Board Technical Guide No. 31 (AFPMB TG-31) cleanliness standards, therefore devoid of biomaterial.
- Movements included Navy Mobile Construction Battalion (NMCB) cargo and equipment to/from Tinian to support Seabee public works projects.
    - Colorado State University Center for Environmental Management of Military Lands (CSU CEMML) conducted arrival and pre-departure biosecurity cleanliness inspections and USDA-WS conducted pre-departure BTS canine inspections.

  - Five (5) pre-departure biosecurity and Brown treesnake inspection events on Guam for cargo and equipment movements to Tinian. One pre-departure biosecurity inspection event on Tinian for cargo and equipment movement to Guam.
- Continued interagency coordination and consultation regarding invasive species management and biosecurity concerns within the region (CRB Working Group, LFA Working Group, GISC, GISAC, RISC, CNMI DLNR, Guam Biosecurity Division, CGAPS).

EPR: CHS NISA MAR JRM Implementation of the Regional Biosecurity Plan; 61128NR860

2019 JRM INRMP Reference: TIS-4; 5-85, TIS-5; 6-44, TIS-5; 7-53, TIS-4; 8-51, TIS-6; 9-73, TIS-1; 11-62, TIS-1; 12-32

Invasive Species Management within the Joint Region Marianas Area of Responsibility - CNMI

Location: JRM **Period of Performance:** AUG2021 – Ongoing

Project Objective

In support of Mariana Islands Training & Testing (MITT) activities:
1) Conduct Early Detection Surveys (EDS) for non-native species at training and cargo staging locations within the JRM AOR (Guam and CNMI (Military Leased Area);
2) Develop and implement standard operating procedures for the control and removal of high-risk invasive species;
3) Develop and implement invasive species rapid response protocols;
4) Develop and implement bio-sanitation standards along with quality assurance/quality control standards via biosecurity inspections; and
5) Development of a programmatic pathway risk analysis for the movement of equipment and personnel within the JRM AOR

Conservation Benefit

Prevent the movement and establishment of invasive species into and out of Guam and the CNMI during training exercises.

FY22 Status

- Ongoing cooperative agreement with CSU CEMML.
- Early Detection Surveys Conducted
    - Tinian MLA – 3 of 4 All-Taxa Survey sites; 16 of 16 Weed Surveys; and Little fire ant (LFA) conducted at five locations (no LFA detections; Figure 5)
    - All-Taxa Surveys – AAFB: 9 of 32 sites; NBG: 10 of 30 sites
    - Weed Surveys – AAFB: 5 of 29 sites; NBG: 27 of 34 sites

- Development of SOPs for the Control/Eradication of High-Risk Species
    - Little Fire Ant (LFA; *Wasmannia auropuncta*) Revised
    - Lollipop Climber (*Diplocyclus palmatus*) Draft
    - Mile-a-Minute vine (*Mikania mircantha*) Draft
    - Greenhouse frog (*Eleutherodactylus planirostris*) Draft
    - Greater Banded Hornet (*Vespa tropica*) Draft in progress
- Invasive Species Rapid Response
    - Thirteen (13) CSU CEMML personnel USGS BTS Rapid Response certified
    - Assisted Guam Biosecurity Division with initial monitoring effort at Won Pat International Airport after a Coqui frog was intercepted at the Saipan International Airport (September 2021)
- Bio-sanitation QA/QC Biosecurity Inspections during Military Training Events
    - One major training event (>100 cargo items; Cope North 22)
    - One minor training event (25 – 100 cargo items; Valiant Shield 22)
    - One unit level training event (<25 cargo items: Nodal Lighting 22)
    - >290 items inspected during arrival and pre-departure biosecurity cleanliness inspections to meet AFPMB TG-31 cleanliness standards
    - Bio-material interceptions (plant material, seeds, soil/gravel)
- Development of a Programmatic Pathway Risk Analysis for Movements into the Mariana Islands and between Islands
    - Ongoing data collection to support the risk analysis

EPR: 2 BO MAR Mariana Islands Training and Testing (MITT) Implementation; 61128NR218
CHS NISA MAR JRM Implementation of the Regional Biosecurity Plan; 61128NR860
USMC HQ MITT Biological Opinion Conservation Measures Implement (FY21 Non-EPR)

2019 JRM INRMP Reference: TIS-6; 5-86, TIS-7; 6-44, TIS-6; 7-53, TIS-5; 8-51, TIS-7; 9-73, TIS-2; 11-62, TIS-1; 12-32; TIS-2; 12-33



Figure 6. LFA survey areas within the Tinian MLA included the Japanese Communications Building grounds, Uni Chiget access trail, North Field center taxiway and Baker runway cargo offload location, Japanese aircraft parking apron, and Uni Chulu beach and access roadways.

Coconut Rhinoceros Beetle (CRB; *Oryctes rhinoceros*) Surveys, Interdiction, and Monitoring – CNMI (Tinian)

Location: JRM **Period of Performance:** AUG2021 – Ongoing

Project Objective

To implement CRB best management practices: 1) Conduct CRB Early Detection Surveys in military training areas, 2) Implement interdiction trapping during military exercises with cargo movement from Guam to Tinian North Field, 3) implement CRB awareness for military personnel, and 4) Implement CRB interdiction measures on Guam and coordinate and collaborate with resources partners in the CNMI to prevent the movement of CRB to the CNMI via military cargo and transport while maintaining military readiness.

Conservation Benefit

Prevention of movement and establishment of CRB into the CNMI during military training activities.

FY22 Status

- Conducted CRB Early Detection Surveys along roadways in the Military Leased Area on Tinian for CRB damaged coconut trees (February/June 2022)
- No CRB damaged coconut trees detected
- Deployed and monitored CRB panel traps at North Field during Cope North 2022 and Valiant Shield 2022 (February/June 2022)
- Provide military personnel with CRB awareness information and sighting protocols during military training exercises conducted in the CNMI.

- Pre-departure biosecurity inspections were conducted on all cargo and equipment prior to transport from Guam to the CNMI during military exercises to ensure all items were devoid of bio-material (including CRB)
- Communicated CRB interdiction measures during FY22 exercises on Tinian with CNMI natural resources partners
- Coordination with regional partners (USDA-PPQ, GovGuam Dept. Ag., CNMI DLNR, Hawaii Dept. Ag.)

EPR: 2 BO MAR Mariana Islands Training and Testing (MITT) Implementation; 61128NR218
CHS NISA MAR JRM Implementation of the Regional Biosecurity Plan; 61128NR860
USMC HQ MITT Biological Opinion Conservation Measures Implement (FY21 Non-EPR)

2019 JRM INRMP Reference: TIS-5; 5-86, TIS-6; 5-87, TIS-6; 6-44, TIS-7; 6-45, TIS-4; 7-53, TIS-6; 7-53, TIS-5; 8-52, TIS-6; 8-52, TIS-5; 9-72, TIS-7; 9-73, TIS-1; 11-62, TIS-2; 11-63, TIS-1; 12-32, TIS-2; 12-33

Marianas Islands Training & Testing Biological Opinion Terms & Conditions 1.1 Compliance – CNMI

Location: CNMI **Period of Performance:** AUG2018 – SEP2022

Project Objective

To comply with the Mariana Islands Training & Testing (MITT) Biological Opinion (BO) Incidental Take Statement Terms and Conditions 1.1 (as amended 28 FEB 2016) to provide funding to the U.S. Fish & Wildlife Service for invasive vertebrate pest control to minimize the effect of take on the Micronesian megapode (*Megapodius laperouse*). DoD is not responsible for project implementation or the results thereof, per the MITT Biological Opinion (BO) amended Terms and Conditions 1.1.

Conservation Benefit

To ensure compliance with the Incidental Take Statement of the 2015 MITT BO to minimize the effect of take on the Micronesian megapode.

FY22 Status

- Interagency Agreement between Joint Region Marianas and the U.S. Fish & Wildlife Service established and funding issued in August 2018.
- U.S Fish & Wildlife Service project currently in implementation phase for Micronesian megapode habitat restoration on Aguiguan.

EPR: 2 BO MAR Mariana Islands Training and Testing (MITT) Implementation; 61128NR218

2019 JRM INRMP Reference: TPS-1; 12-34

TERRESTRIAL PROTECTED SPECIES MANAGEMENT

Mariana Fruit Bat Population Monitoring

Location: Tinian MLA **Period of Performance**: NA

Project Objective

To monitor Mariana fruit bat (*Pteropus mariannus mariannus*/fanihi) abundance and habitat use on the Tinian MLA.

Conservation Benefit

Knowledge of MLA occurrence and use patterns permits implementation of disturbance avoidance measures, and the ability to target habitat protection or enhancement measures.

FY22 Status

- 1st annual broad-scale survey through NAVFAC/CNMI DFW partnership conducted July 28, 2022
- No fanihi were detected during July 2022 survey
- Incidental report of a fanihi sighting south of Hagoi in March 2022

EPR: 1 RP MAR JRM Mariana Fruit Bat Monitoring; 61128NRFBM

2019 JRM INRMP Reference: TPS-7; 11-67



Figure 7. Tinian MLA 2022 fanihi survey locations.

Conservation of Listed Invertebrates

Location: Tinian MLA **Period of Performance**: MAR2022 – MAR2023

Project Objective

Overall objective is to conserve and manage humped tree snail (*Partula gibba*) populations on the Tinian MLA. Specific objective is to determine if snails continue to occupy the Dump Coke site.

Conservation Benefit

Monitoring results inform decisions regarding the need or urgency for management. If snails are located during this search effort, the next step is to discuss management options.

FY22 Status

- Contract awarded March 2022
- No snails have been detected at the Dump Coke sites since they were first detected in June 2013.
- Monthly site searches began in July 2022 – no snails detected after two of six planned visits

EPR: 1 CP JRM Conservation Management of ESA-listed Invertebrates; 61128NR203

2019 JRM INRMP Reference: TPS-5; 11-66



Figure 8. Locations and ranges of Dump Coke humped tree snail populations, June 2013. Reprinted from NAVFAC 2014.

Tinian Forest Bird Monitoring

Location: Tinian MLA **Period of Performance**: MAR2022 – MAR2023

Project Objective

To monitor native forest bird populations with a focus on Tinian monarch (*Monarcha takatsukasae*) and Micronesian megapode (*Megapodius laperouse laperouse*)

Conservation Benefit

Monitoring informs management decisions for conservation of native bird populations. Declining trends may indicate a need for more focused management. Tinian monarch, a single-island endemic species, and ESA-listed Micronesian megapode warrant greater attention.

FY22 Status

- Agreement extension – additional Micronesian megapode survey in 2023
- 2021 VCP survey key findings:
    - "…the landbird community in the Military Lease Area appears to be dynamic and resilient." (USGS)
    - Compared to densities from Camp et al 2012 overlapping regions:
        - White-throated ground dove (*Gallicolumba xanthonura*), Mariana fruit dove (*Ptilinopus roseicapilla*), Micronesian myzomela (*Myzomela rubratra*), Tinian monarch, and bridled white-eye (*Zosterops conspicillatus*) increased
        - Mariana kingfisher (*Todiramphus albicilla*) and rufous fantail (*Rhipidura rufifrons*) decreased
        - Micronesian starling (*Aplonis opaca*) was similar
    - Higher density of bridled white-eye (*Zosterops conspicillatus saypani*) compared to other islands/times

EPR: CHS MAR JRM Tinian Forest Bird Monitoring; 61755NR303

2019 JRM INRMP Reference: TPS-4; 11-65



Figure 9. Location of 2021 MLA survey transects and Camp et al. 2012 regions.

Tinian Monarch Research

Location: Tinian MLA **Period of Performance**: MAR2022 – MAR2023

Project Objective

To conduct basic ecological studies of Tinian monarch (*Monarcha takatsukasae*)

Conservation Benefit

Knowledge of basic Tinian monarch (*Monarcha takatsukasae*) biology and ecology will enable effective and efficient management strategies. Results will guide development of future predator control and/or forest restoration and enhancement measures.

FY22 Status

- Phase 1 complete; 261 birds banded, 151 nests + veg paired plots
- Preparation complete for Phase 2 – telemetry

Preliminary results from MAR2021-MAR2022:

- Survivorship, home range size, incubation period, and nestling development similar to previous findings
- Nesting success rate 55%
- Rat predation - primary cause of nest failure across all nesting stages
- Nests typically under a closed ~4 meter canopy and near a large 11-12 meter tree
- Most common nest trees: *Aglaia mariannensis*, *Ficus tinctoria* in native limestone forest and secondary vegetation; *Bauhinia monandra* in tangantangan forest
- First interim report received May 2022. Next report due spring 2023.

EPR: CHS MAR JRM Tinian Forest Bird Monitoring; 61755NR303

2019 JRM INRMP Reference: TPS-4; 11-65

Table 1. Comparison of habitat characteristics at Tinian monarch nest sites and paired plots.

	Nest sites				
	% bare ground	% leaf litter	% rocks	% plant cover	% canopy cover
Native	5	47	8	40	94
Secondary	2	51	9	38	93
Tangan	2	55	1	42	90
Grand Total	3	51	7	40	93
	Paired plots				
	% bare ground	% leaf litter	% rocks	% plant cover	% canopy cover
Native	2	34	8	56	81
Secondary	1	35	4	60	77
Tangan	1	40	2	58	85
Grand Total	1	35	5	58	80

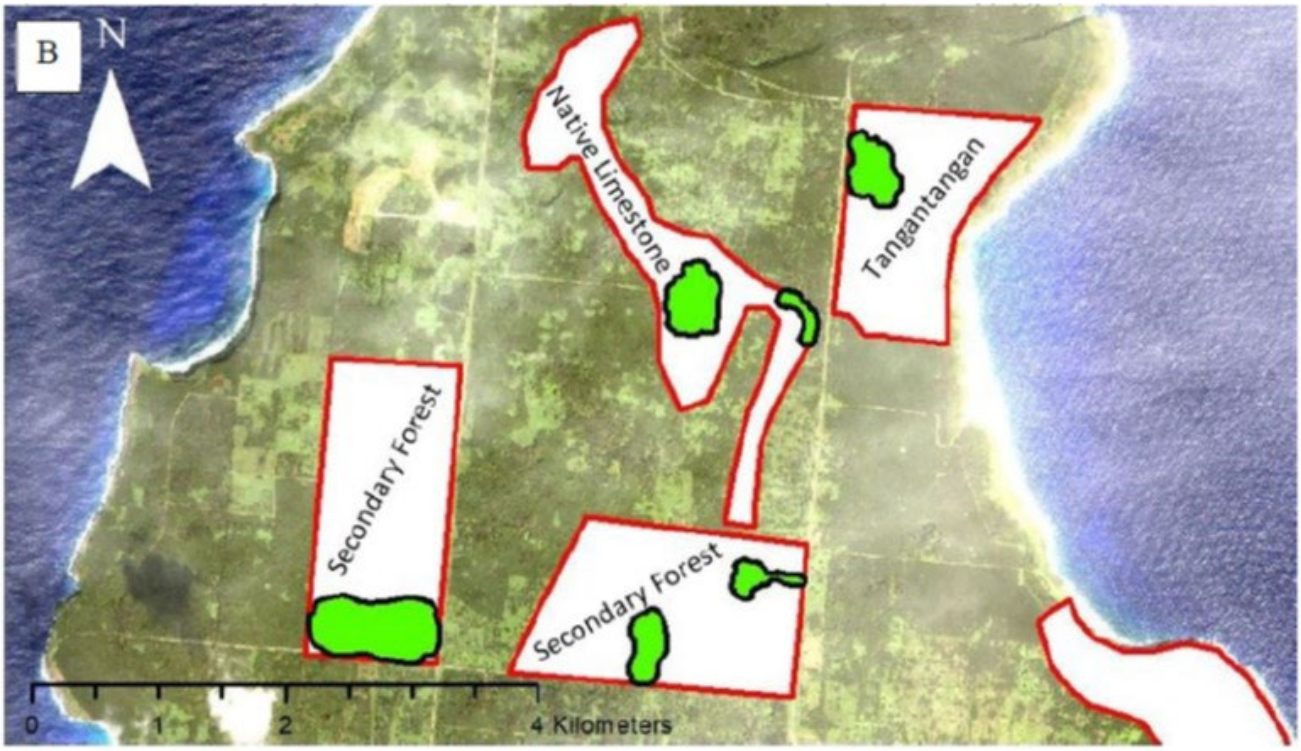

Figure 10. Location of Tinian monarch study sites.

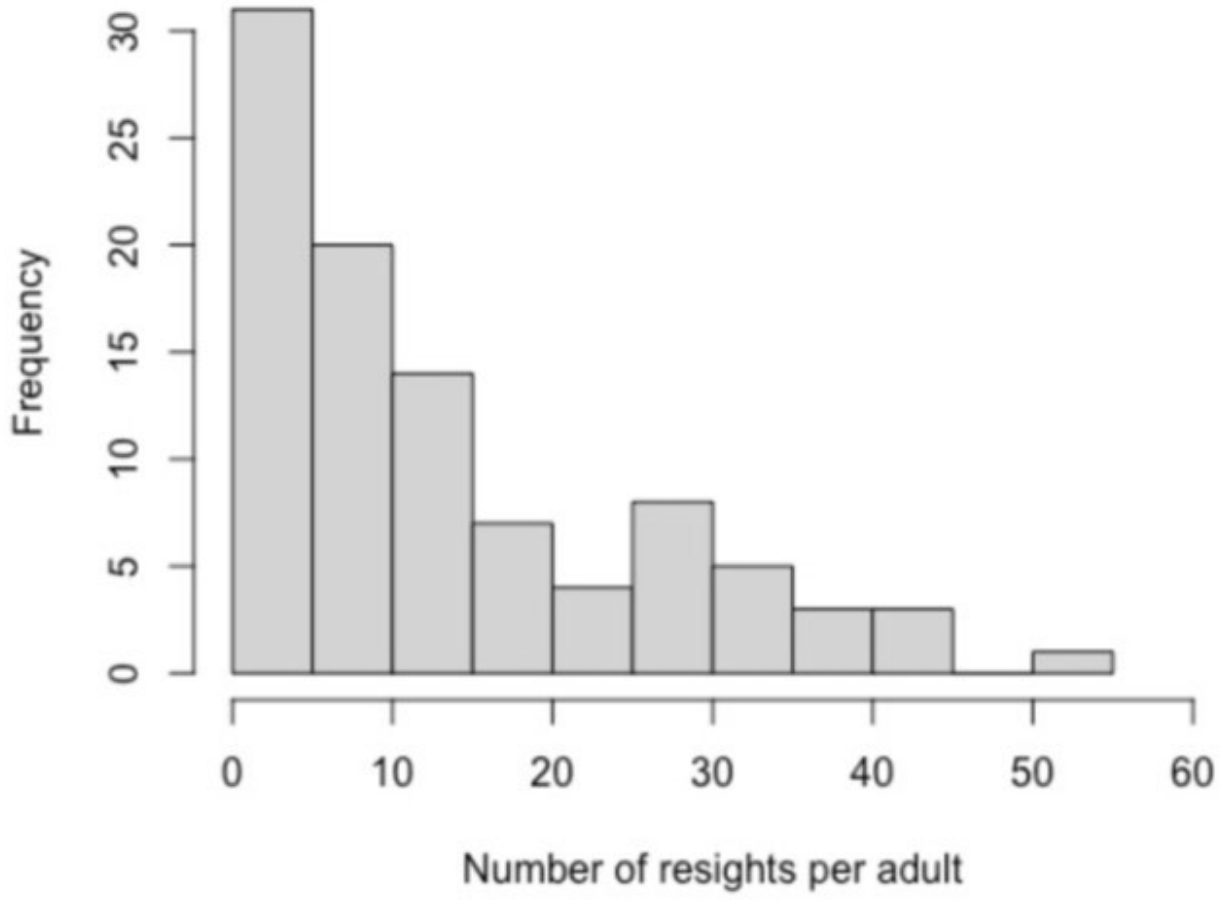

Figure 11. Adult Tinian monarch resight frequency distribution through Feb 2022.

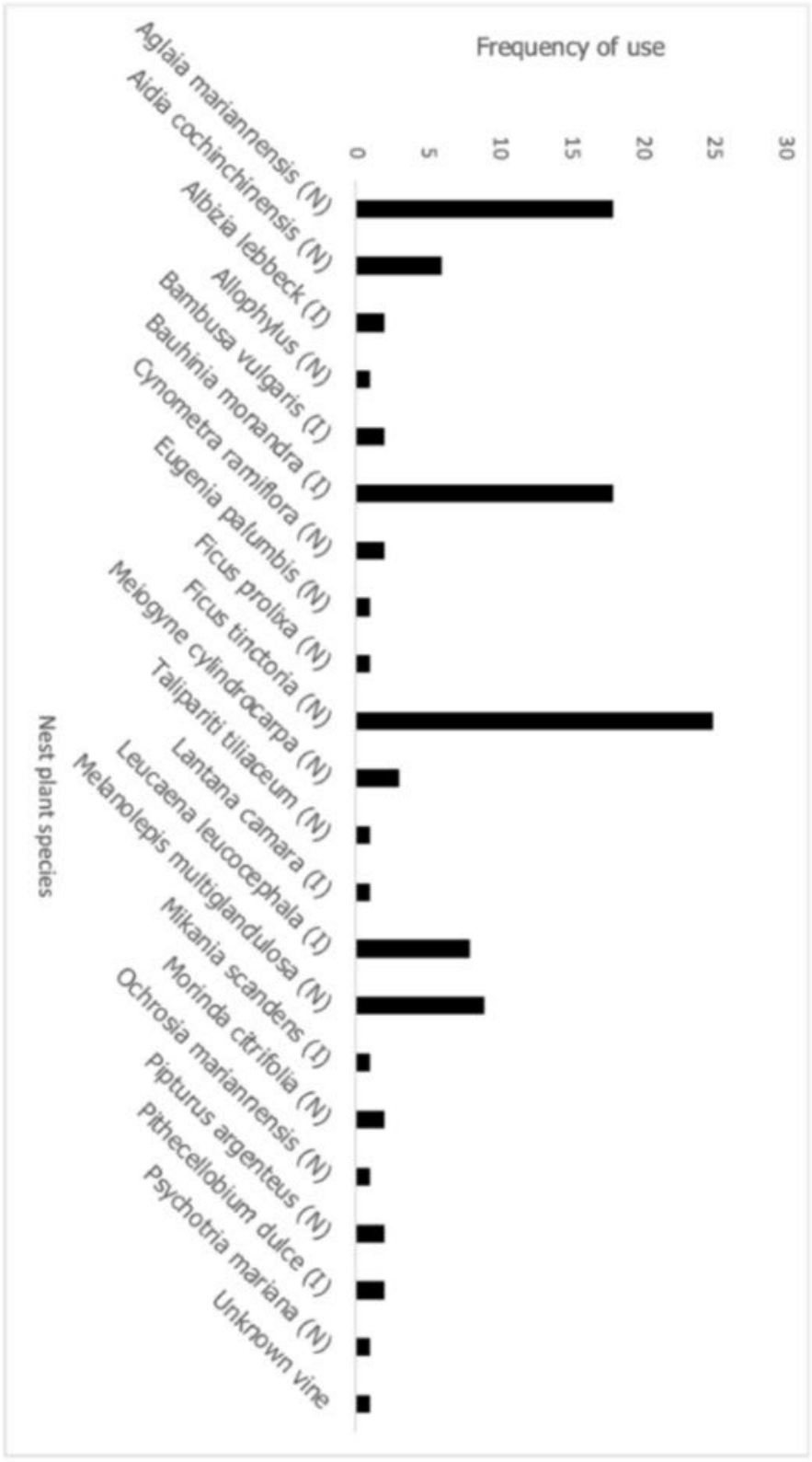

Figure 5. Frequency distribution of Tinian monarch nest plant species across three habitat types in the Military Lease Area on Tinian between 19 March 2021 and 1 March 2022. Habitat types included native limestone forest, secondary vegetation, and tangantangan forest. N = native; I = Introduced.

Figure 12. Tinian monarch nest tree species frequency distribution through Feb 2022.

Mariana Common Moorhen Conservation and Management

Location: Tinian MLA **Period of Performance**: AUG2021 – FEB2024

Project Objective

Monitor and investigate Mariana common moorhen (*Gallinula chloropus guami*) populations and habitat use on the Tinian MLA. Communicate and coordinate with conservation partners.

Conservation Benefit

Monitoring informs management decisions for conservation of moorhen populations. Basic ecological research underpins effective management strategies. Effective communication with partners enhances moorhen conservation and recovery efforts on Tinian and range-wide.

FY22 Status

- Lake Hagoi quarterly monitoring ongoing
- Hagoi population trend continues to appear stable
- Bateha wetlands surveyed in August
- Vegetation surveys completed in August
- DFW-led working group established
- Report will be available summer 2023

EPR: 1 S RP MAR CNMI ESA and MBTA Species Management; 61128NR211

2019 JRM INRMP Reference: TPS-3; 11-65

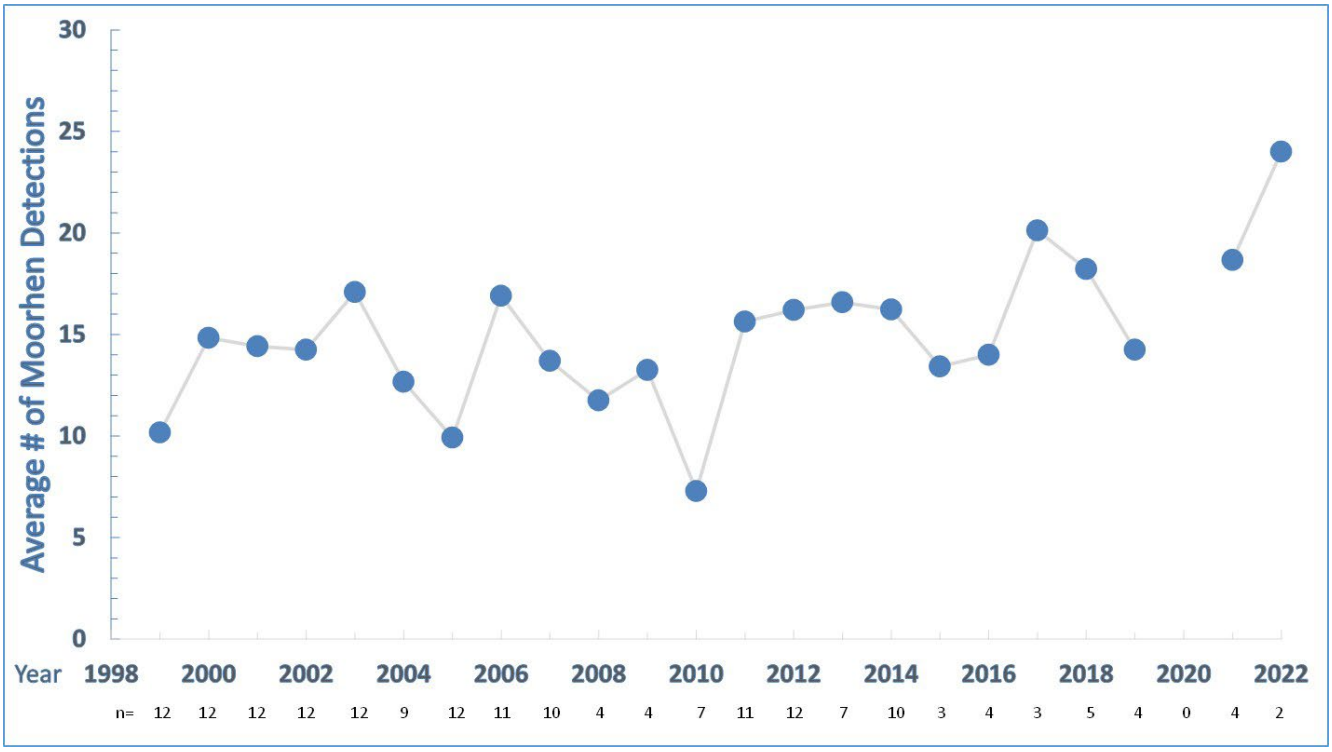

Figure 13. Lake Hagoi average number of Mariana Common Moorhen detections, 1999-2022

Monitoring for Sea Turtle Nesting Activity

Location: Tinian MLA **Period of Performance**: JUN2021 – JUN2022

Project Objective

Maximize sea turtle nesting opportunities and success on all Tinian MLA beaches

Conservation Benefit

Monitoring informs sea turtle conservation and management decisions.

FY22 Status

- Final report for JUN2021-JUN2022 in review
- 34 nests, 8 non-nesting emergences
- Tidal inundation impacted 7% of nests
- 28 nest inventories were conducted: mean clutch size 86; hatch success 77%, emergence success 75%
- New contract awarded JUL2022 – twice monthly surveys ongoing

EPR: 1 S RP MAR CNMI ESA and MBTA Species Management; 61128NR211

2019 JRM INRMP Reference: TPS-2; 11-64

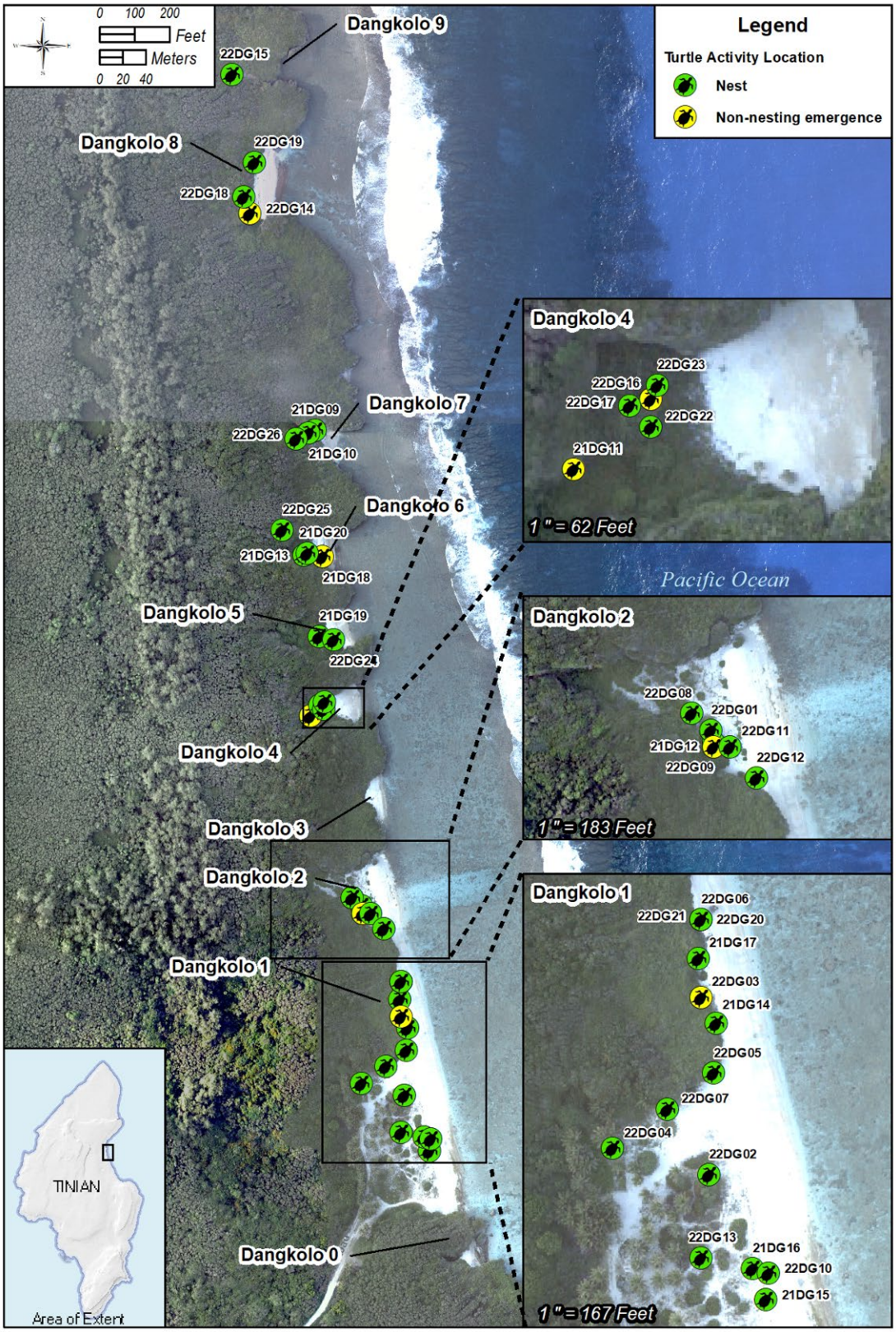

Figure 14. Dangkulo beach, Tinian green turtle nest and non-nesting emergence locations documented between July 8, 2021 and June 18, 2022.



Figure 15. Masålok beach, Tinian green turtle nesting and non-nesting emergence locations documented between July 8, 2021 and June 18, 2022.

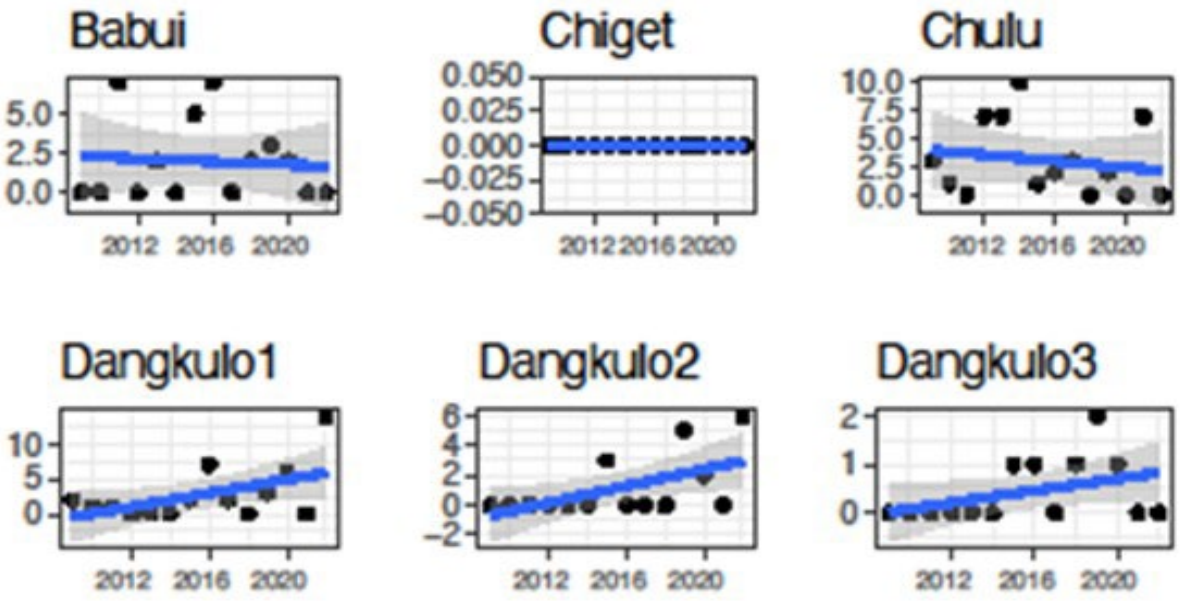

Figure 16. Nesting activity trend for 6 Tinian MLA beaches, 2009-2022

Beach Cleanups on the Tinian MLA

Location: Tinian MLA **Period of Performance**: JUN2021 – JUN2022

Project Objective

Removal of marine debris from all MLA beaches annually to enhance successful sea turtle nesting.

Conservation Benefit

The removal of marine debris reduces entanglements and allows successful nest excavation and egg deposition. Secondary benefits accrue to other marine species and ecosystems, and in goodwill with the Tinian public.

FY22 Status

- 3,103 lbs of debris removed from 18 MLA beaches (~half the weight of previous year)
- Plastic comprised 69.5% of debris collected by weight
- Final report in review
- New contract awarded JUL2022

EPR: 1 RP MAR CNMI ESA and MBTA Species Management; 61128NR211

2019 JRM INRMP Reference: TPS-2; 11-64



Figure 17. Before and after cleanup of Dangkulo pocket beach #7, June 6, 2022. Photo: Jessy's Tag Services

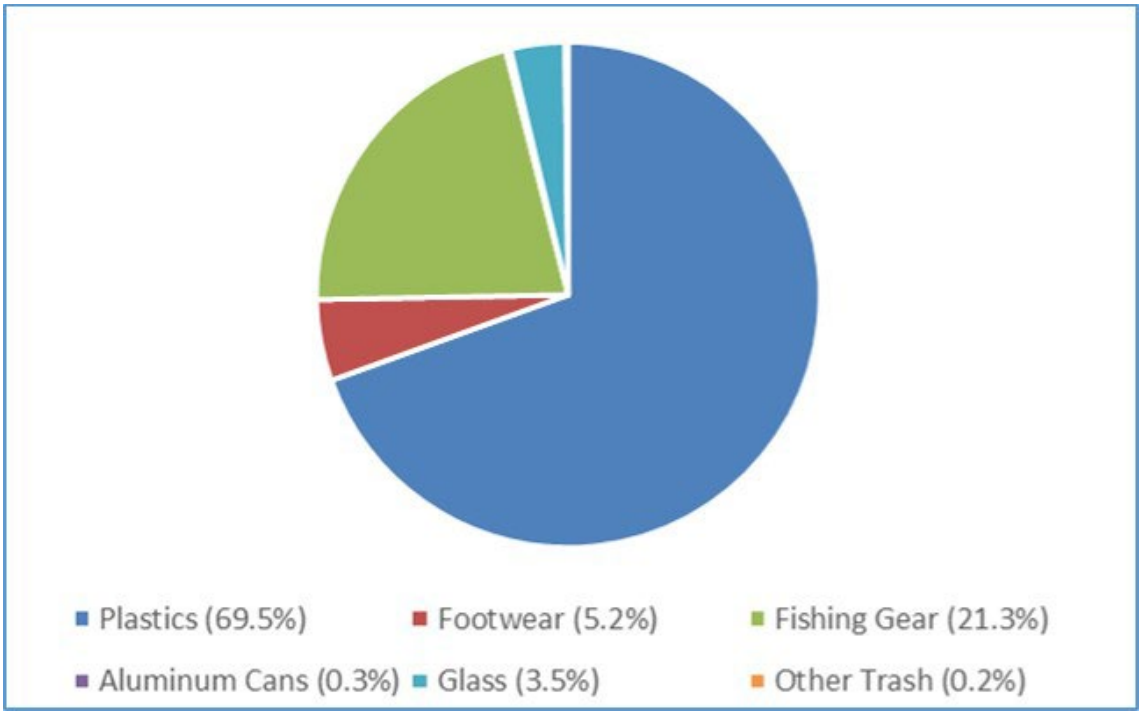

Figure 18. Debris Types Collected at MLA Beach Cleanups JUL2021-JUN2022 (by Weight)

Conservation of Tinian *Cycas micronesica* Plantings

Location: Tinian MLA **Period of Performance**: MAY2022 – MAY2023

Project Objective

To conserve representative plants of Micronesian cycad (*Cycas micronesica*) populations from Guam.

Conservation Benefit

Micronesian cycads on Tinian provide an assurance population which enhances species resiliency to catastrophic events. The Tinian population is suitable for cycad studies and testing of new management strategies.

FY22 Status

- Maintenance of Tinian cycad plots continued
- Annual health assessment data collected
- 35 cycads at 6 tourist sites outside of plots as of February 2022; Mt Lasso Overlook only tourist site w/*Aulacaspis* scale
- No scale predators found in plots during Feb 2022 survey
- Ongoing coordination with partners, including multiple reports in last year with relevance to Tinian:
    - Oct 2021, “Tinian MLA Fadang Ex Situ Population Strategy Evaluation”, NAVFACMAR
    - Mar 2022, “Report to the U.S. Fish and Wildlife Service-Pacific Islands Division on a visit to Guam March 3-17, 2022”, University of Florida
    - Apr 2022, “Monitoring Cycad Aulacaspis Scale (CAS), *Aulacaspis yasumatsui*, Infesting *Cycas micronesica* in the Tinian Conservation Plots Using Sticky Traps”, University of Guam
- Final report due early 2023

EPR: 1 CP MAR Conservation Management of Tinian Cycads; 61128NR162

2019 JRM INRMP Reference: TPS-1; 11-64

Table 2. Number of live ornamental cycads on the Tinian MLA, 2016 and 2022

Site	2016	2022
North Field	12	10
Chulu Roundabout	4	0
Broadway Roundabout	5	5
Hinode Shrine	14	9
WWII Army Hospital	3	3
Mount Lasso Overlook	5	5*
WWII Cannon	5	3
Total	**48**	**35**
*Infested w/*Aulacaspis*		



Figure 19. Reproductive ornamental cycads on the Tinian MLA, 2022. Photo: Jill Liske-Clark

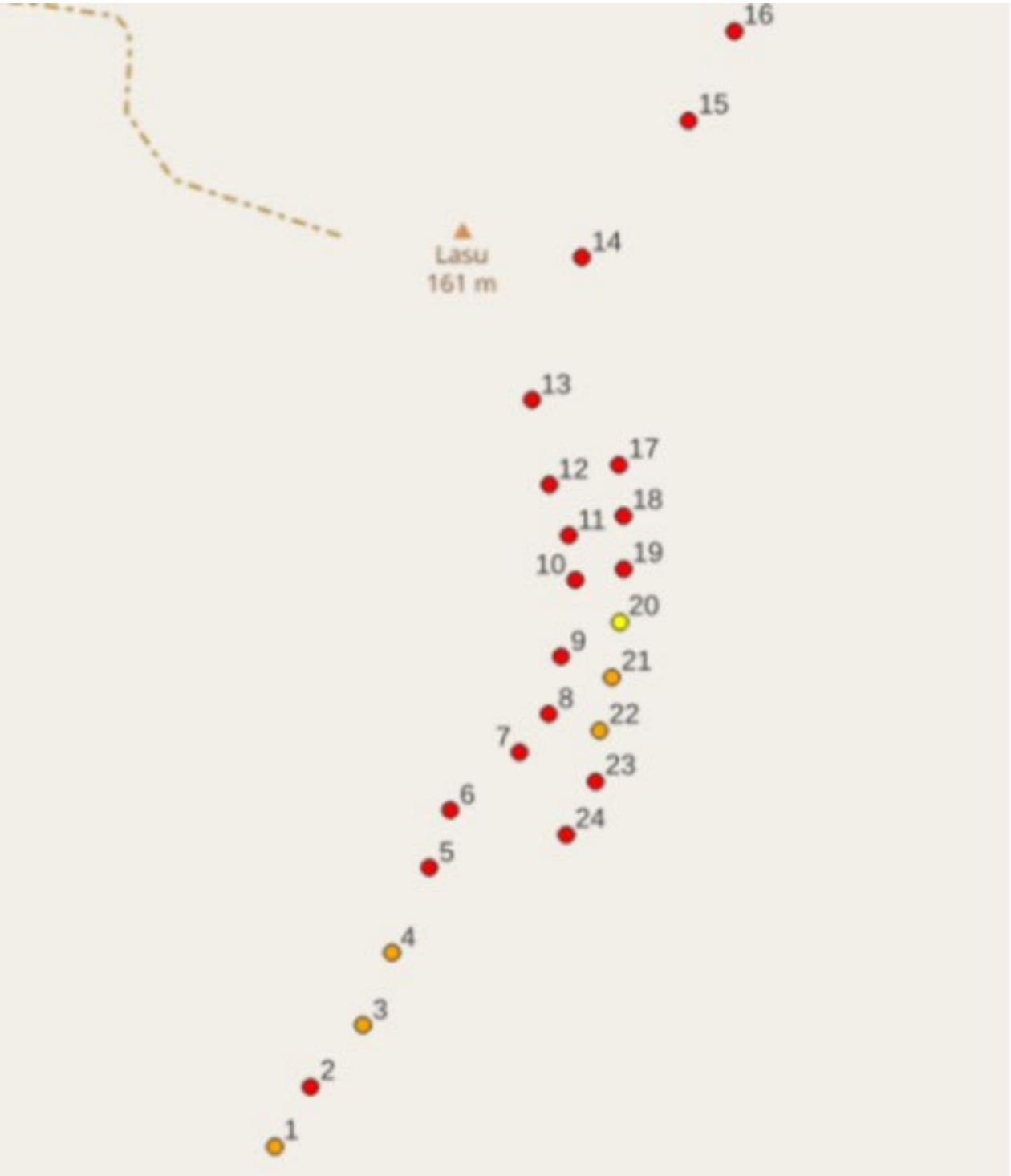

Figure 20. Field evaluation of *Aulacaspis yasumatsui* (presumed) cycad scale infestation level in Tinian plots, February 2022. Yellow=low; orange=medium; red=high

CONSERVATION LAW ENFORCEMENT PROGRAM

Location: Tinian MLA **Period of Performance**: NA

Project Objective

To establish a conservation law enforcement program for the Tinian MLA.

Conservation Benefit

A conservation law enforcement program will detect and deter unauthorized activity that negatively affects natural resources (terrestrial and marine) on the Tinian MLA.

FY22 Status

- Solicited a conservation law enforcement needs assessment contract
- No award was made due to insufficient funding
- Will be re-solicited in FY23

EPR: SIKES MAR JRM Conservation Law Enforcement Program; 61128NR589

2019 JRM INRMP Reference: TLAW-1; 11-69

NATURAL RESOURCES EDUCATION AND OUTREACH

JRM Natural Resources Stewardship Outreach & Public Engagement Program

Location: JRM **Period of Performance**: AUG2021 – Ongoing; New SEP2022

Project Objective

To develop outreach products to effectively and efficiently implement a natural resources (NR) stewardship engagement program. This program aims to better educate uniformed and civilian staff, their dependents, JRM contractors, and the general public in order to improve NR stewardship and awareness within JRM AOR.

Conservation Benefit

The development and production of NR education materials and training is a beneficial support to increasing awareness of Threatened and Endangered species, proper stewardship behavior, and threats to local ecosystems.

FY22 Results

- Ongoing production of Environmental Stewardship Website
- Ongoing production of outreach swag items to support Tinian Art Contest and Turtle Educational Outreach Project
- Ongoing update of Public Access Plan (PAP) site descriptions and photos
- Ongoing 360 degree camera photos of 3 PAP sites to be featured on Environmental Stewardship Website
- Projected completion of tasks by 31OCT2022
- New project awarded 09SEP2022 for the production of 3 to 5 minute outreach video for use across JRM AOR

EPR: 61128NR962 JRM Natural Resources Stewardship Outreach and Public Engagement Program

2019 JRM INRMP Reference: TEDU-1; 5-91, MEDU-1; 5-104

PACFLT Funded JRM Natural Resources Stewardship Outreach & Public Engagement Program

Location: JRM **Period of Performance:** SEP2020 - Ongoing

Project Objective

Improve natural resources (NR) stewardship and awareness within JRM AOR.

Conservation Benefit

The development and production of NR education materials and training is a beneficial support to increasing awareness of T&E species, proper stewardship behavior, and threats to local ecosystems.

FY22 Results

- Ongoing implementation and expansion of Young Environmental Stewards (YES!) youth educational program
- Ongoing CNMI outreach initiative in conjunction with EPR 61128NR962 JRM Natural Resources Stewardship Outreach and Public Engagement Program
- Distribution of 4 T&E species themed reusable shopping bags at installations, various DoD events, and public outreach events on Guam.
- Production and delivery of Nature Journals and Passport interactive materials estimated for OCT2022
- Ongoing development of sea turtle interactive classroom game

EPR: NA- Funding from PACFLT Stewards of the Sea Initiative

2019 JRM INRMP Reference: TEDU-1; 5-91, MEDU-1; 5-104

Horeg, Jennifer A CIV (USA)

From: Horeg, Jennifer A CIV USN NAVFAC
Sent: Wednesday, May 25, 2022 4:50 PM
To: 'Flores, Jacqueline B'; 'tammy_summers@fws.gov'; 'Arlene Pangelinan'; 'Kevin Brindock - NOAA Federal'; 'Joel Moribe - NOAA Federal'; 'Jonathan Brown - NOAA Federal'; 'Steven McKagan - NOAA Federal'; 'jay.gutierrez@doag.guam.gov'; 'glenna.sakisat.palacios@gov.mp'; 'Bogardus, Michelle'
Cc: Lujan, Dana T CIV USN NAVFACMAR; MCVEIGH, Cyndele E LT USN NAVFAC; Moon, Edward E CIV USN NAVFAC; Borja, ALBERT (CAMP BLAZ USMC); Diebel, Sarah E (USAF); Cruz, Mark D CIV USN NAVFAC; Burrell, Noah S CIV USN NAVFAC; 'Conkle, Tamara S CIV NAVFAC HQ, EV'; 'Mayes, Thomas A CIV USN COMNAVFACENGCOM DC (USA)'; 'Gardner, Jeffrey A CIV USN COMNAVFACENGCOM DC (USA)'; 'Watterson, James C (Carter) CIV USN NAVFAC LANT NOR VA (USA)'; Podbesek, Jennifer A CIV USN DCNO N4 (USA)
Subject: FY22 Joint Region Marianas Natural Resources Metrics - September 2022

Hafa Adai Resource Partners,

I would like to kindly request your participation in the FY22 Joint Region Marianas Natural Resource Metrics meetings. We will be holding in-person meetings on the following dates:

15-16 Sep: CNMI
21-22 Sep: Guam

More information regarding the venues and agenda will be provided as we get closer to the meeting dates.

Please mark your calendars and have a great summer!

Jennifer Cruce Horeg
Natural Resources Program Supervisor / Section 7 Lead
Naval Facilities Engineering Systems Command Marianas (NAVFACMAR)
Jennifer.horeg@fe.navy.mil
Office: 671-339-1275

* Please note that I am currently teleworking and am available at the following number: (671) 487-2040

FY22 Guam Natural Resources Metrics Meeting

21 Sep 2022

Guam Hyatt

NAME	ORGANIZATION	EMAIL
(Trey) William Dunn	USFWS	William_Dunn@FWS.GOV
Matthew D Burt	Navy	Matthew.burt.4@us.af.mil
Leanne	Navy	Leanne.Obra@fe.navy.mil
Scott Vogt	Navfac	
MATT KEDZIORA	NAVY	matthew.kedziora@fe.navy.mil
Sheeka Tareyama	Camp Blaz	sheeka.tareyama@usmc.mil
Candice Arceo	NAVFAC/AAFB	candice.arceo@us.af.mil
Barbara Torres	NAVFAC MAR	barbara.torres@us.af.mil
Megan Volksteadt	DAWR	megan.volksteadt@doag.guam.gov
Diane Vice	DAWR	diane.vice@doag.guam.gov
Jane Dia	DAWR	jane.dia@doag.guam
Michelle Bogardus	USFWS	Michelle_Bogardus@FWS.GOV
Jacqueline Flores	USFWS	jacqueline_flores@fws.gov
Toni Mizerek	USFWS	toni_mizerek@fws.gov
Jerome Perez	NAVFAC / MCBCB	jerome.perez@usmc.mil
A. Loerzel	Camp Blaz	
MARIO MARTINEZ	NAVFAC	mario.martinez@fe.navy.mil
Stephen Mosher	NAVFAC MAR	stephen.mosher@fe.navy.mil
Jude Martinez	NAVFAC MAR	jude.martinez@fe.navy.mil
HALL, MARC	NAVFAC MAR	marc.hall@fe.navy.mil
Megan Parker	NAVFAC MAR	megan.parker@fe.navy.mil
Shermaine Garcia	NAVFAC MAR	shermaine_nicole.garcia.2@us.af.mil
Frank Alig	NAVFAC MAR	franklin.alig@pz.navy.mil

FY22 Guam Natural Resources Metrics Meeting

21 Sep 2022

Guam Hyatt

NAME	ORGANIZATION	EMAIL
ANDRES REYES	NAVFAC MAR	
ALBERT BOTA	MCBCB PWD	
Anjelica Perez	NAVFAC MAR NBG PWD	
Noah Burrell	NAVFAC MAR EV CNRÉ	
Christine C. Fejeran	Guam DOAG- Forestry	Christine.fejeran@doag.guam.gov

FY22 Guam Natural Resources Metrics Meeting

21 Sep 2022

Guam Hyatt

Telecom Link

NAME	ORGANIZATION	EMAIL
DAWN BRUNS	USFWS	
LAUREN TAYLOR	USFWS	
MIKE RICHARDSON	USFWS	
Christine Fejeran	Guam Ag / Forestry	
Jonathan Brown	NMFS	
Coralie Cobb	NFP / Camp Blaz	
Suzanne Medina	DAWR	
Jay Gutierrez	DAWR	
Jason Biggs	DAWR	
Odessa San Nicolas	Guam Ag / Foresty	
Rudy Estay	Guam Ag / Foresty	
Tammy Conkle	NAVFAC HQ	
Laura Dunbar	USFWS	
Heather Benedict	USFWS	

FY22 Guam Natural Resources Metrics Meeting

22 Sep 2022

Guam Hyatt

NAME	ORGANIZATION	EMAIL
Anjelica Perez	NAVFAC MAR NBG PWD	
A. Loerzel	NavFacMar Camp Blaz	
Matthew Burt	Nav Fac Mar AAFB	
Scott Vost	NAVFACMARAAFB	
Jacqueline Flores	USFWS	jacqueline_flores@fws.gov
Toni Mizerek	USFWS	Toni_Mizerek@fws.gov
Trey Dunn	USFWS	William_Dunn@FWS.GOV
Diane Vice	DAWR	diane.vice@doag.guam.gov
ANDRES REYES	NAVFAC MAR	andres.reyes@fe.navy.mil
Megan Parker	NAVFAC MAR	megan.parker@fe.navy.mil
FRANK ALIG	NAVFAC MAR	Franklin.alig@fe.NAVY.mil
Stephen Mosher	NAVFAC MAR	stephen.mosher@fe.navy.mil
MARIO MARTINEZ	NAVFAC MAR	mario.martinez@fe.
LAUREN GUTIERREZ	NAVFAC	lauren.gutierrez@usmc.mil
Sheeka Tareyama	NavFac Camp Blaz	sheeka.tareyama@usmc.mil
Jude Martinez	NAVFAC MAR	jude.martinez@fe.navy.mil
Shermaine Garcia	NAVFAC MAR	shermaine_nicole.garcia.2@us.af.m
Candice Arceo	NAVFAC MAR/AAFB	candice.arceo@us.af.mil
Megan Volsteadt	DAWR	megan.volsteadt@doag.guam.gov
Brent Tibbatts	DAWR	brent.tibbatts@doag.guam.gov
Noah Burrell	NAVFAC MAR	
Leanne Obra	NAVFAC MAR	Leanne.Obra@fer.navy.mil
MATT KEDZIORA	NBG	matthedziora@fe.navy.mil

FY22 Guam Natural Resources Metrics Meeting

22 Sep 2022

Guam Hyatt

NAME	ORGANIZATION	EMAIL
Christine C. Fejeran	DOAG- Forestry	Christine.fejeran@doag.guam.gov
Barbara Torres	NAVFAC MAR-Andersen AFB	barbara.torres@us.af.mil
Emily Snider	NAVFACMAR-AAFB	emily.snider.2@us.af.mil
Jill Liske-Clark	NAVFACMAR	jill.liske-clark@fe.navy.mil

FY22 Guam Natural Resources Metrics Meeting

22 Sep 2022

Telecom Link

Guam Hyatt

NAME	ORGANIZATION	EMAIL
Tammy Conkle	NAUFAC HQ	
Carlie Cobb	NFP	
Lauren Taylor	USFWS	
Heather Benedict	USFWS	
Dawn Burns	USFWS	
Suzanne Madej	DAWR	
Jay Gutierrez	DAWR	
Justin Fujimoto	NFP	
Lorraine Shaughnessy	NFP	

FY22 CNMI JRM INRMP METRICS MEETING

Pacific Islands Club

Annex Room

Thursday, September 15, 2022

Conference Call Information: 1-(866)-692-4538

Participant Code: 5382476#

SIGN-IN SHEET

	Name	Agency	Phone #	Email
1	Noah Burrell	NAVFACMAR	6716854580	noah.burrell@fe.navy.mil
2	Stephen Mosher	NAVFACMAR	671-486-1164	stephen.mosher@fe.navy.mil
3	ANDRES REYES	NFM	671-489-5404	andres.reyes@fe.navy.mil
4	MARIO MARTINEZ	NFM	671-685-5610	mario.martinez@fe.navy.mil
5	Megan Parker	NAVFACMAR	6713392344	Megan.Parker@fe.navy.mil
6	Kim Hofschneider	INDOPACOM	671-682-6852	kimberly.hofschneider.1@us.af.mil
7	Jill Liske-Clark	NAVFACMAR	671-687-0600	jill.liske-clark@fe.navy.mil
8	MANNY M. Pangelinan	DLNR-DFW	670-483-6262	Mpangelinan.cnmidfw@gmail.com
9	Lisa Sztukowski	DLNR	6703229834	lisaszt.dlnr@gmail.com
10	Brad Eichelberger	DLNR-DFW	670-588-7297	beichelberger.cnmi.dfw@gmail.com
11	Emilie Kohler	DLNR-DFW	6702857125	Kohler.dfw@gmail.com
12	LeeRoy Sablan	DLNR-DFW	671-977-8402	leeroys.cnmidfw@gmail.com
13	Ellie Roark	DLNR-DFW	670 287 6241	eroark@.dfw@gmail.com
14	Arthur Charfauros	BECQ-DCRM	670 664 8300	ACHARFAUROS@DCRM.GOV.MP
15	Rich Salas	BECQ-DCRM	670 664 8300	rSalas@dcrm.gov.mp
16	Nathan Van Ee	DLNR-DFW	670 285 8800	nvanee.cnmidfw@gmail.com
17	Michael Tenorio	DLNR-DFW	670 285 0427	mtenorio_dfw@live.com
18	Rodney Camacho	BECQ-DCRM	6706648300	rcamacho@dcrm.gov.mp
19	Tyler Willsey	USFWS	670 488-8957	tyler_willsey@fws.gov
20	Trey Dunn	USFWS	6702878076	William_Dunn@fws.gov
21	Conya Achar	CNMI	C704880330	administrative.assistant@cnmi.gov.mp
22	Michelle Bogardus	USFWS	252-267-9738	Michelle_BOgardus@fws.gov
	JACQUELINE FLORES	USFWS	6717896094	jacqueline_flores@fws.gov

People

Share invite

Currently in this meeting (9)

DL Dana Lujan (Guest)

AS Amanda Santos (Guest)

FS Frances Sablan (Guest)

IK Ignacio Kiyoshi

JK James Kwon (Guest)

JH JD Herndon

JG Joshua Guilbert

LT Lauren Taylor (Guest)

MP **megan parker**
Organizer

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D5 2023 Annual Report

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DEPARTMENT OF THE NAVY
JOINT REGION MARIANAS
PSC 455, BOX 211
FPO AP 96540-1000

5090
Ser J4/0055
22 Feb 24

From: Commander, Joint Region Marianas
To: Resource Partners

Subj: FISCAL YEAR 2023 NATURAL RESOURCES/INTEGRATED NATURAL RESOURCES MANAGEMENT PLAN METRICS SUMMARY REPORT

Ref: (a) OPNAV-M-5090.1

Encl: (1) JRM INRMP Summary of FY23 Projects for Guam and CNMI
(2) FY 2023 Natural Resources INRMP Metrics Results
(3) FY 2023 Natural Resources INRMP Metrics Invitation and Attendee List

1. In accordance with reference (a), Navy installations are required to submit an annual report summarizing the recent Natural Resources/Integrated Natural Resources Management Plan (INRMP) Metrics meeting and status of the INRMP in enclosure (1). The Natural Resources/INRMP Metrics summary scores presented in enclosure (2) are generated from the Navy Conservation website to reflect current status of INRMP execution.

2. The Fiscal Year (FY) 23 Joint Region Marianas (JRM) Natural Resources/INRMP Metrics meeting for Commonwealth of the Northern Mariana Islands (CNMI) resource partners was held at the Hyatt Regency Saipan on September 14, 2023 and the JRM INRMP Metrics meeting for Guam resource partners was held at the Hyatt Regency Guam on September 20 and 21, 2023 in enclosure (3).

3. The Final 2019 JRM INRMP was completed and signed by partner agencies (U.S. Fish and Wildlife Service, National Marine Fisheries Service, Guam Department of Agriculture, and CNMI Department of Land and Natural Resources-Division of Fish and Wildlife) in June through August 2019. Annual updates are conducted each calendar year beginning in 2020 and a 5-year review for operation and effect will be conducted in 2024 per the OPNAVINST 5090.1E, reference (b), sections 670a-f. The FY22 JRM INRMP update was completed and distributed in March 2023.

4. Thank you for your participation in our Natural Resources/INRMP Metrics meeting and for your support of the JRM Natural Resources Program. If you have any questions, please contact Jennifer Horeg, Natural Resources Program Supervisor, at 671-339-1275 or via e-mail at Jennifer.a.horeg.civ@us.navy.mil.

G. C. HUFFMAN

Subj: FISCAL YEAR 2023 NATURAL RESOURCES/INTEGRATED NATURAL RESOURCES MANAGEMENT PLAN METRICS SUMMARY REPORT

Distribution:

Earl Campbell, PhD
Field Supervisor
U.S. Fish and Wildlife Service
Pacific Islands Fish and Wildlife Office
300 Ala Moana Boulevard, Room 3-122 Box 5008
Honolulu, HI 96816

Mr. Michael Tosatto
Regional Administrator
National Marine Fisheries Service
Pacific Islands Regional Office
1845 Wasp Blvd., Bldg 176
Honolulu, HI 96818

Ms. Chelsa Muna-Brecht
Director
Guam Department of Agriculture
163 Dairy Road
Mangilao, GU 96913

Mr. Sylvan Igisomar
Director
CNMI Department of Land and Natural Resources
P.O. Box 10007
Saipan, MP 96950

Programmatic Division U.S. Fish and Wildlife Service
Pacific Islands Fish and Wildlife Office
Marianas Office, U.S. Fish and Wildlife Service, Pacific Islands Fish and Wildlife Office
300 Ala Moana Boulevard, Room 3-122 Box 5008
Honolulu, HI 96816

Mariana Islands Refuges and Monument Complex
P.O. Box 8134, MOU-3
Dededo, GU 96912

U.S. Fish and Wildlife Service
Ecological Services
P.O. Box BT
Hagatna, GU 96932

CNIC Washington DC (N45) NAVFACENGCOM Washington DC (EV2)

FY23 Natural Resources/INRMP Metrics Results

2023 Natural Resources Annual Report: NSA ANDERSEN

Summary Score

Focus Area	Score
1 - Natural Resources Management	0.59
2 - Listed Species Critical Habitat	0.81
3 - Recreation Use and Access	0.95
4 - Sikes Act Cooperation	0.88
5 - Team Adequacy	0.60
6 - INRMP Implementation	0.86
7 - Support of Installation Mission	0.64
NSA ANDERSEN - Overall Score	0.76

2023 Natural Resources Annual Report: NB Guam

Summary Score

Focus Area	Score
1 - Natural Resources Management	0.81
2 - Listed Species Critical Habitat	0.88
3 - Recreation Use and Access	0.95
4 - Sikes Act Cooperation	0.87
5 - Team Adequacy	0.89
6 - INRMP Implementation	0.91
7 - Support of Installation Mission	0.64
NB Guam - Overall Score	0.85

FY23 Natural Resources/INRMP Metrics Results

2023 Natural Resources Annual Report: Tinian MLA

Summary Score

Focus Area	Score
1 - Natural Resources Management	0.56
2 - Listed Species Critical Habitat	0.81
3 - Recreation Use and Access	0.83
4 - Sikes Act Cooperation	0.89
5 - Team Adequacy	0.74
6 - INRMP Implementation	0.96
7 - Support of Installation Mission	0.68
Tinian MLA - Overall Score	0.78

2023 Natural Resources Annual Report: Farrallon de Medinilla FDM

Summary Score

Focus Area	Score
1 - Natural Resources Management	0.58
2 - Listed Species Critical Habitat	0.58
3 - Recreation Use and Access	N/A
4 - Sikes Act Cooperation	0.88
5 - Team Adequacy	0.84
6 - INRMP Implementation	0.83
7 - Support of Installation Mission	0.68
Farrallon de Medinilla - Overall Score	0.63

2023 Natural Resources Annual Report: OVERALL SCORE SUMMARY

Summary Score

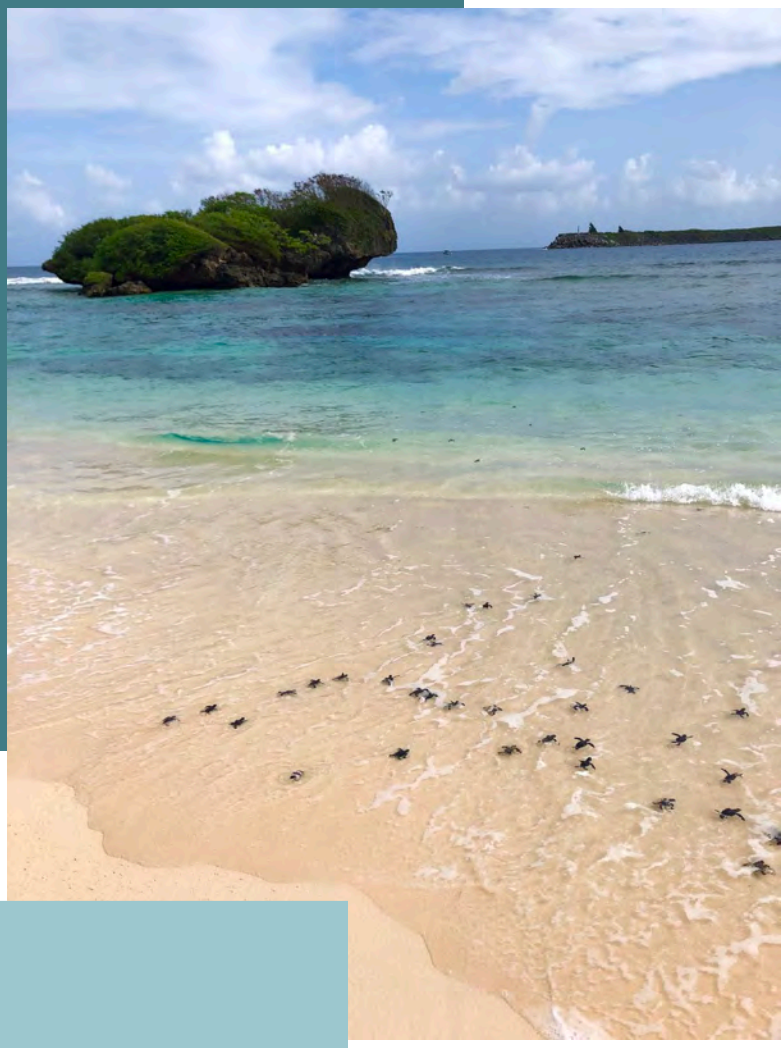
Focus Area	Score
1 - Natural Resources Management	0.64
2 - Listed Species Critical Habitat	0.77
3 - Recreation Use and Access	0.68
4 - Sikes Act Cooperation	0.88
5 - Team Adequacy	0.77
6 - INRMP Implementation	0.89
7 - Support of Installation Mission	0.66
Overall Score Summary (Farrallon de Medinilla FDM, NB Guam, Tinian MLA, NSA ANDERSEN)	0.76

- The Navy Conservation Website is the tool used to collect data
- Scoring and Weighting
  - INRMP Implementation Focus Area
    - Red = 0-50% , Yellow = 50%-75%, Green = 75%-100%



  - Remaining 6 Focus Areas
    - Key questions have higher weighted values to influence the total score
    - The score of each Focus Area is a “weighted average”
  - The final score of Focus Area is expressed as a decimal value between 0 and 1.
    - Not a percentile measurement
    - Red = 0.0 to 0.33, Yellow = 0.34 to 0.66, Green = 0.67 to 1.0





Release of 50 green sea turtle hatchlings at Spanish Steps beach.

Photo: US Navy.

Joint Region Marianas Integrated Natural Resources Management Plan Project Summaries 2023

GUAM REPORT

Naval Facilities Engineering Systems Command
NAVFAC Marianas

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ACRONYMS AND ABBREVIATIONS

ACRONYM	DESCRIPTION
AAFB	Andersen Air Force Base
ADS	Automated Delivery System
AFPMB	Armed Forces Pest Management Board
AOR	Area of Responsibility
BO	Biological Opinion
BTS	Brown Treesnake
CESU	Cooperative Ecosystem Studies Units Network
CEMML	Center for Environmental Management of Military Land
CGAPS	Coordinating Group on Alien Pest Species
CIS	Center for Island Sustainability
CNMI	Commonwealth of the Northern Mariana Islands
COMPACFLT	Commander, U.S. Pacific Fleet
COTS	Crown-of-thorns Seastar
CP	Closed Population
CRB	Coconut Rhinoceros Beetle
CRU	Cooperative Research Unit
CSU	Colorado State University
DAWR	Division of Aquatic and Wildlife Resources
DFW	Division of Fish and Wildlife
DLNR	Department of Lands and Natural Resources
DNM	Dead Neonatal Mice
DoD	Department of Defense
DON	Department of the Navy
EOD	Explosive Ordnance Disposal
ERA	Ecological Reserve Area
ESA	Endangered Species Act
FDM	Farallon de Medinilla
Ft	foot/feet
FY	Fiscal Year
GIS	Geographic Information System

GISAC	Guam Invasive Species Advisory Committee
GISC	Guam Invasive Species Council
GMK	Guam Micronesian Kingfisher
GNWR	Guam National Wildlife Refuge
GPEPP	Guam Plant Extinction and Prevention Program
GDOAg	Guam Department of Agriculture
ha	hectare(s)
HACCP	Hazard Analysis and Critical Control Points
HMU	Habitat Management Unit
ISU	Iowa State University
INRMP	Integrated Natural Resources Management Plan
IRP	Installation Restoration Program
JRM	Joint Region Marianas
LFA	Little fire ant
LFTRC	Live Fire Training Range Complex
M	meter(s)
MEDU	Marine Natural Resources Educational Outreach
MCBCB	Marine Corps Base Camp Blaz
MGIS	Marine GIS and Data Management
MHM	Marine Habitat Management
MIG	Marine Bird Management
MIRC	Mariana Islands Range Complex
MIS	Marine Invasive Species Management
MISMP	Marine Invasive Species Management Plan
MITT	Mariana Islands Training and Testing
MLA	Military Lease Area
MLAW	Marine Natural Resources Law Enforcement
MOA	Memorandum of Agreement
MPS	Marine Protected Species Management
MSA	Munitions Storage Area
NAVFAC	Naval Facilities Engineering Systems Command
NBG	Naval Base Guam

NBGTS	Naval Base Guam Telecommunications Site
NMFS	National Marine Fisheries Service
NMS	Naval Base Guam Naval Munitions Site
NNE	Non-Nesting Emergence
NOAA	National Oceanic and Atmospheric Administration
NWF	Northwest Field
NWRC	National Wildlife Research Center
PACOM	Pacific Command
PIERC	Pacific Island Ecosystems Research Center
QA/QC	Quality Assurance/Quality Control
SOP	Standard Operating Procedure
TEDU	Terrestrial Natural Resources Educational Outreach
TGIS	Terrestrial GIS and Data Management
THM	Terrestrial Habitat Management
TIS	Terrestrial Exotic and Invasive Species Management
TLAW	Terrestrial Natural Resources Law Enforcement
TPS	Terrestrial Protected Species Management
RBP	Regional Biosecurity Plan for Micronesia and Hawaii
RFMP	Range Fire Management Plan
RISC	Micronesian Regional Invasive Species Council
UOG	University of Guam
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
USDA-WS	United States Department of Agriculture- Wildlife Services
WERI	Water and Environmental Research Institute

MARINE HABITAT MANAGEMENT

JRM Marine Invasive Species Management Plan (JRM MISMP)

Location: JRM AOR **Period of Performance:** AUG2022 – OCT2023

Project Objective

To develop standard operating procedures (SOP) and protocols to avoid and minimize: (1) the spread of new marine invasive species (MIS) into the Department of Defense (DoD) submerged lands within the JRM Area of Responsibility (AOR), and (2) the transfer of any MIS from DoD submerged lands within the JRM AOR to the Pacific region.

Conservation Benefit

The development of SOPs and protocols for a MISMP shall support natural resource managers to monitor, detect, respond, control, eradicate, and prevent the risk of MIS incursions into, out of, and within the JRM AOR, thus maintaining marine biodiversity and ecosystem functions within JRM's AOR.

FY23 Status

- Resource partners provided comments and feedback on draft chapters
- Revisions for Draft Final JRM MISMP copy currently ongoing
- Final JRM MISMP document scheduled to be completed by OCT 2023

EPR: 1 S MAR JRM Marine Ecosystem Monitoring and Coral Reef Indicators (CHS); 61128NR168

2019 JRM INRMP Reference: MIS-1; 5-102, MIS-2; 5-102, MIS-1; 8-64, MIS-2; 8-65, MIS-1; 9-88, MIS-2; 9-88, MIS-1; 11-75, MIS-2; 11-75

Water Quality Monitoring on JRM Submerged Lands

Location: JRM AOR **Period of Performance:** JUN2021 – NOV2023

Project Objective

To quantify the conductivity, temperature, depth, pH, chlorophyll A, dissolved oxygen, nitrate, and phosphate concentrations in shallow reef systems. This project aims to provide water quality data for the JRM submerged lands, Guam.

Conservation Benefit

These quantitative data will assist in determining the parameters associated with climate change that may be impacting coral reefs in order to avoid, minimize or mitigate potential adverse effects to the marine resources within these areas, especially marine protected species.

FY23 Status

- Ongoing project with UOG WERI
- Retrieved five (5) sensors from Apra Harbor after Typhoon Mawar to assess impacts on coastal water quality
- Will retrieve three (3) sensors from Inner Harbor, Ayuyu Cave, and Pati Point when weather permits to assess impacts of Typhoon Mawar
- Weekly water sampling at five (5) rivers – Sasa, Laguas, Aguada, Atantano, and Namo – measuring DO concentrations, temperature, pH, total inorganic dissolved nitrogen, and total suspended solids.
- All sensors will be redeployed after data retrieval and maintenance

EPR: EO 13751 MAR JRM Monitoring and Control of Acute Impacts on Coral Reefs – Climate; 61128CN222: Coral Habitat Enhancement

2019 JRM INRMP Reference: MIS-2; 8-65, MHM-1; 8-62, MHM-2; 8-63, MHM-3; 8-63, MGIS-1; 8-68, MHM-1; 11-73, MHM-2; 11-74, MHM-3; 11-74, MIS-2; 11-75, MPS-1; 11-76

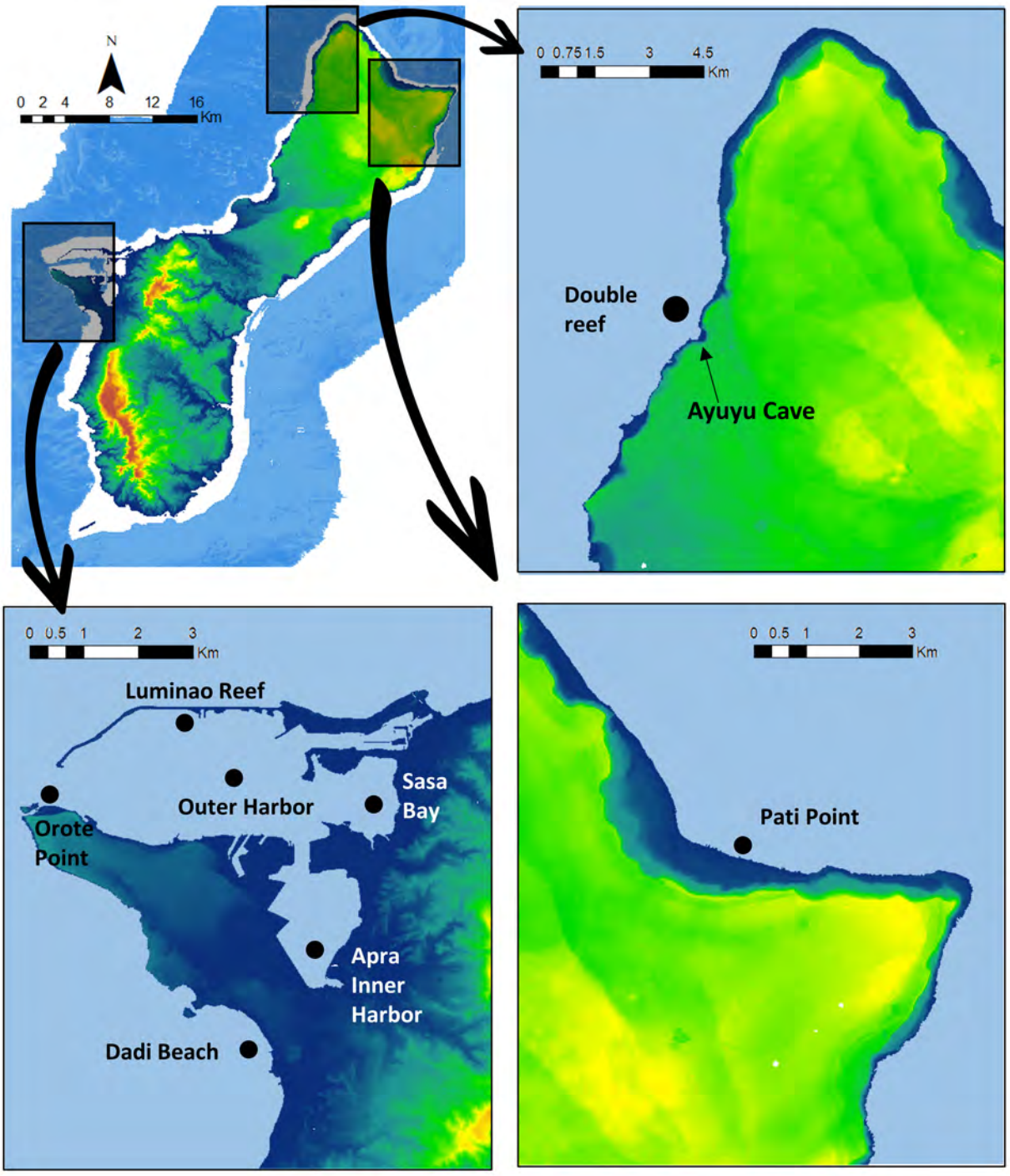


Figure 1. Deployment locations of water quality sensors in JRM submerged lands, Guam (Photo by Dr. Chris Yeo, UOG WERI).

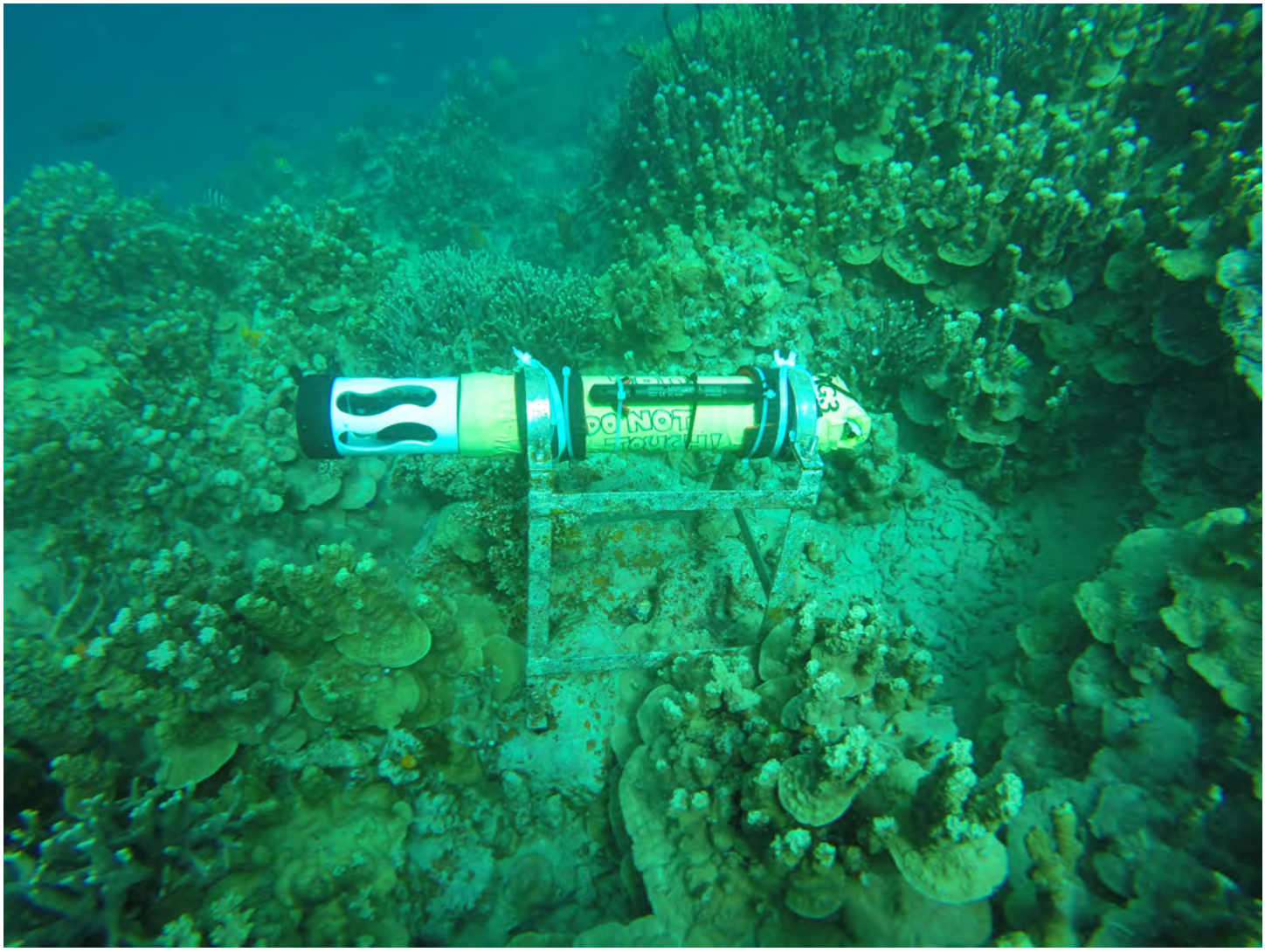


Figure 2. Example of the OTT HydroMet HL7 water quality sensor installed at Apra Harbor, Guam (Photo by Dr. Chris Yeo, UOG WERI).

Identification and Genetic Analysis of Endangered Species Act Listed Corals on Joint Region Marianas Submerged Lands in Guam

Location: NBG **Period of Performance:** AUG2023 - Ongoing

Project Objective

To identify the locations of corals, protected under the Endangered Species Act (ESA); precisely mark the location of the corals; determine the health, size, and morphology of ESA-listed corals; characterize the substrate of the corals; and conduct genetic analyses to confirm the coral identifications in JRM submerged lands in Guam.

Conservation Benefit

Mitigate damages to ESA-listed corals on JRM submerged lands in Guam, provide the best available scientific data for ESA-listed coral locations, assist with the annual updates for the JRM Integrated Natural Resources Management Plan (INRMP), and allow for critical habitat exemptions for ESA-listed species.

FY23 Status

- Awarded in AUG 2023 to Naval Information Warfare Center, Pacific (NIWC Pacific)

EPR: EO 13751 MAR JRM Monitoring and Control of Acute Impacts on Coral Reefs – Climate; 61128CN222: Coral Habitat Enhancement

2019 JRM INRMP Reference: MIS-2; 8-65, MHM-1; 8-62, MHM-2; 8-63, MHM-3; 8-63, MGIS-1; 8-68, MHM-1; 11-73, MHM-2; 11-74, MHM-3; 11-74, MIS-2; 11-75, MPS-1; 11-76

Identification and Removal of Non-Permitted Buoys on JRM Submerged Lands

Location: NBG **Period of Performance:** JUL2020 - SEP2023

Project Objective

To identify, locate, and remove the non-permitted buoys (NPBs) in JRM submerged lands.

Conservation Benefit

The identification, location, and removal of NPBs will allow individuals to use authorized (i.e., USACE-permitted) moorings in order to avoid, minimize or mitigate potential adverse effects to the marine resources within these areas, especially marine protected species.

FY23 Status

- Ongoing project with Navy Information Warfare Center
- Fieldwork completed in MAY 2023
- Final deliverables expected before SEP 2023

EPR: EO 13751 MAR JRM Monitoring and Control of Acute Impacts on Coral Reefs – Climate; 61128CN222: Coral Habitat Enhancement

2019 JRM INRMP Reference: MIS-2; 8-65, MHM-1; 8-62, MHM-2; 8-63, MHM-3; 8-63, MGIS-1 8-68



Figure 3. A shallow water mooring system buoy installed at Gab Gab Beach, Apra Harbor, Guam.



Figure 4. A possible NPB in Apra Harbor, Guam.



Figure 5. A possible NPB in Apra Harbor, Guam showing extensive damage to the surrounding benthos.



Figure 6. A possible NPB in Apra Harbor, Guam showing extensive damage to the surrounding benthos.

Coral Bleaching and Crown of Thorns Starfish (COTS) Monitoring on JRM Submerged Lands

Location: JRM AOR **Period of Performance:** JUN2021 – NOV2023

Project Objective

To quantify the coral bleaching and abundance distribution of COTS, and if necessary conduct COTS culling.

Conservation Benefit

These quantitative data will assist in determining the parameters associated with coral bleaching and COTS outbreak events that may be impacting coral reefs in order to avoid, minimize or mitigate potential adverse effects to the marine resources within these areas, especially marine protected species.

FY23 Status

- Ongoing project with UOG Sea Grant
- Fieldwork delayed due to Typhoon Mawar

EPR: EO 13751 MAR JRM Monitoring and Control of Acute Impacts on Coral Reefs – Climate; 61128CN222: Coral Habitat Enhancement

2019 JRM INRMP Reference: MIS-2; 8-65, MHM-1; 8-62, MHM-2; 8-63, MHM-3; 8-63, MGIS-1; 8-68, MHM-1; 11-73, MHM-2; 11-74, MHM-3; 11-74, MIS-2; 11-75, MPS-1; 11-76

Characterization of Marine Benthic Habitats in Outer Apra Harbor Guam and Haputo ERA

Location: NBG; MCBCB **Period of Performance** SEP2019 – MAR2024

Project Objective

To provide habitat predictions and maps of submerged lands (i.e., coral reef) in Outer Apra Harbor and Haputo ERA using a variety of GIS data (e.g., lidar, side scan, multibeam, aerial imagery, etc.) and underwater photos and videos.

Conservation Benefit:

Identification and characterization of the marine benthic habitats will inform military training and testing, as well as the consultations with regulatory agencies, in order to avoid, minimize or mitigate potential adverse effects to the marine resources within these areas, especially marine protected species.

FY23 Status

- Ongoing project with NOAA NCCOS
- Developed draft habitat predictions and map
- Draft habitat predictions and map review planned for SEP2023
- NCE planned for MAR2024 for final deliverables

EPR: 1 CP MAR NBG Benthic Habitat and Coral Mapping and Management (CHS); 61755NR818

2019 JRM INRMP Reference: MIS-2; 8-65; MHM-1; 8-62, MHM-2; 8-63, MHM-3; 8-63, MGIS-1; 8-68

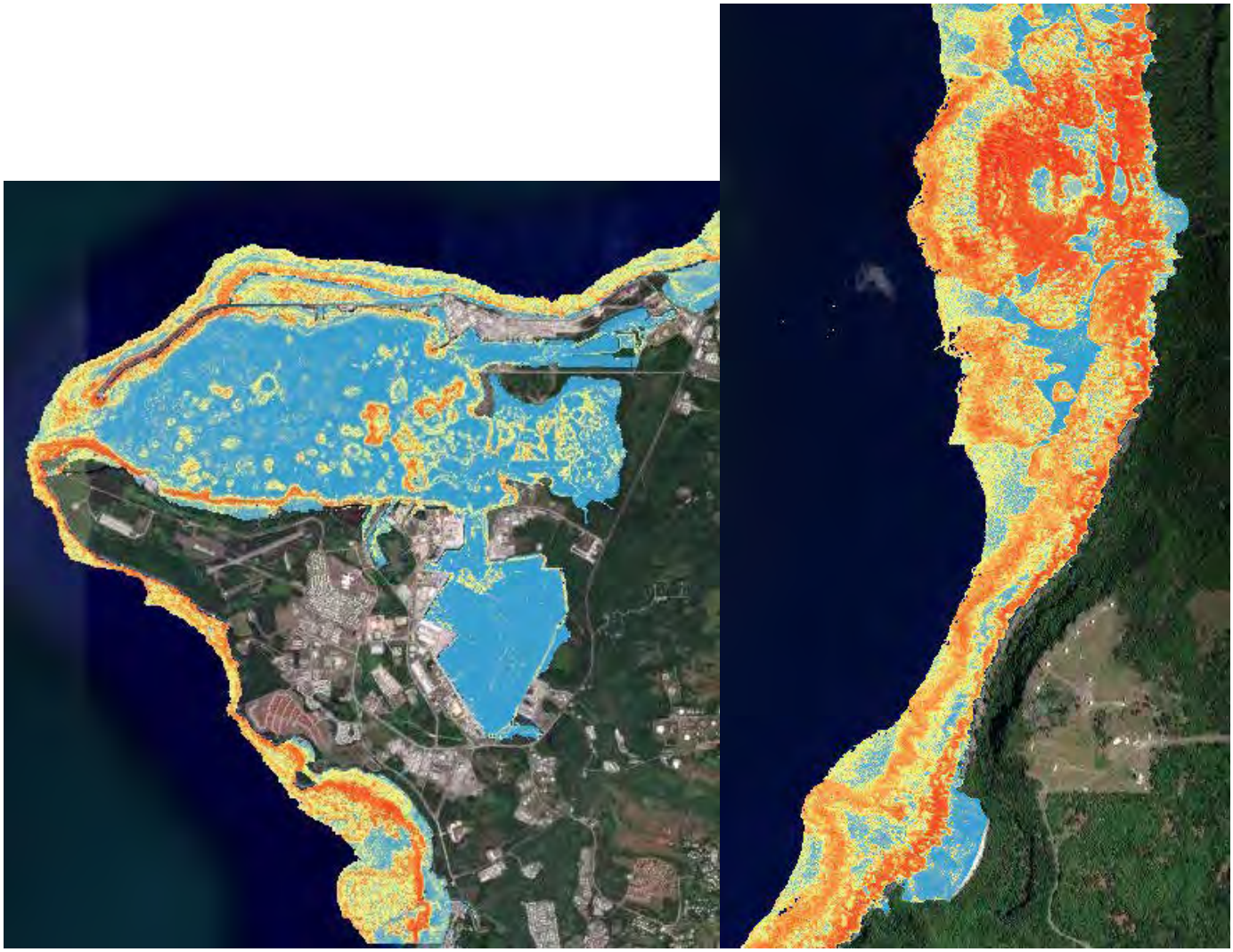


Figure 7. Example of habitat prediction map for Apra Harbor (1A, left) and Haputo ERA (1B, right), Guam (Photo by NOAA NCCOS).

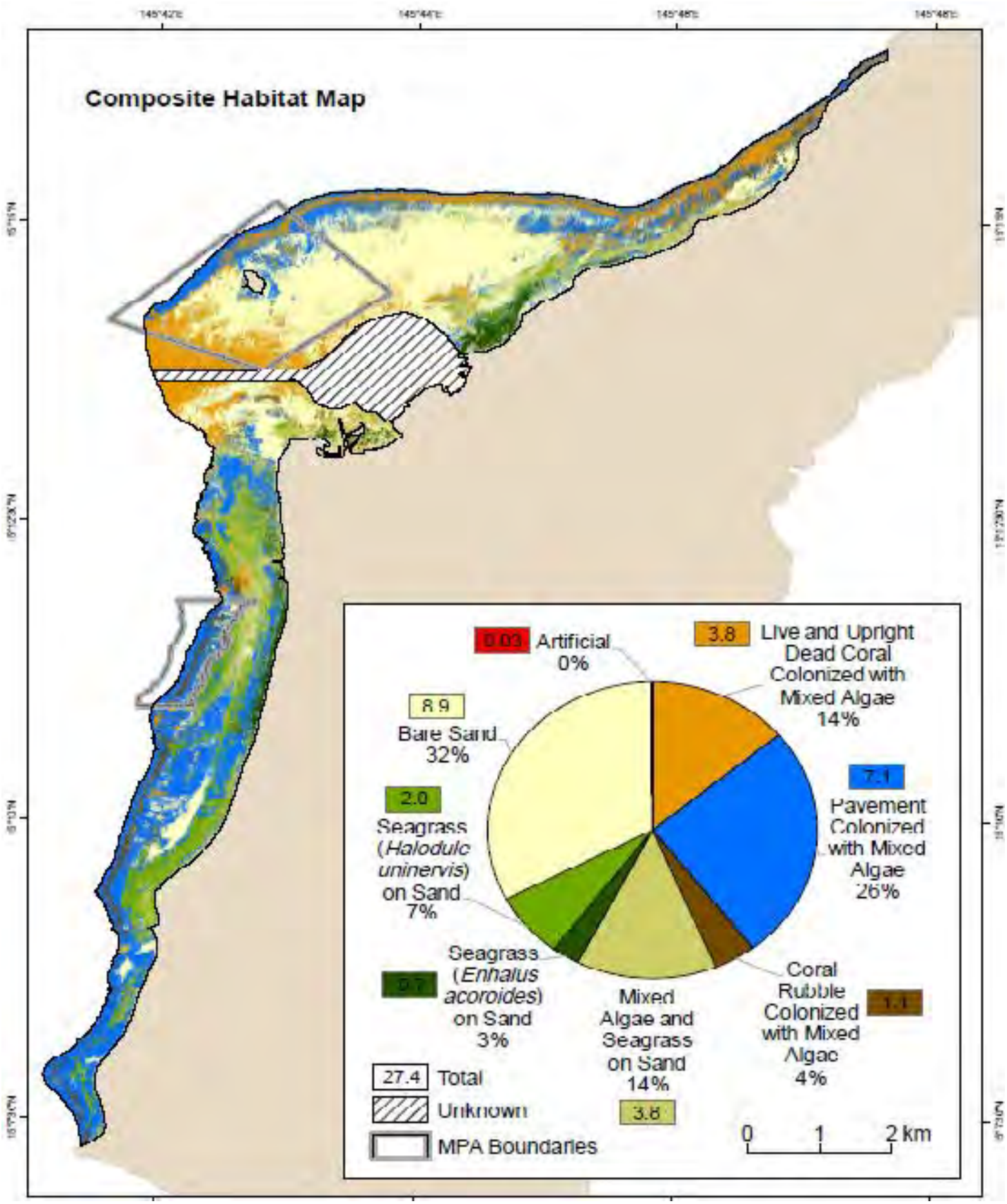


Figure 8. Example of habitat map from Benthic Habitat Map of Saipan Lagoon project (Photo by NOAA NCCOS).

Co-Knowledge Production Historic Property and Habitat Assessments on Navy Coastal Submerged Lands for the Island of Guam

Location: JRM AOR **Period of Performance:** SEP2018 – SEP2023

Project Objective

To identify and evaluate underwater cultural heritage sites and characterize the community composition and 3D structural characteristics of coral reef habitats on Navy submerged lands around Guam.

Conservation Benefit

To identify and evaluate underwater cultural heritage sites and characterize the community composition and 3D structural characteristics of coral reef habitats on Navy submerged lands around Guam.

FY23 Status

- Project ending SEP 2023
- Final edits and revisions currently in progress

EPR: 1 S MAR JRM Marine Ecosystem Monitoring and Coral Reef Indicators (CHS); 61128NR168

2019 JRM INRMP Reference: MIS-1; 5-102, MIS-2; 5-102, MIS-1; 8-64, MIS-2: 8-65, MIS-1; 9-88, MIS-2; 9-88, MIS-1; 11-75, MIS-2; 11-75

Ecosystem Monitoring and Coral Reef Indicators

Location: JRM AOR **Period of Performance:** SEP2018 – SEP2023

Project Objective

In an effort to enhance coral habitat, the objective of this project is to monitor and track changes in the health of corals at the ten long-term monitoring stations in Outer Apra Harbor and nearshore waters off Orote Peninsula. Through field surveys and data analyses, coral cover, coral species richness, coral predation, and coral community health were determined. The results of this project will be compared to prior year data at the ten stations. Trends observed will guide conservation and management strategies to improve coral habitat.

Conservation Benefit

The conservation benefits of project include: (a) ensure self-sustaining resilient populations to maintain and increase native species and diversity; (b) ensure self-sustaining resilient populations to include the use of novel techniques in adaptive management of “target” species populations; and (c) no net loss of current species range.

FY23 Status

- Field surveys at 10 permanent sites in OAH
- Benthic characterization
- Assessment of coral community
- OAH dominated by single species, Porites rus (71%, n=10)
- Sediment accumulation dominant at eastern sites
- Competition with macroalgae and sponges at western sites
- Pending final report and data synthesis

EPR: EO 13089 MAR NBG Ecosystem Monitoring and Coral Reef Indicators - Climate; 61755NR168

2019 JRM INRMP Reference: MHM-1; 5-98



Figure 9. Ten long-term monitoring sites in OAH. Photo: Google Earth.

Incident Response Plan to Coral Reef Damage

Location: JRM AOR **Period of Performance:** JUL2023 – SEP2024

Project Objective

In an effort to effectively and proactively manage NBG marine habitat, the objective of this project is develop protocols for immediate assessment and response to reef damage caused by unanticipated. This project is focused on reef damage that may result from small and large vessel groundings, anchor drops, and marine debris, with the potential to include a plan for impacts due to chemical discharges or underwater neutralization of unexploded ordinance. This project will involve discussions with key stakeholders, both federal and local, and will culminate with an in-person workshop to present the components of the Incident Response Plan.

Conservation Benefit

The conservation benefits of project include: (a) improve stewardship of natural resources at NBG by integrating conservation program requirements; (b) ensure compliance with all applicable federal and territorial laws, regulations, policies, and legal decisions; and (c) protect and manage sufficient marine habitat needed for species conservation.

FY23 Status

- Interagency Agreement with USFWS
- SEP/DEC 2023: Introductory meetings
- SEP 2024: Workshop

EPR: 1 CP MAR NBG Benthic Habitat and Coral Mapping and Management; 61755NR168

2019 JRM INRMP Reference: MHM-1; 5-98



Figure 10. Large *Porites rus* colony overturned following vessel grounding at Jade Shoals in 2017.

MARINE PROTECTED SPECIES MANAGEMENT

Sea Turtle Distribution and Habitat Use

Location: NBG **Period of Performance:** AUG2018 - Ongoing

Project Objective

In an effort to protect and enhance sea turtle population in the marine waters of Navy-submerged lands, JRM entered a multi-year interagency agreement with NOAA NMFS. The goal of this project is to understand the distribution and habitat use of sea turtles on Navy-submerged lands. Information generated from the project will inform management actions to protect sea turtles and be used to assess potential impacts from proposed actions within Navy-submerged lands.

Conservation Benefit

The conservation benefits of project are to (a) sustain and enhance the sea turtle population; (b) maintain sea turtle species range and distribution; and (c) increase the use of adaptive management techniques for sea turtles.

FY23 Status

- Local participation from DAWR, USFWS, Sea Grant, JTS
- Final report pending satellite tracking results
- Entered into new Interagency Agreement AUG 2023 focused on northern Guam and Tinian

EPR: 1 RP MAR JRM Sea Turtle Monitoring, Migration, and Habitat Use; 61128NRGST

2019 JRM INRMP Reference: MPS-2; 5-103

TERRESTRIAL EXOTIC AND INVASIVE SPECIES MANAGEMENT

Implementation of the Regional Biosecurity Plan of Micronesia and Hawaii (RBP) - Guam

Location: JRM AOR **Period of Performance**: AUG2022 - Ongoing

Project Objective

Implement priority actions from the RBP aimed at: 1) Preventing the spread of invasive species within and in/out of JRM Area of Responsibility (AOR); 2) Foster regional coordination and collaboration; 3) Invasive species management and control; and 4) Strengthening capacity for biosecurity.

Conservation Benefit

Protection of native species, particularly those that are threatened and endangered, from the threat of invasive species within the JRM AOR.

FY23 Status

- Implement arrival and/or pre-departure biosecurity inspections of non-training military equipment and cargo movements into/out of JRM AOR to ensure Armed Forces Pest Management Board Technical Guide No. 31 (AFPMB TG-31) cleanliness standards, therefore devoid of biomaterial. Biosecurity inspections conducted by Colorado State University Center for Environmental Management of Military Lands (CSU CEMML) and pre-departure Brown treesnake (BTS) canine inspection conducted by USDA-Wildlife Services (WS).
    - Movements included Navy Mobile Construction Battalion (NMCB) cargo and equipment to/from Tinian and Palau for Navy public works projects.
        - Eight (8) pre-departure biosecurity and BTS inspection events on Guam for cargo and equipment movements to Tinian.
        - One (1) pre-departure biosecurity inspection event on Tinian for cargo and equipment movement to Guam.
        - Six (6) pre-departure biosecurity and BTS inspection events on Guam for cargo and equipment movements to Palau.
    - U.S. Air Force prepositioned equipment to/from Saipan.
        - One (1) pre-departure biosecurity and BTS inspection event on Guam for equipment movement to Saipan.
    - Rotational units and/or unit deployments.
        - Twelve (12) arrival/pre-departure biosecurity inspection events on Guam.
- Early Detection Surveys Conducted
    - All-Taxa Surveys – AAFB: 10 of 32 sites (Figure 11); NBG: 5 of 30 sites (Figure 12)

  - Weed Surveys – AAFB: 3 of 29 sites; NBG: 4 of 34 sites
  - Tinian MLA – 5 of 5 All-Taxa Survey sites (including LFA, no detections)
- Continued interagency coordination and consultation regarding invasive species management and biosecurity concerns within the region (CRB Working Group, LFA Working Group, GISC, GISAC, RISC, CNMI DLNR, Guam Biosecurity Division, CGAPS).

EPR: CHS NISA MAR JRM Implementation of the Regional Biosecurity Plan; 61128NR860

2019 JRM INRMP Reference: TIS-4; 5-85, TIS-5; 6-44, TIS-5; 7-53, TIS-4; 8-51, TIS-6; 9-73

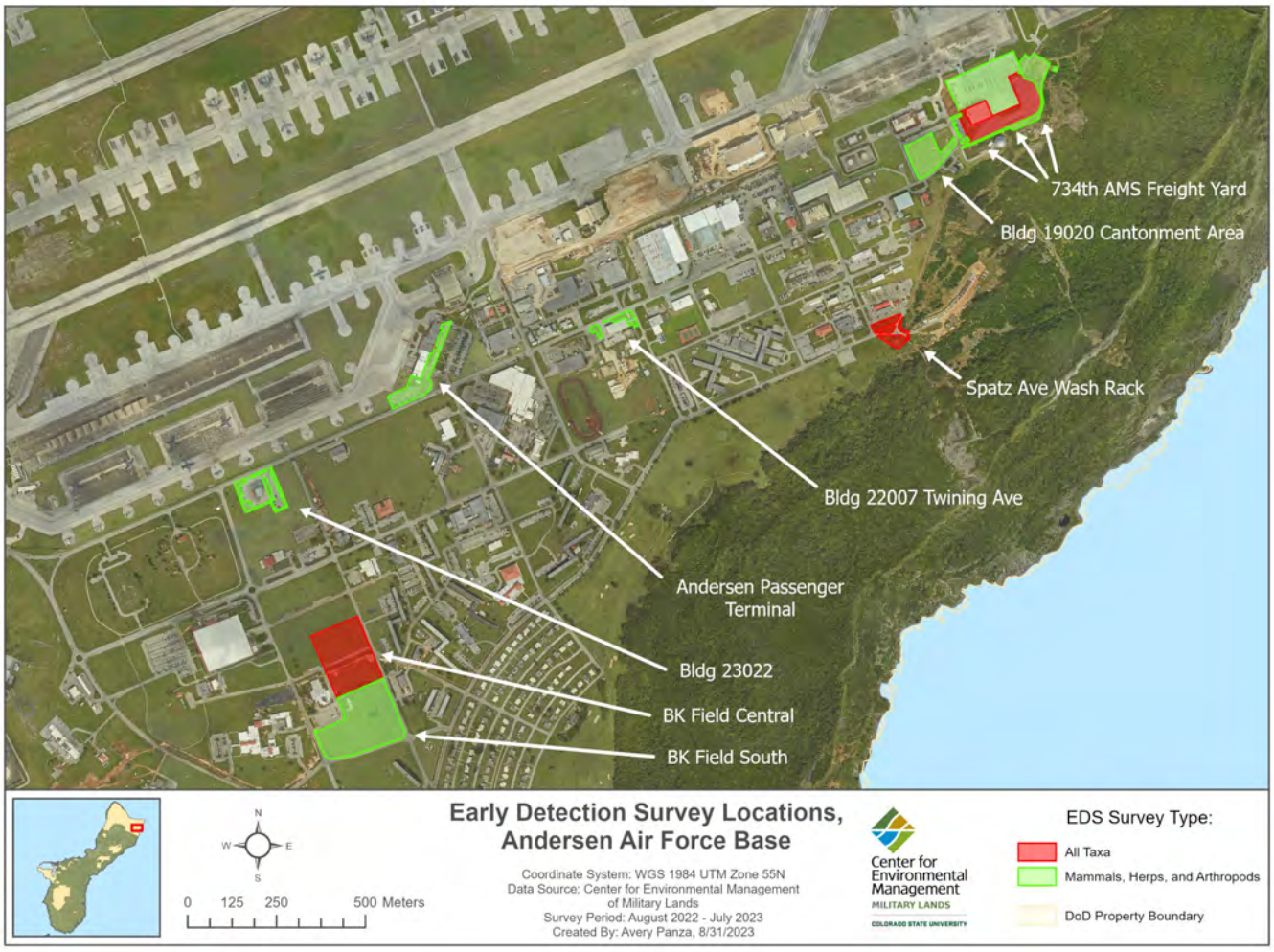


Figure 11. Early Detection Surveys (EDS) for invasive species conducted on Andersen Air Force Base.

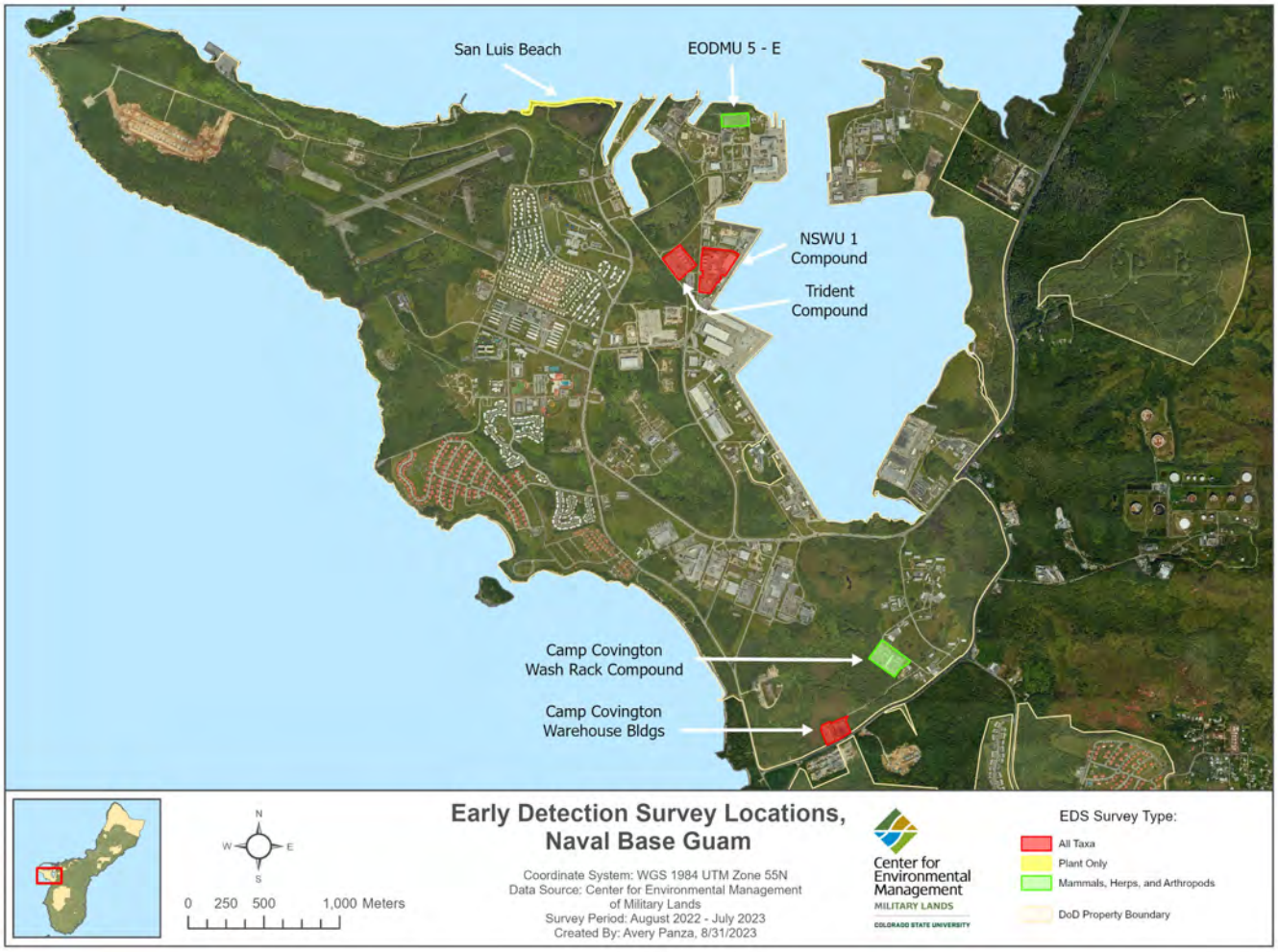


Figure 12. Early Detection Surveys (EDS) for invasive species conducted on Naval Base Guam Mainbase.

Little Fire Ant (LFA), *Wasmannia auropunctat*a, Surveys, Eradication, and Monitoring - Guam

Location: JRM AOR **Period of Performance**: AUG2022- Ongoing

Project Objective

To implement LFA Early Detection Surveys (EDS); control and eradicate LFA on DoD lands: coordinate and collaborate with resources partners; and provide outreach materials to reduce impacts to native ecosystems and military readiness activities.

Conservation Benefit

Enhance and restore habitats by prevention of the spread and establishment of the invasive LFA.

FY23 Status

- Ongoing Cooperative Agreement with CSU CEMML:
- LFA Early Detection Surveys
    - Andersen AFB (AAFB): 19 surveys covering 29.6 miles (Figure 13)
    - Naval Base Guam (NBG): 18 surveys covering 12.0 miles (Figure 14)
    - Marine Corps Base Camp Blaz (MCBCB): 2 surveys covering 1.9 miles (Figure 15)
- New LFA Infestation Detections
    - Three (3) new infestations detected along installation borders and two (2) new infestations within installation borders (Figures 13-15).
        - AAFB: Route 9, Santa Rosa Fence Line East, and Contractor Laydown Yard
        - NBG Mainbase: South Tipalao and Polaris Point Road Construction Si
- LFA Infestations Status
    - Seventeen (17) known LFA locations (not including Andersen South locations) on AAFB (5), MCBCB (2), NBG Mainbase (5), and NBG Naval Munitions Site (5) (Table 1).
    - Ongoing border treatment occurring at seven (7) locations, pending eradication efforts at seven (7) locations, delineation pending at two (2) locations, and eradication completed at one (1) location (Table 1).

EPR: CHS EO 13751 MAR Little Fire Ant Surveys and Eradication; 61128NR207

2019 JRM INRMP Reference: TIS-5; 5-86, TIS-6; 6-44, TIS-4; 7-52, TIS-6; 8-52, TIS-5; 9-72

Table 1. Status of Twelve Little Fire Ant (LFA) Infestation Locations on Guam Installations

Installation	Site	Status	Acres
AAFB*	Santa Rosa Fence Line East	Treatment: Border	1.75
AAFB	Santa Rosa Fence Line West	Treatment: Border	0.7
AAFB	NW Field Hunter's Shack	Eradication Treatment #6	0.9
AAFB*	Route 9	Eradication: Treatment #4	1.0
AAFB*	Contractor Laydown Yard	Eradication: Treatment #3	3.0
MCBCB	Haputo Beach Trailhead	Eradication: Complete	0.00
MCBCB	Haputo Beach (Trail bottom)	Eradication: Treatment #1	1.2
NBG Mainbase	Dadi Beach	Eradication: Treatment #4	11.0
NBG Mainbase	Polaris Point Fence Line	Treatment: Border	2.0
NBG Mainbase*	Polaris Point Road Con. Site	Treatment: Border	2.0
NBG Mainbase	Nimitz Hill Facilities	Delineation: Pending	N/A
NBG Mainbase*	South Tipalao	Eradication: Treatment #4	2.0
NBG NMS	Santa Rita Fence Line	Treatment: Border	1.5
NBG NMS	Firebreak Road #3	Eradication: Treatment #6	0.6
NBG NMS	West Drainage	Delineation: Pending	N/A
NBG NMS	Highway 12 Fence Line	Treatment: Border	0.5
NBG NMS	Highway 12 NMS Main Gate	Treatment: Border	0.1

Note: AAFB = Andersen Air Force Base; MCBCB = Marine Corps Base Camp Blaz; NBG = Naval Base Guam; NMS = Naval Munitions Site

*= New LFA infestation site

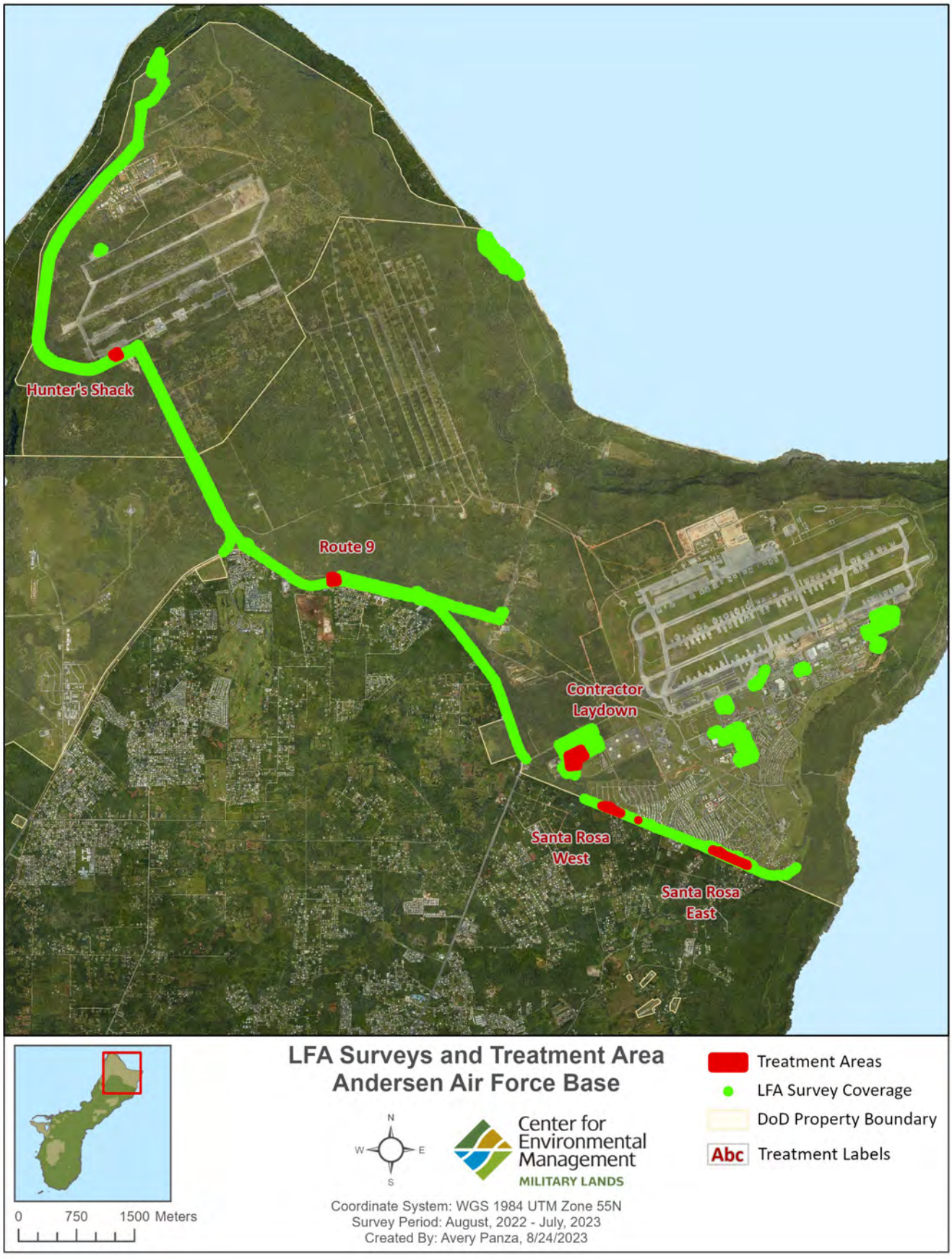


Figure 13. Little Fire Ant (LFA) Survey and Treatment Areas on Andersen Air Force Base.

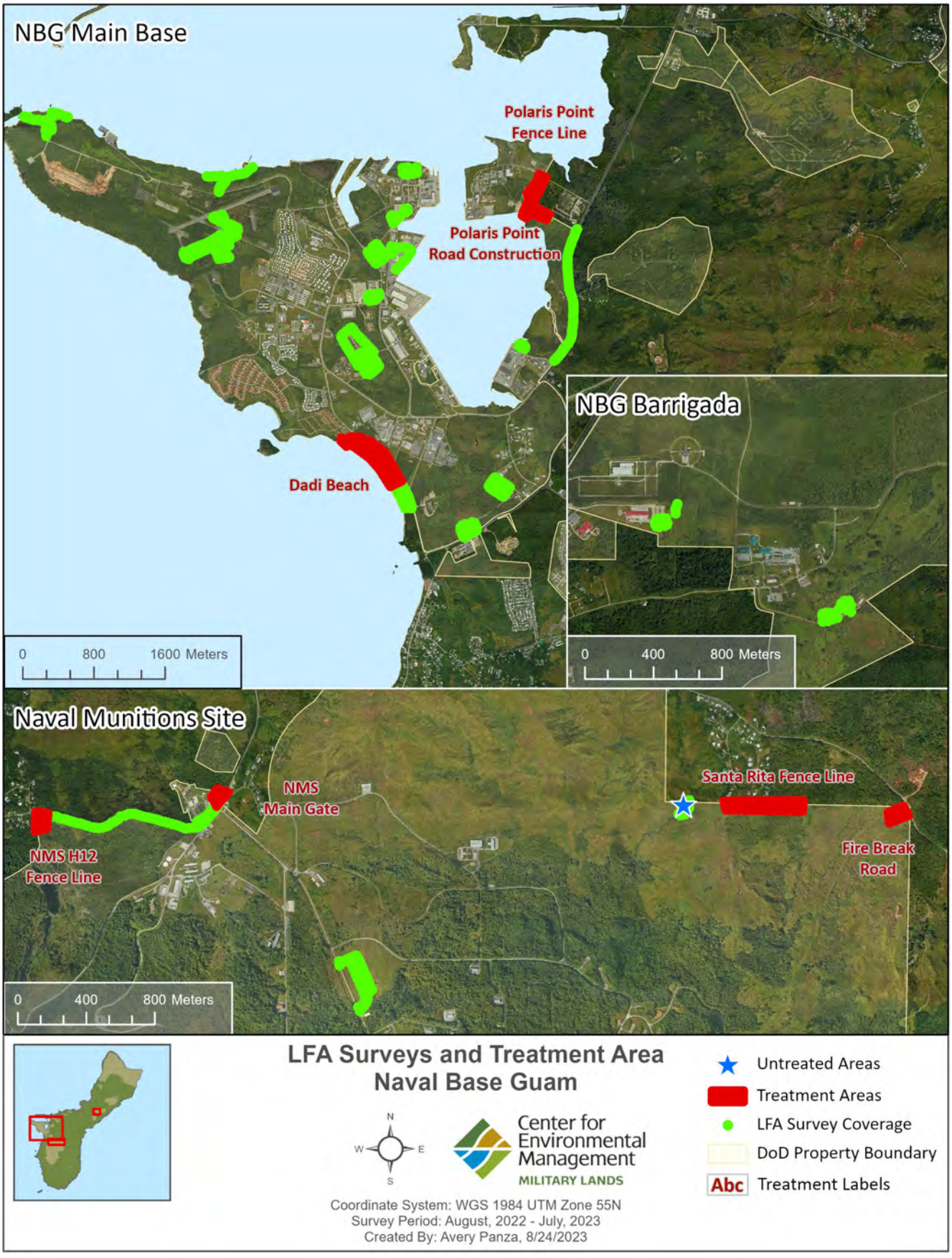


Figure 14. Little Fire Ant (LFA) Survey and Treatment/Monitoring Areas on Naval Base Guam Mainbase and Naval Munitions Site.

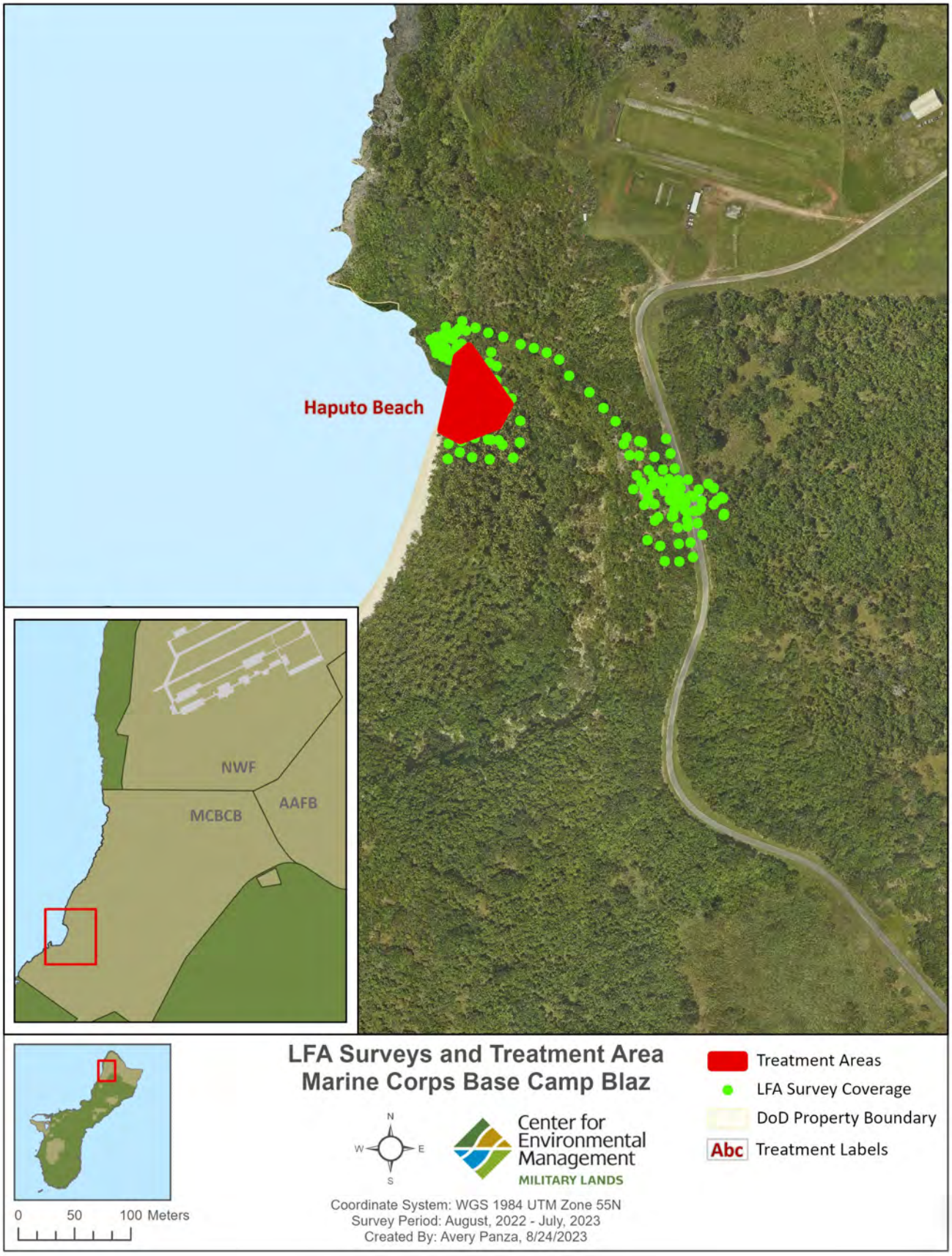


Figure 15. Little Fire Ant (LFA) Survey and Treatment/Monitoring Areas on Marine Corps Base Camp Blaz Mainbase.

Coconut Rhinoceros Beetle (CRB; *Oryctes rhinoceros*) Surveys, Interdiction, and Monitoring - Guam

Location: JRM **Period of Performance:** AUG2022 – Ongoing

Project Objective

To implement CRB best management practices: 1) identify and remove breeding sites, 2) implement interdiction and sentinel trapping, and 3) implement CRB awareness; coordinate and collaborate with resources partners, and provide outreach materials to installation and military training participants to reduce impacts to native ecosystems and military readiness activities.

Conservation Benefit

Prevention of the spread and establishment of the invasive CRB to other locations within and outside of the JRM AOR.

FY23 Status

- CSU CEMML implementing CRB best management practices
- Breeding Site Identification
    - Biannual breeding site surveys in urbanized areas of Andersen AFB Mainbase (AAFB), AAFB Northwest Field (NWF) and Naval Base Guam (NBG) Mainbase: November 2022 (Table 2, Figures 16 - 18)
    - Typhoon Mawar delayed the second breeding site survey until September 2023
- Interdiction/Sentinel Trapping
    - CRB black panel traps serviced biweekly on AAFB Mainbase (144 traps) and NBG (143 traps), since August 2020 and AAFB Northwest Field (NWF) (21 traps), since September 2023
    - CRB Tekken netting traps serviced biweekly on AAFB (50 traps), since April 2021
    - During this reporting period (August 2022 to July 2023), 6,728 CRB have been capture in panel traps and Tekken netting traps (AAFB Mainbase: 4,057, AAFB NWF: 499, NBG: 2,172; Figures (19 - 21)
    - Approximately 25,000 CRB have been captured over the past 3-years (Figure 21)
- Coordination with regional partners (USDA-PPQ, GovGuam Dept. Ag., CNMI DLNR, Hawaii Dept. Ag.)

EPR: CHS NISA MAR JRM Implementation of the Regional Biosecurity Plan; 61128NR860

2019 JRM INRMP Reference: TIS-4; 5-85, TIS-5; 5-86, TIS-5; 6-44, TIS-6; 6-44, TIS-4; 7-53, TIS-5; 7-53, TIS-4; 8-51, TIS-6; 8-52, TIS-5; 9-72, TIS-6; 9-73, TIS-1; 11-62, TIS-1; 12-32

Table 2. Coconut Rhinoceros Beetle (CRB) Breeding Site Survey Status (November 2022)

Installation	Potential Breeding Sites Identified	Potential Breeding Sites Removed*	Potential Breeding Sites Added**
AAFB Mainbase	767	159	172
AAFB Northwest Field	4	N/A	N/A
NBG Mainbase	111	72	39

Note: AAFB = Andersen Air Force Base; NBG = Naval Base Guam

*= Potential breeding sites removed since previous survey conducted May 2022

**= Potential breeding sites gained since previous survey conducted May 2022

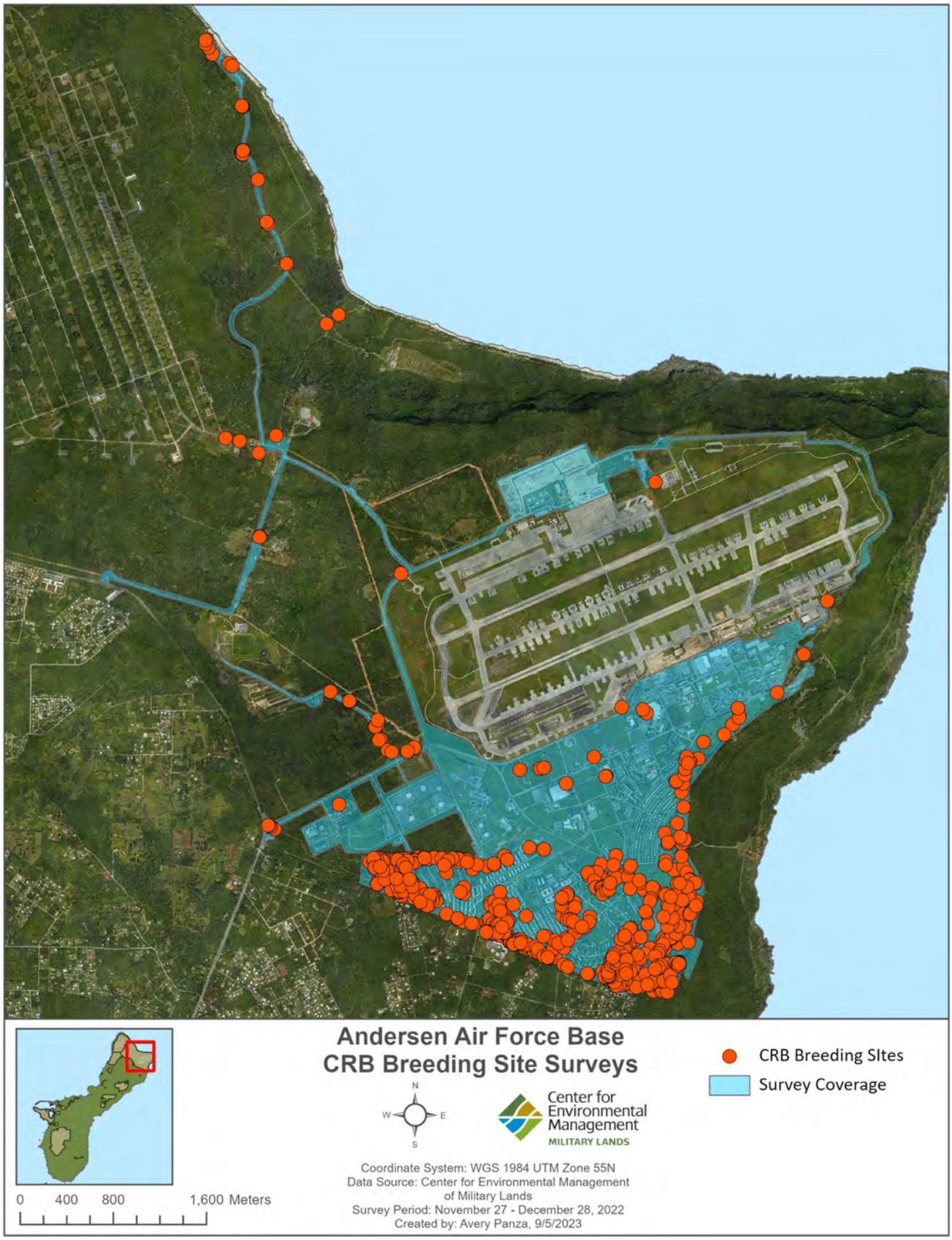


Figure 16. Biannual Coconut Rhinoceros Beetle (CRB) breeding site survey area conducted in November 2022 and identified potential breeding sites (RED) at Andersen Air Force Base Mainbase.

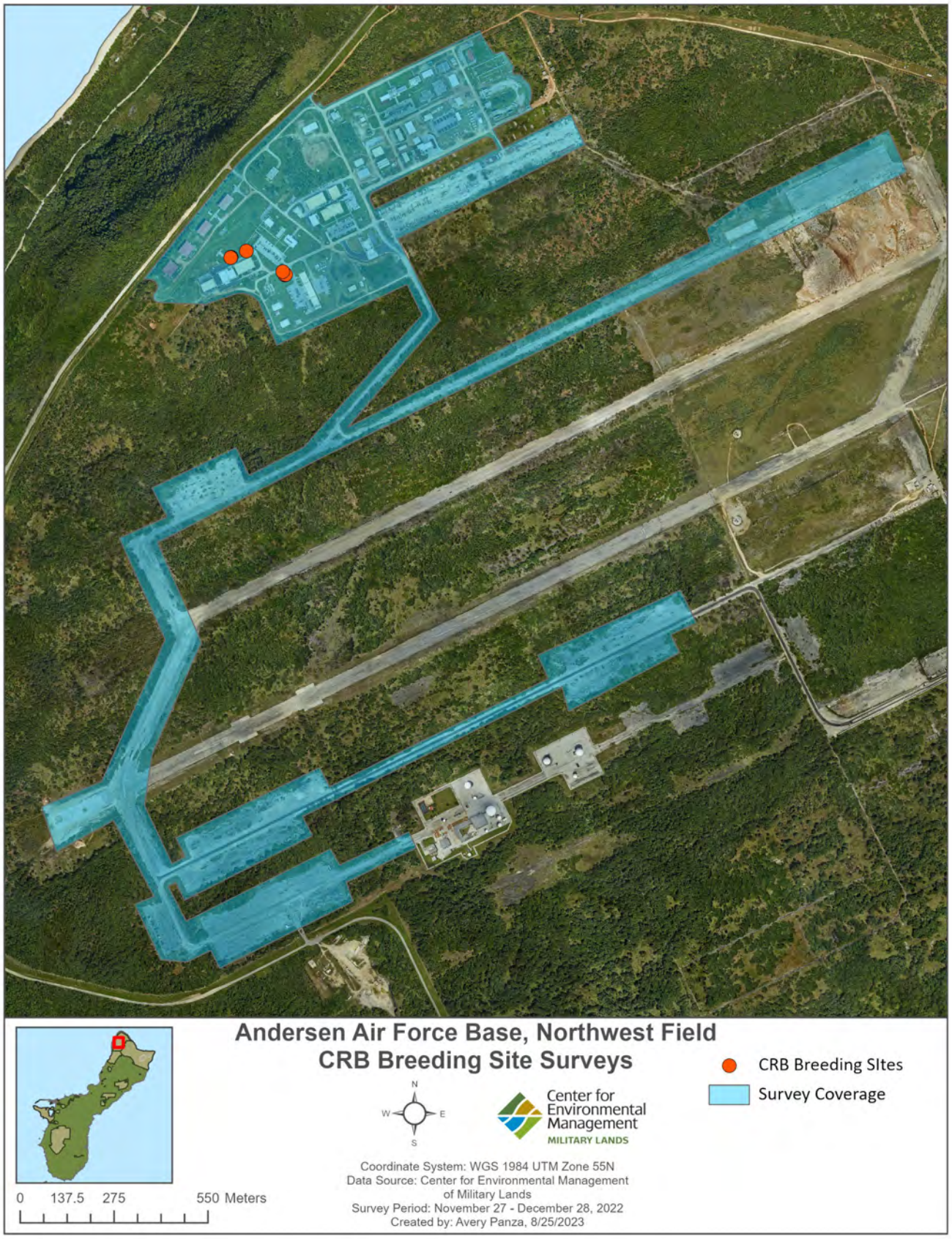


Figure 17. Biannual Coconut Rhinoceros Beetle (CRB) breeding site survey area conducted in November 2022 and identified potential breeding sites (RED) at Andersen Air Force Base Northwest Field.

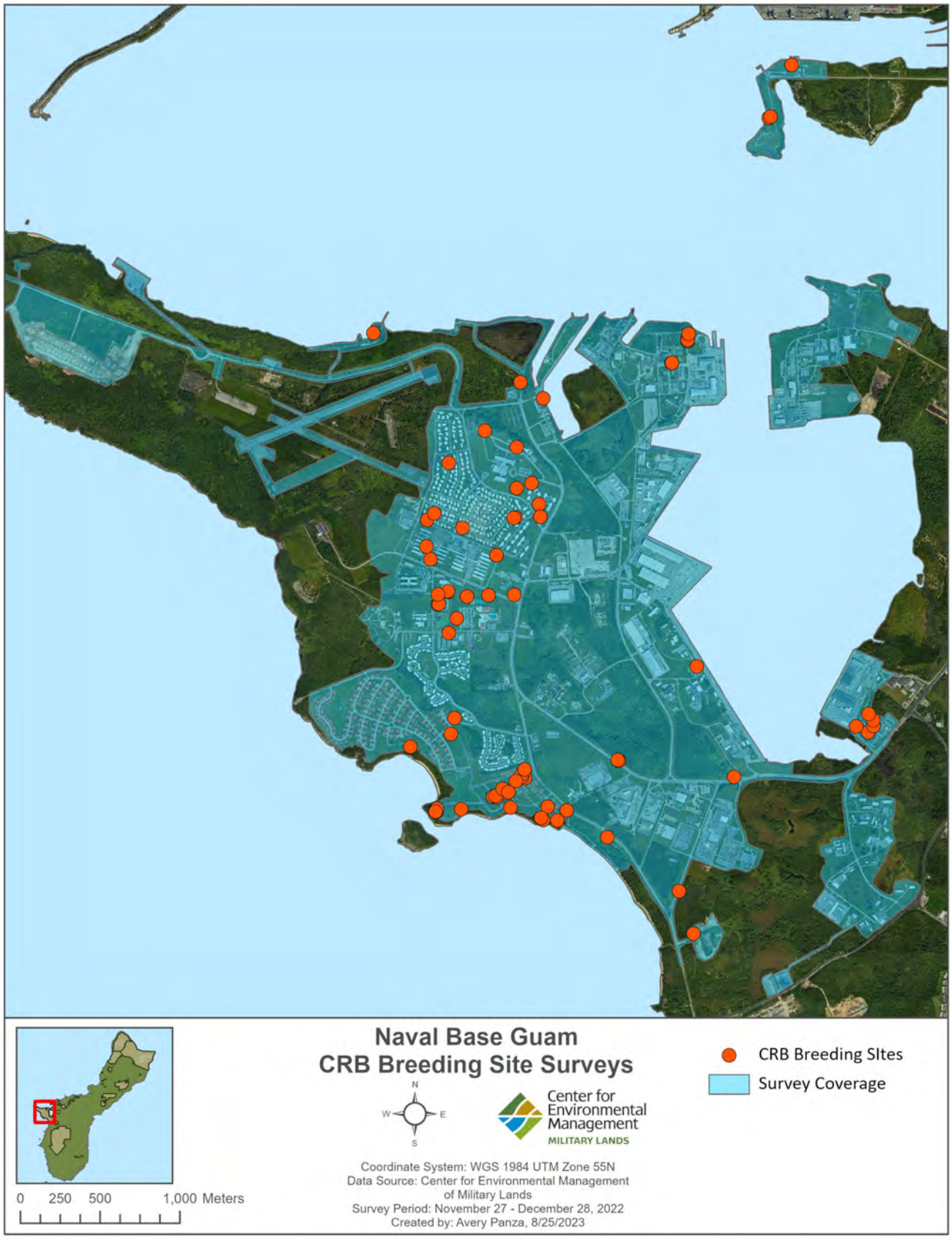


Figure 18. Biannual Coconut Rhinoceros Beetle (CRB) breeding site survey area conducted in November 2022 and identified potential breeding sites (RED) at Naval Base Guam Mainbase.

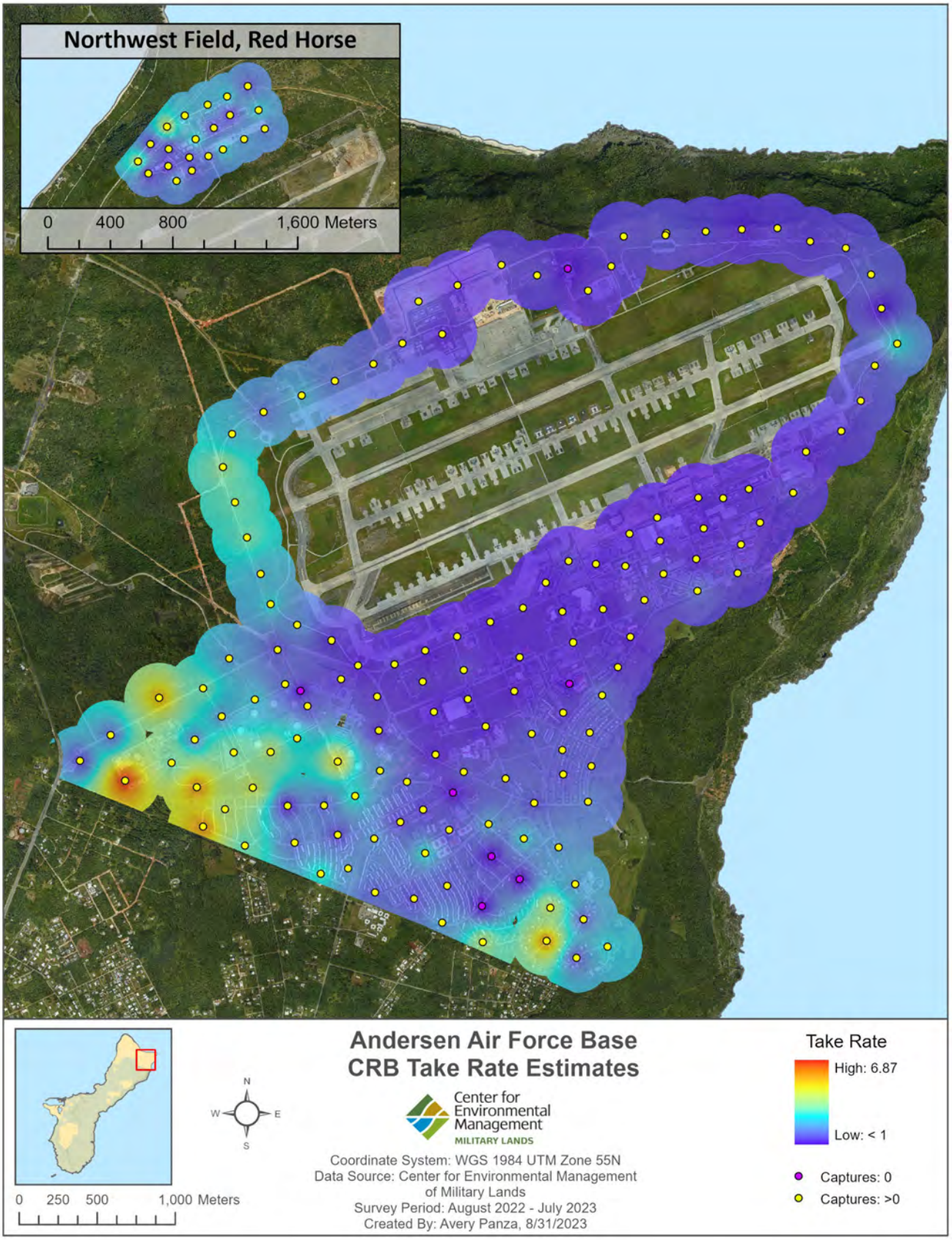


Figure 19. Coconut Rhinoceros Beetle (CRB) interdiction/sentinel trapping efforts on Andersen Air Force Base Mainbase and Northwest Field. Heat map depicts average capture rates from August 2022 to July 2023 across the CRB survey area (225 m buffer zone) shown.

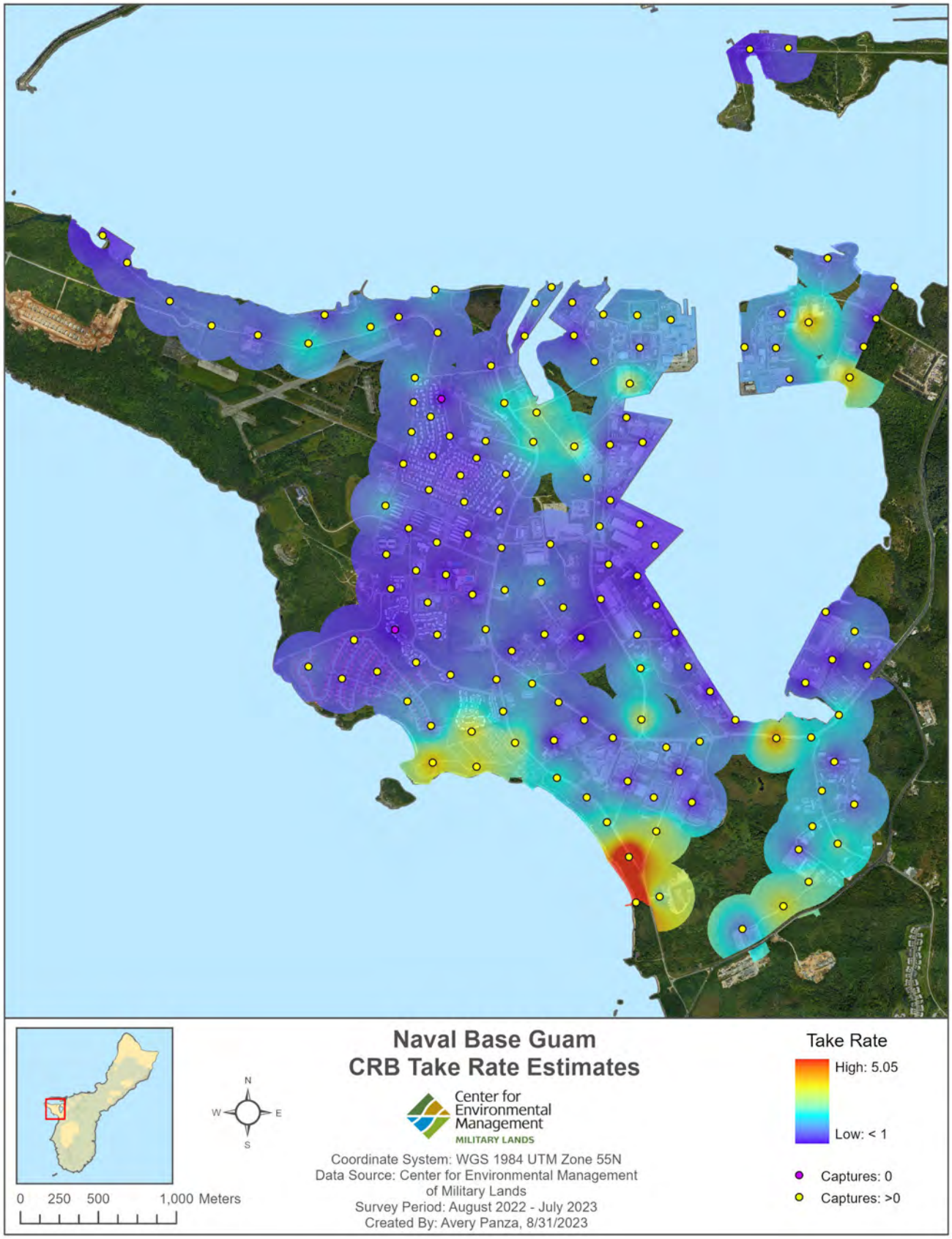


Figure 20. Coconut Rhinoceros Beetle (CRB) interdiction/sentinel trapping efforts on Naval Base Guam Mainbase. Heat map depicts average capture rates from August 2022 to July 2023 across the CRB survey area (225 m buffer zone) shown.

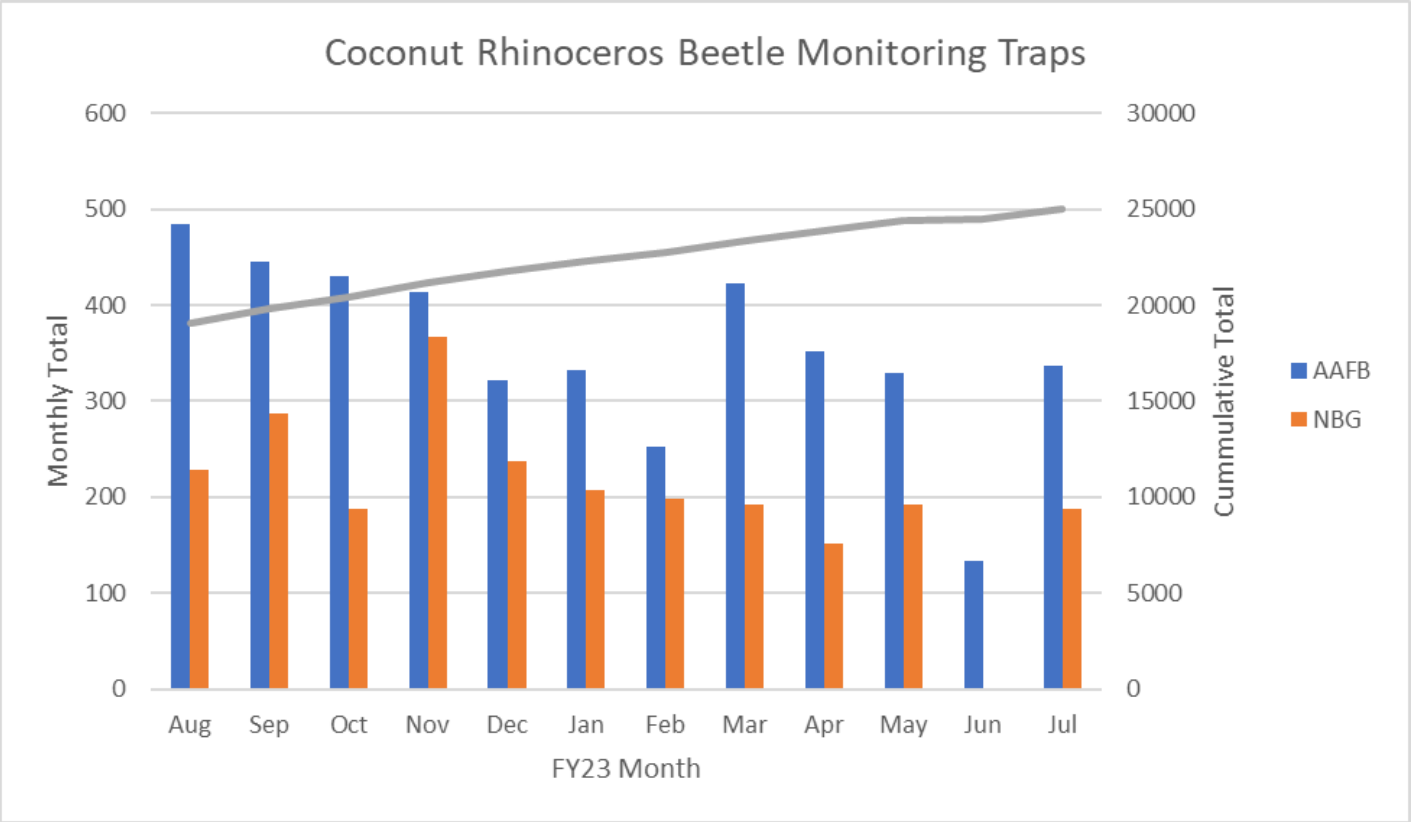


Figure 21. Monthly total of Coconut Rhinoceros Beetle (CRB) captures shown for Andersen Air Force Base (BLUE) and Naval Base Guam (RED) for August 2022 through July 2023 and cumulative total captures from black panel traps since initial activation on August 2020 through July 2023. Gray line indicates cumulative panel trap capture totals (~25,000).

Little Fire Ant Perimeter Monitoring/Control and Eradication at MCBCB UTC, Guam

Location: MCBCB, UTC **Period of performance:** AUG2022 – Ongoing

Project Objective

Delimit targeted Little Fire Ant (LFA) infestations within MCBCB Urban Training Complex (UTC). Implement eradication protocols to eradicate this invasive species. Conduct post-treatment monitoring to evaluate treatment effectiveness. Implement early detection and rapid response (EDRR) surveys for long-term monitoring of the UTC perimeter.

Conservation Benefit

LFA pose significant threats to listed species. Eradication will benefit listed species directly as well as the habitat that supports them.

FY23 Status

- Awarded new Cooperative Agreement with Center for Environmental Management of Military Lands (CEMML)
- Delimited three (3) known sites (6,7, and 1) and two (2) new sites (9 and 10)
- Ongoing delineation surveys at known site 8 and implementation of informal consultation BO
- Commenced treatments at sites 6, 7, 9, 10, and perimeter of 1
- Awarded option year 1 (OY1) Cooperative Agreement modification

EPR: MCBCB Project

2019 JRM INRMP Reference: TIS-4



Figure 22. The LFA eradication team applies tango spray to vegetation at MCBCB UTC to address little fire ant infestation within the training area.



Figure 23. Little fire ants crawl on vegetation within MCBCB UTC.



Figure 24. A positive monitoring result for little fire ants within MCBCB UTC.

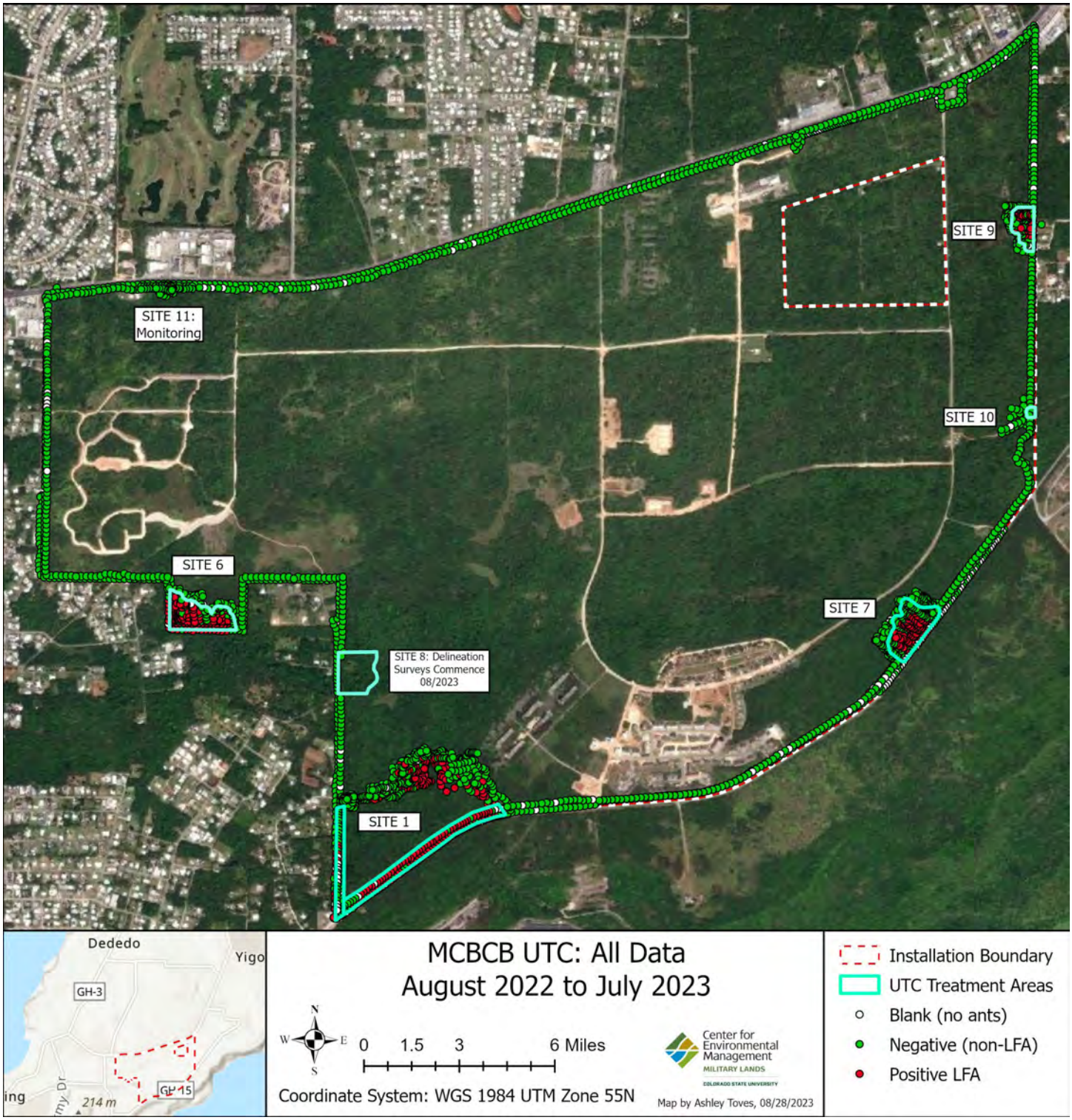


Figure 25. Map of the LFA positive areas within MCBCB UTC.

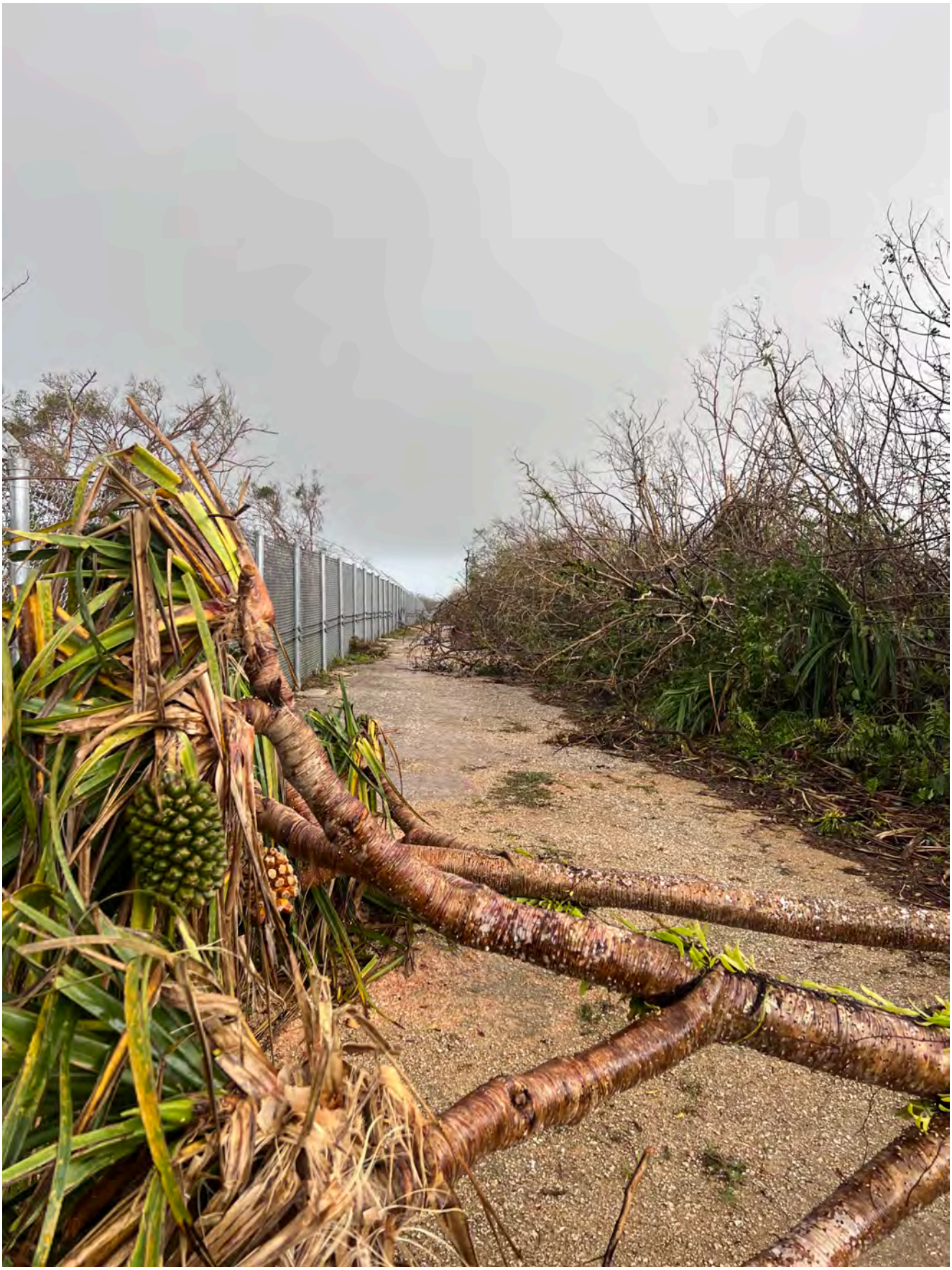


Figure 26. Entrance to LFA positive site within MCBCB UTC.

Feral Dog and Cat Control

Location: NMS **Period of performance:** SEP2021 - Ongoing

Project Objective

Remote sensing, live trapping and removal of target feral animals in sensitive habitats (remote wetlands).

Conservation benefit

The conservation benefits of the project are to a) protect and preserve habitats needed for sensitive species conservation and to b) provide response to incipient invasive and nuisance species populations to ensure no loss of moorhen species range.

FY23 Status

- IAA with USDA APHIS-WS
- Identify and remove feral cats and dogs in NMS wetlands
- Remote camera deployment identified 4 cats and 2 dogs
    - 3 cats removed/transferred to GAIN
    - 7 monitor lizards captured
- Current/Ongoing efforts
    - Remove lizards from habitat
    - Document stomach contents
- Continuous immigration due to open property boundaries
- USDA-APHIS WS report pending

EPR: CHS MAR NBG Feral Dog and Cat Control and Management; 617555NR358

2019 JRM INRMP Reference: TIS-7; 5-87, TIS-4; 6-43, TPS-5; 6-47

Table 3. Number of species observed and captured.

	Observed				Captured			
Location	Cats	Dogs	Monitor Lizards	Non-Targets	Cats	Dogs	Monitor Lizards	Non-Targets
Spanish Steps Session 1	1	0	Many	6	1	0	6	0
Mahlac Pond Session 2	0	0	7	11	0	0	1	0
Mahlac South Session 3	3	2	2	33	2	0	0	1
Total	4	2	9	50	3	0	7	1

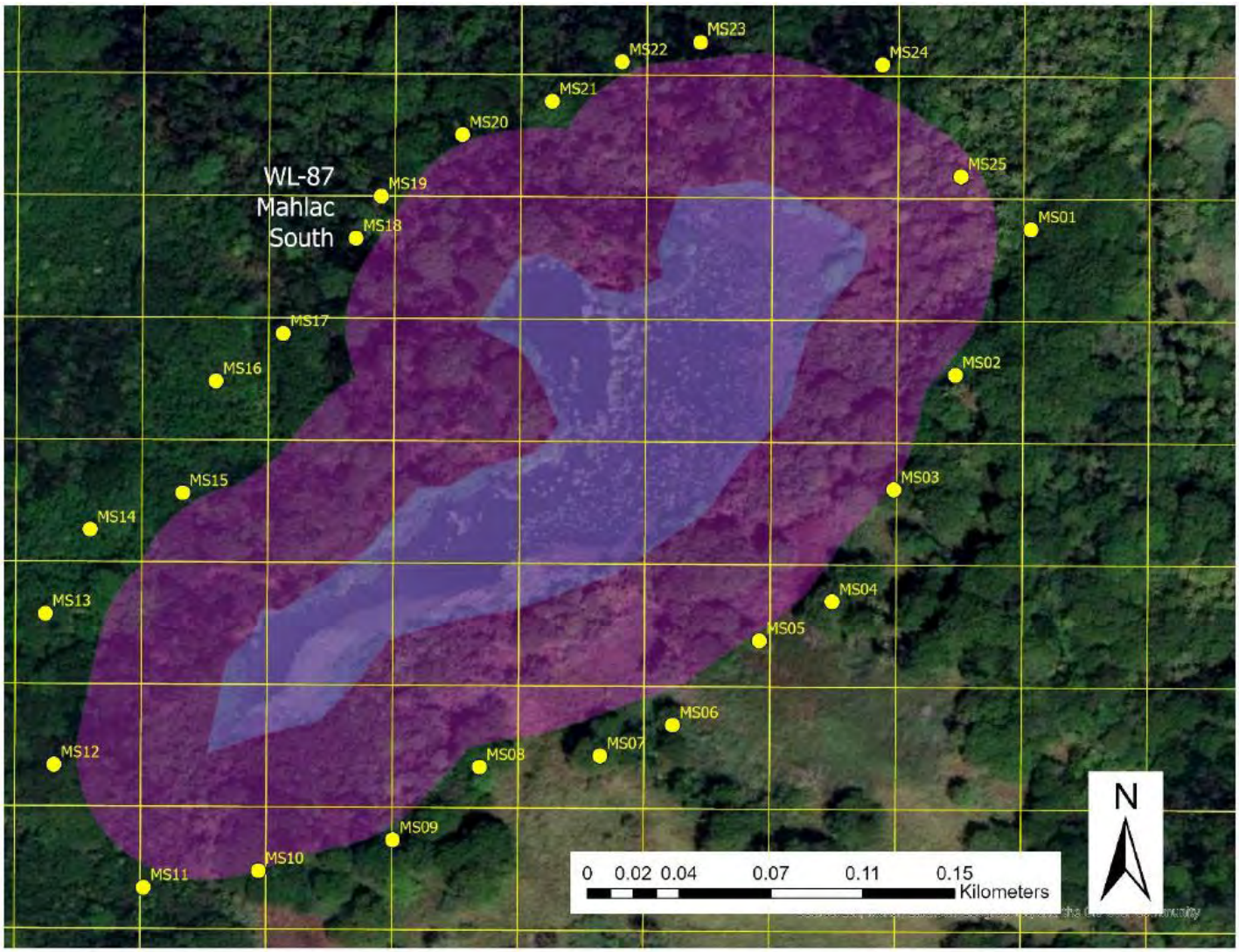


Figure 27. Map of trap stations at Mahlac South, NMS. Photo: USDA-APHIS-WS-Guam.



Figure 28. Captured feral cat at NMS, delivered to GAIN. Photo: USDA-APHIS-WS-Guam.

Brown Treesnake Interdiction to Prevent the Spread Via the DOD Transportation Network Originating On Guam

Location: JRM **Period of Performance:** AUG2022 – Ongoing

Project Objective

To prevent the spread of BTS to other Pacific islands including the CNMI and Hawaii, this JRM project is funded to conduct BTS control and interdiction efforts on Navy Base Guam (NBG) and Andersen AFB (AAFB) to prevent snakes from getting into the DoD transportation network. Methods include BTS trapping, toxicants, nighttime visual fence line searches, and canine inspections of outbound items. The BTS Interdiction program also supports training events occurring in the region that originate from Guam. Joint Region Marianas develops BTS control and interdiction plans for each training exercise that requires the movement of personnel and assets to the CNMI from Guam. Additional BTS inspections and control measures are implemented in the CNMI when determined necessary by the stakeholders.

Conservation Benefit

Preventing the spread of BTS via the military transportation network keeps BTS on Guam and from establishing in other ecologically sensitive areas in the Pacific region where vulnerable island species would be susceptible to BTS predation.

FY23 Status

- Ongoing and enduring JRM requirement
- Interdiction support provided to four large military exercises inspecting over 1,400 items during FY2022
- Four missed inspections
- No BTS detected in outbound cargo

EPR: Project is funded by facilities maintenance dollars, no conservation funding for this project.

2019 JRM INRMP Reference: TIS-1; 5-84, TIS-1; 6-42; TIS-1; 7-51, TIS-1; 8-50, TIS-1; 9-70

Table 4. BTS Take and K9 Inspections AUG2022 – JUL2023

	Number Traps*	Trap Captures	CPUE	Spotlight Captures	CPUE**	# Baits	# Bait Takes	% Bait Take
AAFB	559	1460	1 BTS per 137 nights:trap	275	2.9	23,754	2719	11%
NBG	385	723	1 BTS per 189 nights:trap	379	3.3	49,314	5273	11%
	ITEM				**DESTINATION**			
	Cargo	**Aircraft**	**Vehicles**	**HHG**	**CNMI**	**Hawaii**	**CONUS**	**Other Pacific**
AAFB K9	117045	3157	508	1909	1551	4432	29471	10698
NBG K9	43983	1881	1552	784	2016	900	10198	8454
Total	***161028***	***5038***	***2060***	***2693***	***5701***	***5332***	***39430***	***19152***

Brown Treesnake Control at Mariana Swiftlet Caves

Location: NBG; NMS **Period of Performance**: OCT2018 – Ongoing

Project Objective

To provide long-term sustained protection for the Mariana Swiftlet (*Aerodramus bartschi*) from BTS predation. Protection consists of maintaining BTS control devices (bait tubes laden with toxicant-laced dead mouse baits) situated along transects that are 10 m apart at varying distances around swiftlet-occupied caves: Mahlac, Fachi, and Maemong.

Conservation Benefit

Project activities address two of the recovery criteria in the Amendment to the Recovery Plan for Mariana Islands Population of the Vanikoro Swiftlet (*Aerodramus vanikorensis bartschi*) (USFWS 2019) by protecting and managing roosting and nesting habitat and managing predation by BTS.

FY23 Status

- Ongoing project - renewed annually
- 30, 33, and 43 bait tubes at Fachi, Maemong, and Mahlac respectively
- Plan is to incorporate in-cave BTS removal efforts
- Concurrent project evaluating spatial configuration and baiting technique

EPR: 1 RP NBG Mariana Swiftlet Population Protection; 67155NR834: BTS Trapping

2019 JRM INRMP Reference: TIS-3; 6-43, TPS-4; 6-47

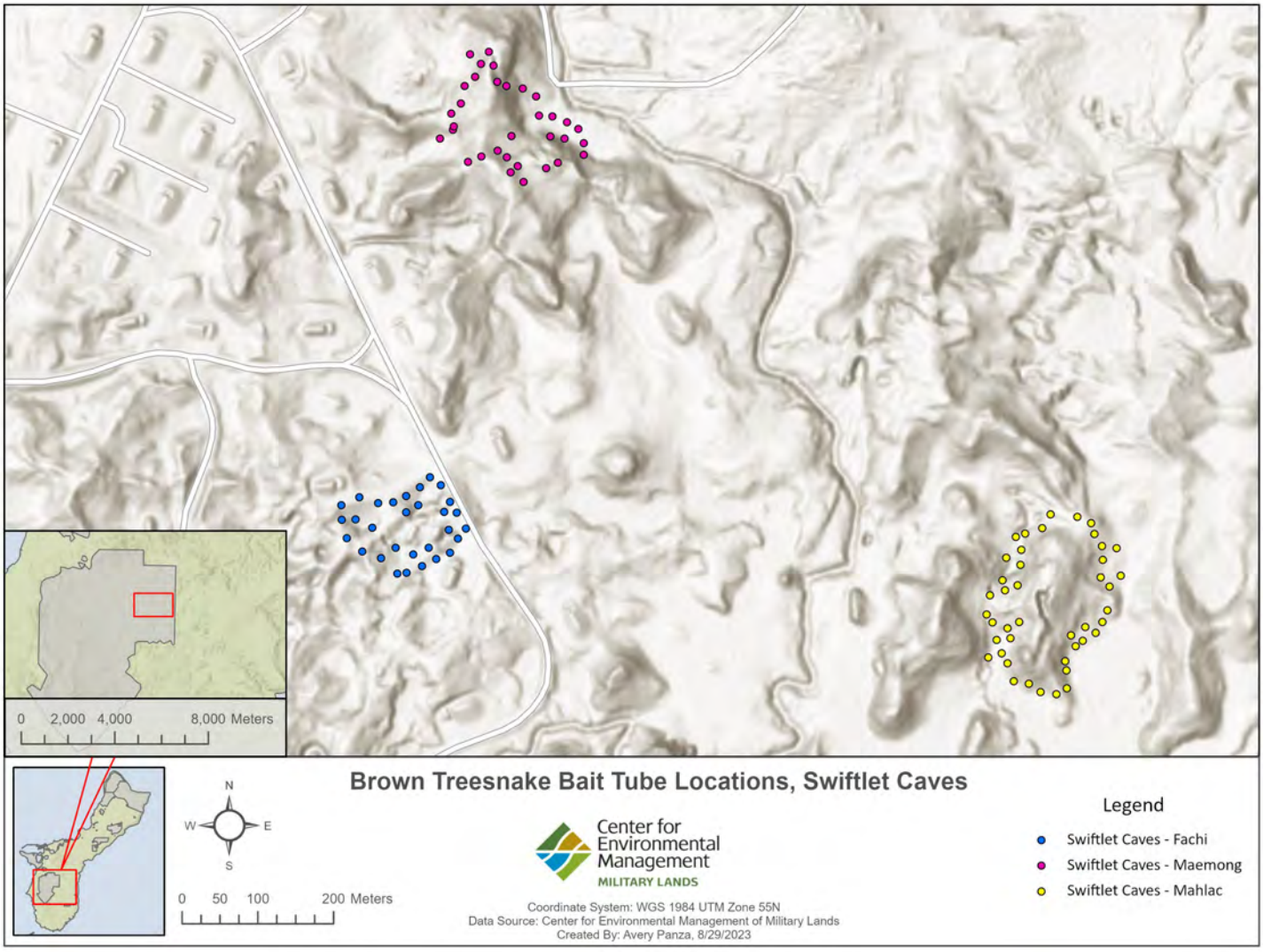


Figure 29. BTS bait tube locations, swiftlet caves. Source: CEMML

Developing a Framework for Coordinated Management of Vertebrate Restoration and Brown Treesnake Control on Guam

Location: JRM **Period of Performance:** SEP2021 – MAR2023

Project Objective

Furthering the development of a decision-analytic framework to guide BTS management and vertebrate species restoration on Guam. The project builds on the subject matter experts previous efforts building a decision model. The group are from management agencies, regulators, stakeholders, and scientific experts and uses a workshop model for the purpose of framework development.

Conservation Benefit

The decision model will help with planning for future conservation management decisions through an analytical process to enhance the planning phase. This includes prioritization, management application, problem solving, evaluating specific actions, and collaboration to manage costly, complex long-term conservation problems. The process should provide a more structured approach to addressing conservation challenges.

FY23 Status

- Pending status from Principle Investigator (USGS-CRU)
- Pending final report

EPR: 1 RP JRM Brown Tree Snake Eradication and Control to Support Recovery of ESA-Listed Species; 61128NR202

2019 JRM INRMP Reference: TIS-3; 9-72

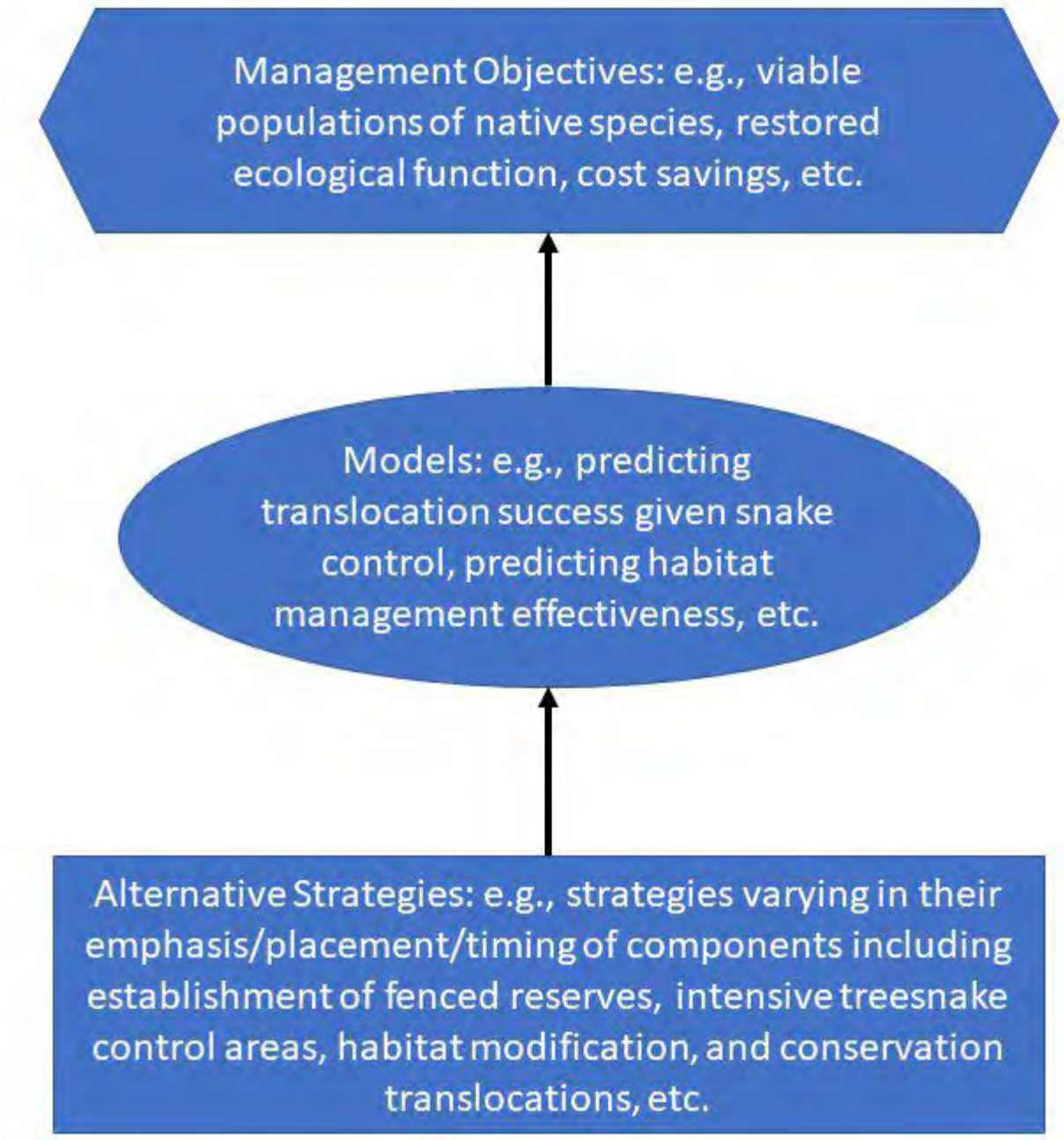


Figure 30. The three main components that form the core of a decision-analytic framework. These components include alternative strategies, models, and management objectives.

Dynamic Monitoring and Management of BTS

Location: JRM **Period of Performance:** JAN2022 – JUN2024

Project Objective

To identify a suite of combined monitoring and management alternatives for managers depending on the status of a target BTS population before and after treatments. With further objects of identifying thresholds where monitoring methods and management efforts shift in efficacy based on the existing/remaining population of BTS in a targeted management area. The project will also create a cost model and application to assess the cost of monitoring and management actions.

Conservation Benefit

Landscape-scale BTS management is predicted to incur substantial costs. Planning and management at scales of hundreds of hectares will require new tools and methods to plan and assess management efforts. The dynamic modeling for monitoring and management for BTS could help with cost efficient management and assist with a structured approach to BTS management decision making.

FY23 Status

- Collated and analyzed data sets from previous BTS projects (2009-2021)
- Developed an individual-based model (IBM)
- Consulting with experts about the model's realism and utility

EPR: 1 RP JRM Brown Tree Snake Eradication and Control to Support Recovery of ESA-Listed Species; 61128NR202

2019 JRM INRMP Reference: TIS-3; 9-72

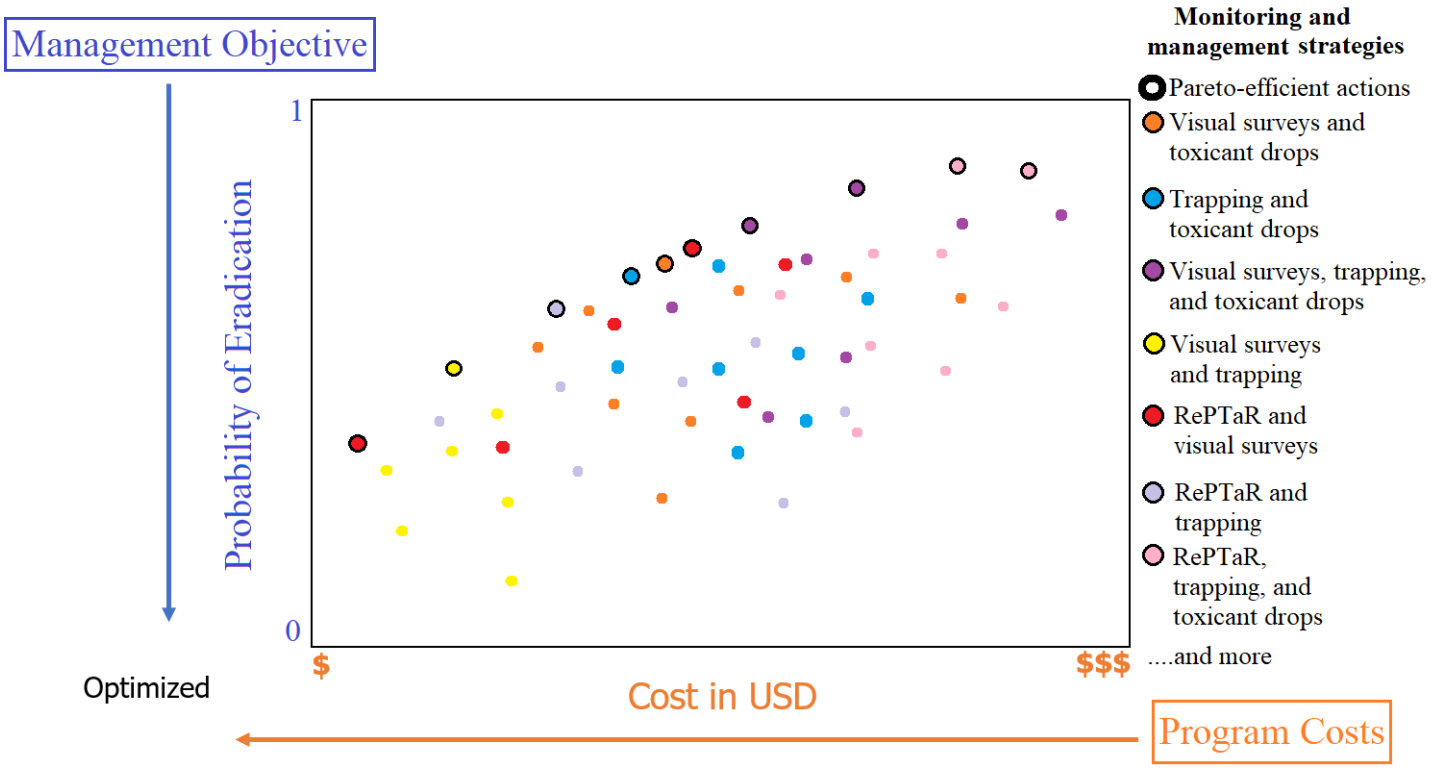


Figure 31. Hypothetical example of results from analysis of integrated monitoring and management strategies. The strategies that represent the best management outcome for a given cost, or the lowest cost for a given management outcome, are the Pareto-efficient strategies (bolded points).

Adaptive Management of BTS to Support Landscape-scale Suppression for Vertebrate Recovery Goals

Location: JRM **Period of Performance:** SEP2022 – MAR2024

Project Objective

To determine if the baiting program at the swiftlet-occupied caves are effective at suppressing the BTS population around the cave and whether integrating chick bait into the program may reduce BTS captures in the cave. Tasks include: 1) determining whether an alternative bating structure expands the suppression zone surrounding swiftlet caves; 2) comparing BTS take rates of chick and mouse baits staged in close proximity to caves, including a specific investigation of bait take by snakes known to have entered caves; 3) monitoring a subset of bait stations fitted with camera traps at set distances along transects from cave openings to measure relative take rates of baits; and 4) conducting in-cave visual surveys to detect decline in BTS captures through time.

Conservation Benefit

Swiftlet protection is a long-term effort that helps support goals of the swiftlet recovery plan. Since mid-2018 it has been 100% toxicant-based control, and while slightly more effective than trapping, the impacts to BTS have not been adequately assessed. Additionally, a better understanding of BTS population dynamics near a rich prey base needs to be improved. The data collected will inform future BTS management strategies in and around the swiftlets cave. Improved BTS population data will inform future conservation efforts for listed species on Guam.

FY23 Status

- Currently baits alter between chicks and mice
- 20 bait tube stations are being monitored per cave

EPR: 1 RP NBG Mariana Swiftlet Population Protection: BTS Trapping; 67155NR834

2019 JRM INRMP Reference: TIS-2; 6-43

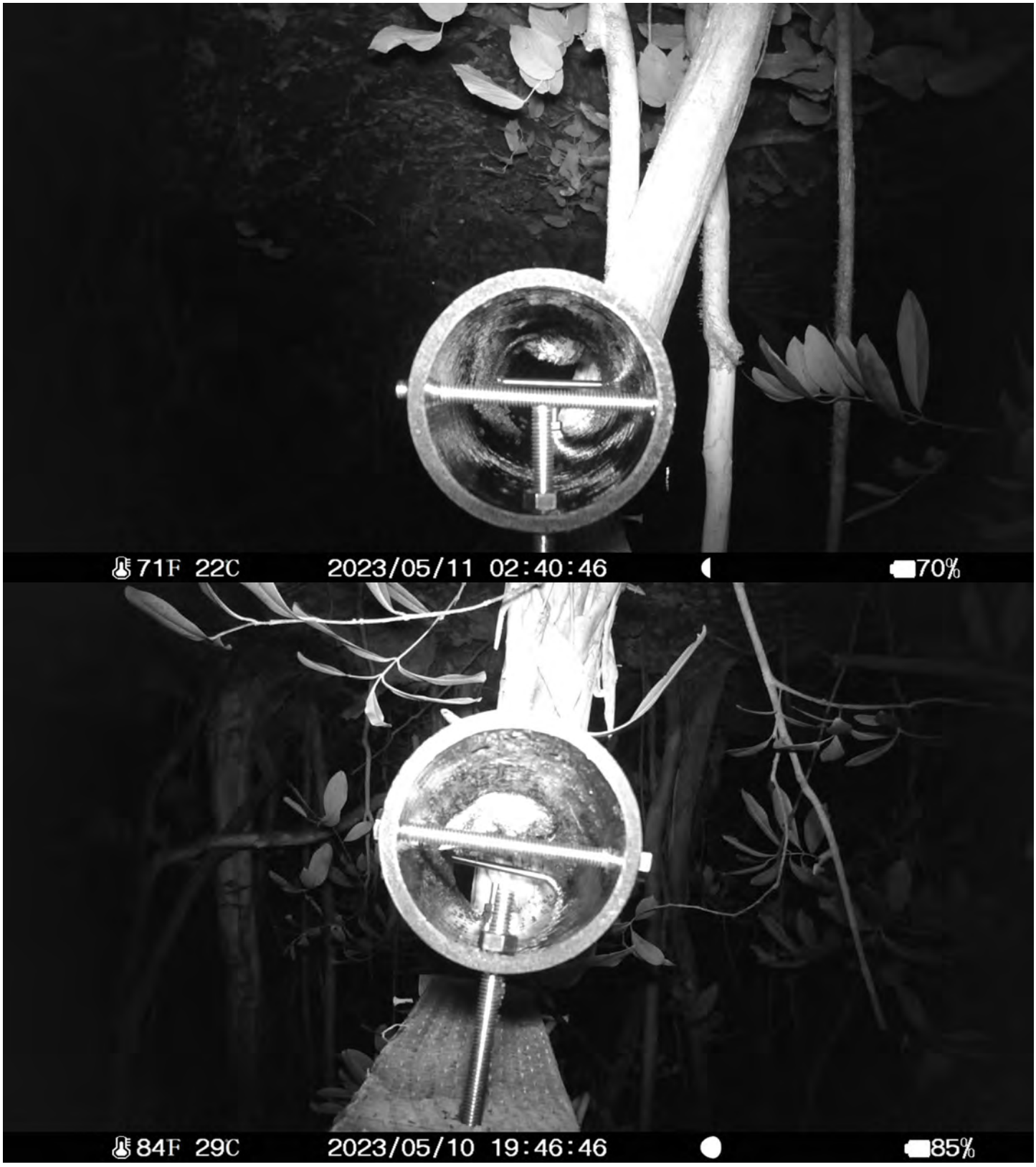


Figure 32. Video stills of footage from bait tubes outside of cave entrances

Tracking Movement of Micronesian Starlings and Brown Treesnakes on AAFB with an Automated Telemetry Tracking Network

Location: AAFB **Period of Performance:** JAN2022 – JUN2023

Project Objective

To track the movement of Micronesian starlings (Aplonis opaca [Sali]) and BTS on AAFB to identify areas of high use and routes of transit through a network of automated telemetry towers, and to document areas where BTS and Sali may interact. This project is one of four projects that, collectively, will further develop information on BTS behaviors related to predation and movement in the presence of abundant avian species.

Conservation Benefit

Tracking animals across the landscape over time can provide important information on habitat selection, resource needs, and factors influencing distribution and density. For a predator such as BTS, tracking movement can provide information on hunting patterns, dispersal potential, and identify areas that may be particularly susceptible to predation. Overlapping simultaneous movement from both predators and their prey can help identify areas of greatest contact, which may vary spatially and temporally. Additionally, population demographics that could be useful for supporting future avian restoration projects and controlling BTS in low density with competing food sources in the presence of control regimes.

FY23 Status

- Tracked 35 BTS for a median of 61 days and a median of nearly 60,000 detections per individual
- Estimated that the BTS tracked predated large (Sali size) animals 1.4 times every 30 days
- Tracked 65 Sali fledglings for 2 days
- Pending final report

EPR: 1 RP JRM Brown Tree Snake Eradication and Control to Support Recovery of ESA-Listed Species; 61128NR202

2019 JRM INRMP Reference: TIS-2, TIS-3; TPS-6, 5-85, 6-43; 7-52, 8-50-51, 9-71, 9-77

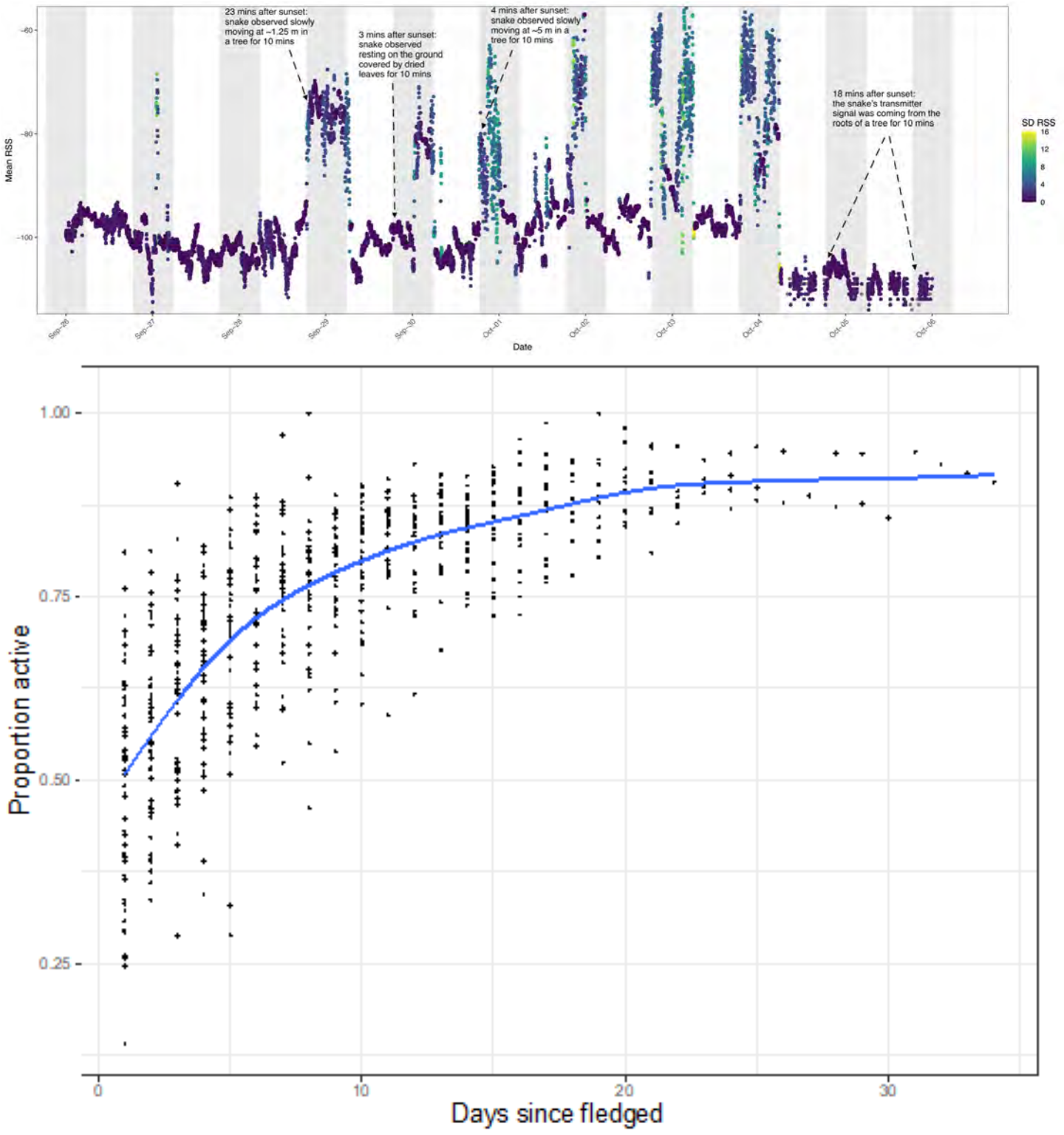


Figure 33. BTS (top) and Sali (bottom) Activity. Source: USGS-PIERC

Evaluating and Reducing Brown Treesnake Predation Threat in Urban Micronesian Starling Habitat

Location: AAFB **Period of Performance:** SEP 2019- JAN 2023

Project Objective

To evaluate and understand the effects of suppression of BTS on Micronesian Starling survival and habitat use on AAFB and to develop a strategy for urban BTS control to improve biosecurity and human quality of life. Tasks include: 1) assessing bait and lure preference in urban areas and 2) performing intensive, sustained removal of BTS in experimental plots, to test the effects of lethal BTS control on the survival of Micronesian starling fledglings. This project is one of four projects that will, collectively, further develop information on BTS behaviors related to predation and movement in the presence of abundant avian species.

Conservation Benefit

Previous studies on AAFB have demonstrated that snakes in the housing area are having a pervasive impact on Micronesian Starling survival at all age classes. Snakes in these urban areas also constitute a greater risk for accidental export of live snakes to other vulnerable regions because shipments of household goods are routine. Additionally, previous research has shown that very large snakes, which pose the greatest predation and reproduction risk, are more often found in urban areas. For these reasons, it is important to begin to consider BTS risk mitigation in urban habitats.

FY23 Status

- Final Report provided June 2022
- No difference among take rates for bait types
- Little human or non-target risk from acetaminophen baiting
- Chicken chick and rodent baits used for removal efforts (2020-2021)
- Iowa State found no statistical indication of increased survival time in treated vs untreated areas

EPR: 1 RP JRM BTS Eradication and Control to Support Recovery of ESA- Listed Birds

2019 JRM INRMP Reference: TIS-2, TIS-3; 5-85, 6-43; 7-52, 8-50-51, 9-71



Figure 34. Bait tube and bracket emulating a tree branch with a time lapse trail camera set to monitor baits. Source: USDA-NWRC

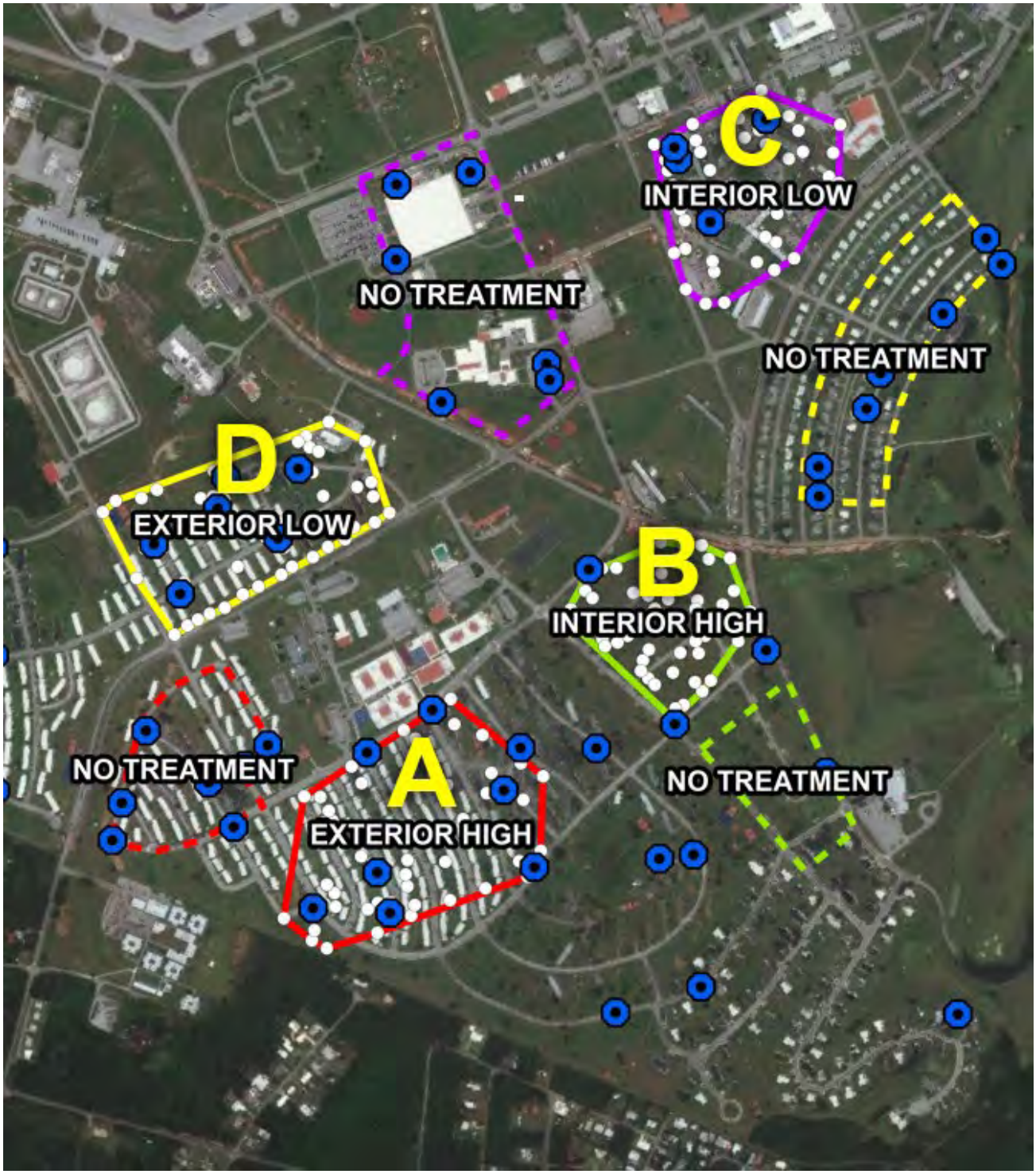


Figure 35. Locations of plots treated with acetaminophen (solid borders) and matched untreated control plots (dashed borders). Plots were characterized by combinations of two factors: High or Low snake density and Interior or Exterior location with respect to forested boundaries. Plots were assigned letters A-D for convenience of reference. White points within treatment areas depict locations of 50 bait tubes per plot. Blue points represent locations of Micronesian Starling artificial nest boxes. Source: USDA-NWRC

Spatial and temporal interactions of Brown Treesnakes and the endangered Mariana Swiftlet on the Naval Munitions Site (NMS)

Location: NMS **Period of Performance:** SEP2023 – FEB2025

Project Objective

To determine predation pressure, as well as gain a practical understanding of how snakes access nests, setting the stage for better control efforts targeted at BTS in and around occupied swiftlet caves. Tasks include: 1) Develop and deploy camera system in swiftlet caves to document spatial and temporal interactions of BTS and swiftlets. 2) Develop computer vision algorithms for detection of BTS in caves recorded by camera system. 3) Map locations of key BTS and swiftlet interactions and estimate predation pressure. 4) Create 3-Dimensional digital maps of NMS caves.

Conservation Benefit

Project activities address two of the recovery criteria in the Amendment to the Recovery Plan for Mariana Islands Population of the Vanikoro Swiftlet (Aerodramus vanikorensis bartschi) (USFWS 2019) by protecting and managing roosting and nesting habitat and managing predation by BTS.

FY23 Status

- New project for FY23
- USGS-PIERC is in the process of updating USFWS Recovery Permit
- Coordinating with USGS and CEMML to obtain info on spatial locations of snakes during in-cave searches
- No data available at this time

EPR: 1 RP NBG Mariana Swiftlet Population Protection; 67155NR834

2019 JRM INRMP Reference: TIS-2; 6-43.

Aerial Baiting Operations and Ground Support for Suppression in the HMU, AAFB

Location: AAFB **Period of Performance**: MAR2022 – AUG2023

Project Objective

To provide operational helicopter support, including a pilot, mechanic, technical support, and post-drop data collection and monitoring of bait drops during aerial baiting applications within the Habitat Management Unit (HMU), AAFB.

Conservation Benefit

The development and performance of aerial delivery system for BTS suppression, demonstrates the potential for meaningful impacts on BTS populations at the landscape level. Dropping aerial baits in the HMU will provide data and insight into BTS responses to aerial baiting over time. Aerial baiting increases the amount of landscape targeted for BTS suppression and control. Landscape level control would likely improve JRM conservation efforts in support of the recovery of listed species on JRM lands and assist with interdiction efforts.

FY23 Status

- Two bait applications every three (3) months
- 108 bait tube transects for a total of 1,080 bait tubes
- Live lure contact rates with camera platforms
- Two (2) fruit bats observed before baiting operations and zero (0) during aerial baiting operations

EPR: 1 RP JRM BTS Eradication and Control to Support Recovery of ESA- Listed Species; 61128NR202/ GMKI MOA Funds

2019 JRM INRMP Reference: TIS-1, TIS-2, TIS-3; 5-85, 6-43; 7-52, 8-50-51, 9-71

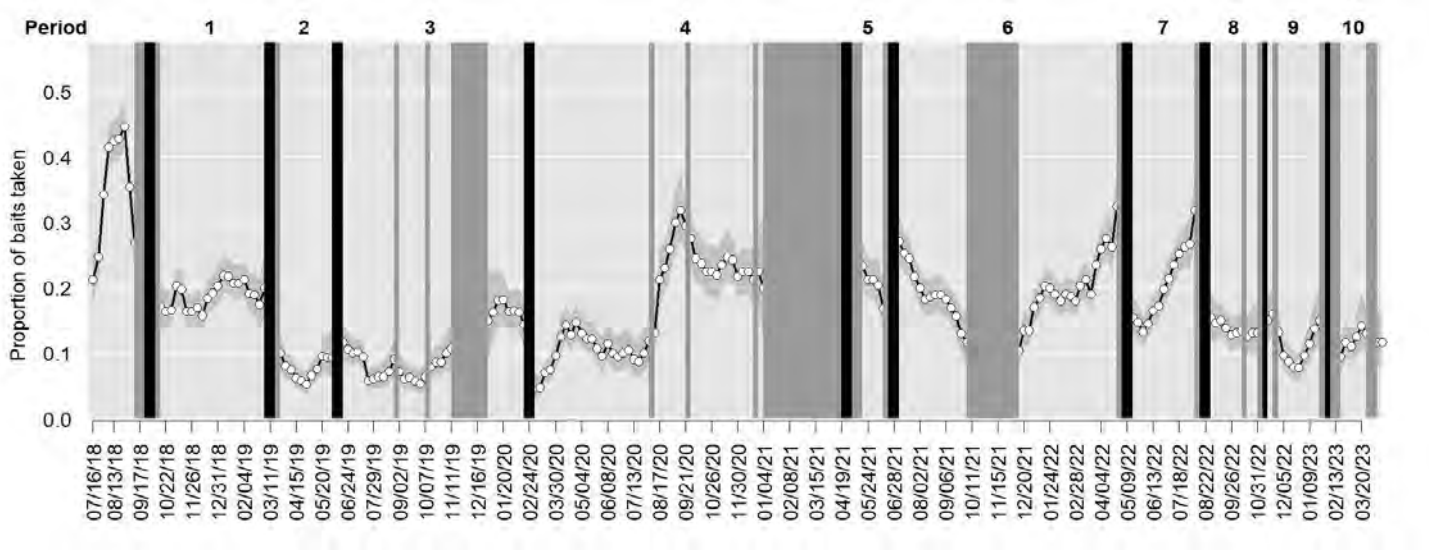


Figure 36. Bait take rate from all five subplots of HMU. Vertical gray bars are periods without bait tube monitoring and vertical black bars denote ADS treatments to HMU. Source: USDA-WS.

Aerial and Ground-Based Brown Treesnake Control on Fenced and Unfenced Landscapes to Evaluate Suppression and Eradication Feasibility

Location: AAFB; MCBCB **Period of Performance:** SEP2022 – JAN2024

Project Objective

To provide ground-based brown treesnake control (BTS) and monitoring of aerial baiting application impacts within the Northern Forest Enhancement Site (N-FES), Marine Corps Base Camp Blaz (MCBCB), and the Habitat Management Unit (HMU), Andersen Air Force Base (AAAFB). The project will use a multi-tool approach towards eradication in the HMU, and determine achievable levels of suppression in an unfenced area (N-FES).

Conservation Benefit

The development and performance of aerial delivery system for BTS suppression, demonstrates the potential for meaningful impacts at the landscape level, however, studies are showing that a multi-tool approach is likely necessary to remove larger snakes. Eradication in the HMU would create a BTS free environment to support future vertebrate conservation efforts. Determining levels of suppression in an unfenced area will provided insights in the feasibility of true landscape-scale management for BTS. Landscape level control would likely improve JRM conservation efforts in support of the recovery of listed species on JRM lands and assist with interdiction efforts.

FY23 Status

- Multi-agency project: USGS-PIERC, USDA-NWRC, USDA-WS
- Typhoon Mawar halted field work in HMU
- Established 4 km of transects in NFES for trapping and surveys
- Completed baseline (pre-treatment) data collection
- Commenced aerial baiting at NFES on Aug 7 and Aug 10

EPR: No EPR - Guam Micronesian Kingfisher MOA funds.

2019 JRM INRMP Reference: TIS-1, TIS-2, TIS-3; 5-85, 6-43; 7-52, 8-50-51, 9-71

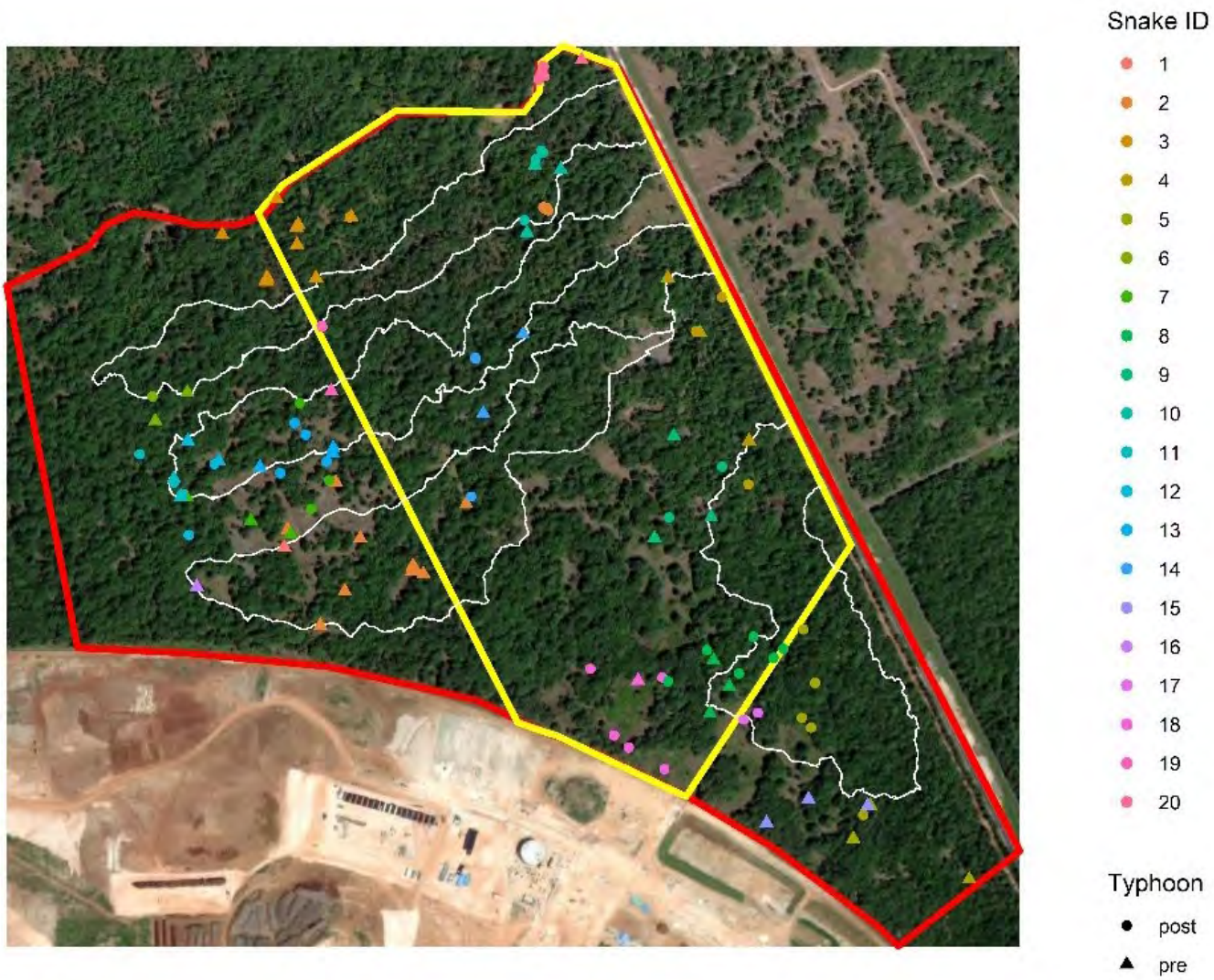


Figure 37. Northern (Caiguat) Forest Enhancement site study area depicting location of 20 telemetered BTS between April 2023 to present. The red polygon indicates the boundary of the Caiguat study area and the yellow polygon delineates the 60-ha aerial baiting area. White lines indicate the 4 transects loops. Triangles indicate snake locations pre-typhoon, and circles indicate locations post-typhoon. Source USGS-PIERC/USDA-NWRC.

Trial Restoration and Probabilistic Evaluation of Vertebrate Reintroduction Techniques Using Species Traits in a Barrier Undergoing a BTS Eradication

Location: AAFB **Period of Performance:** SEP2020 – APR2023

Project Objective

Project seeks to develop a conceptual demographic model for reintroduction strategies. Using three unlisted native lizard species *Nactus pelagicus* (Pacific slender-toed gecko), *Perochirus ateles* (Micronesian saw-tailed gecko), and *Gehyra oceanica* (Oceania gecko), the objective is to develop a predictive response model to BTS predation based on species traits e.g., reproduction, habitat preference, behaviors, sensitivity to predation, etc. Once a model is built, a release strategy will be developed for hard and soft releases in plots controlled and uncontrolled for BTS. Success is to be defined under the following two criteria: evidence of reproduction (juvenile lizards detected) and persistence of the species > 6 months following release.

Conservation Benefit

For reintroductions to occur, managers on Guam will need to understand if species 1) require snake eradication to establish or what level of suppression is required for establishment to occur and 2) snake abundance thresholds that support persistence of prey species. Some of these metrics are likely to be dependent on the desirability of the species as a prey item and therefore their sensitivity to snake abundance. The use of native lizards presents a relatively safe species to study and inform decisions. In a system with numerous unknowns, their benefits include only small areas to establish populations, are not a federally listed species, have species with high variation in sensitivity to BTS predation, and could be used as a monitoring metric/tool to evaluate BTS suppression actions and inform reintroduction goals.

FY23 Status

- Utilized simulation model to evaluate viability of re-introduction strategies
- Controlled BTS (2017-2023); Translocated lizards (2021-2022)
- Introduces concept of “functional eradication”
- Oceania gecko persisted 19 months after release, Green anole persisted 17 months after release, and Pacific slender toed gecko only persisted 5 months after release

EPR: 1 RP JRM BTS Eradication and Control to Support Recovery of ESA- Listed Species; 61128NR202

2019 JRM INRMP Reference: TIS-2, TIS-3; 5-85, 6-43; 7-52, 8-50-51, 9-71



Figure 38. Lizard species: *Gehyra oceanica* (Oceania gecko), *Nactus pelagicus* (Pacific slender-toed gecko), *Anolis carolinensis* (Green anole), *Perochirus ateles* (Micronesian saw-tailed gecko). Source: Elijah Wostle http://elijahwostl.weebly.com/

Evaluating the Effect of Bait Size and Species on Removal of BTS That Are Not Susceptible to ADS Control

Location: AAFB **Period of Performance:** JUL2020 – SEP2022

Project Objective

To evaluate a multi-tool/multi bait approach to eradicating a small, known population of BTS in the Closed Population area on AAFB. The project will use a phased approach continuing with replicating aerial baiting (suspending baits form vegetation); adding a perimeter of larger rodent and bird baits in bait tubes; and use live bird and rodent lures. The baits will have transmitters to track the fate of the snakes. The same approach will be taken within the interior of the Closed Pop to analyze for any spatial effects. As the population of BTS within the Closed Pop is known, following the impacts by the multi-tool approach to provide useful data towards improving BTS suppression and eradication within enclosures.

Conservation Benefit

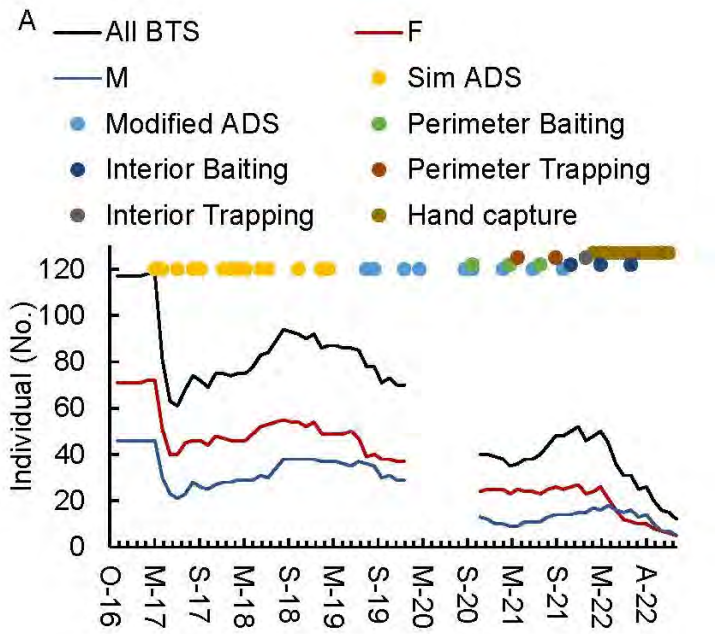
Aerial baiting can distribute bait across the landscape quickly but we still do not have enough data to state conclusively if eradication is achievable. Aerial baiting is the only method used to attempt suppression/eradication of BTS in the HMU. Data projections indicate aerial baiting alone may not be enough to meet the goal of eradication. This is, in part, due to a sub-set of the BTS population not consuming bait (too small/too large). The ability to better target all size classes of BTS with a complex of control tools could help achieve eradication within enclosures but also may provide a substantial benefit to recovery of listed species by severely suppressing the BTS population to allow population recruitment to stay ahead of predation.

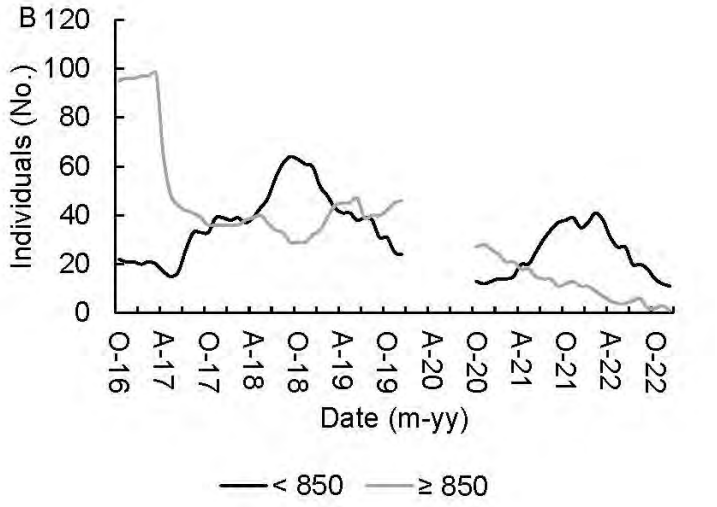
FY23 Status

- Utilized multiple tools for BTS eradication effort (2016-2022)
- Reduced BTS by 95% (117 individuals to an estimated population size of 6)
- ADS greatest rate of removal per days of treatment
- Target removals not met until live avian lures were deployed
- Evaluated functional prey response following predator control

EPR: 1 RP JRM Brown Tree Snake Eradication and Control to Support Recovery of ESA-Listed Species; 61128NR202

2019 JRM INRMP Reference: TIS-2, TIS-3; TPS-6, 5-85, 6-43; 7-52, 8-50-51, 9-71, 9-77


A
All BTS
F
M
Sim ADS
Modified ADS
Perimeter Baiting
Interior Baiting
Perimeter Trapping
Interior Trapping
Hand capture
Individual (No.)
120
100
80
60
40
20
0
O-16
M-17
S-17
M-18
S-18
M-19
S-19
M-20
S-20
M-21
S-21
M-22
A-22


B
Individuals (No.)
120
100
80
60
40
20
0
O-16
A-17
O-17
A-18
O-18
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O-22
Date (m-yy)
< 850
≥ 850

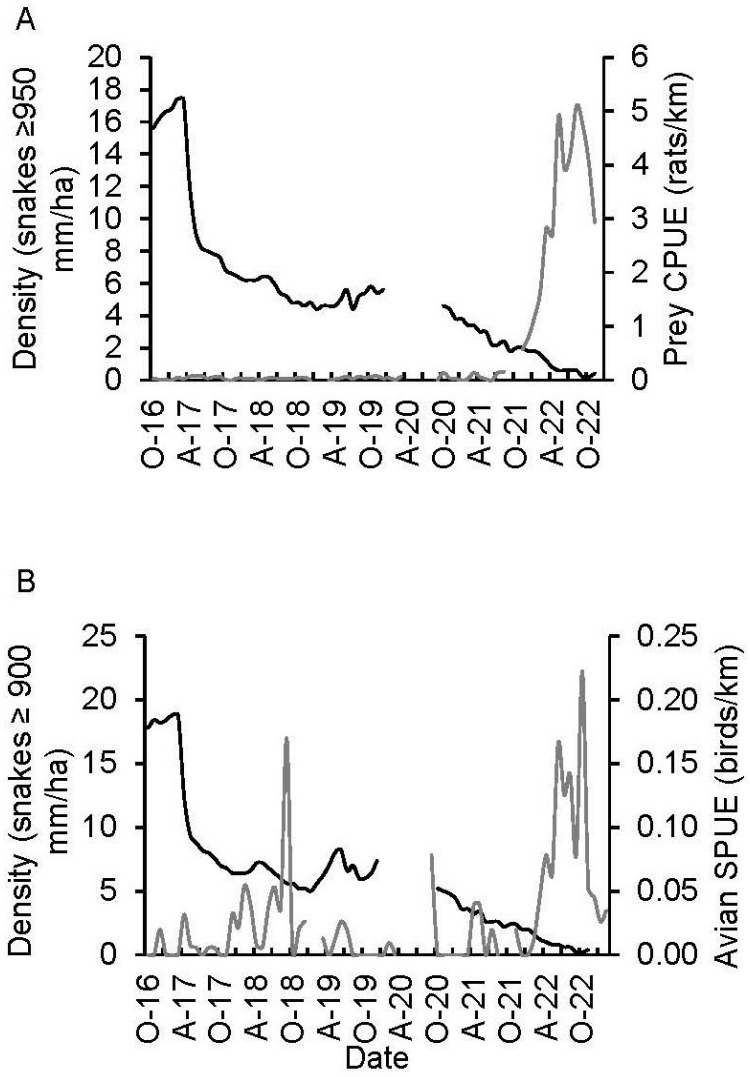


Figure 39. A) The number of total, male, or female BTS (A) and the number of specific size classes (B), including juvenile snakes (< 850 mm snout vent length (SVL, mm), control tool susceptible snakes (≥ 850 mm SVL), and reproductively mature (≥ 1050 mm SVL) snakes in a 5-ha enclosure from October 2016 – December 2022 at monthly intervals. Throughout the course of the period the population was subjected to a series of management actions to remove snakes that increased in complexity including simulating the Aerial Delivery System (sADS), a modified version of the ADS with larger ground baits (mADS), placement of mixed species (rodent and bird) toxic baits in bait canisters during perimeter and then interior placement, live trapping using mouse and finch lures during perimeter then interior placement, followed by hand capture during nocturnal surveys. b) The density of BTS by specified snout-vent length (SVL) in a 5-ha enclosure from October 2016 – November 2022 relative to the number of rats (A) or birds (B) counted (CPUE) during nocturnal surveys in the enclosure over the same period of time. Weekly surveys yielded snake counts throughout a 6-year removal program that cycled through three phases of control to determine if avian recovery in an area enclosed by a snake barrier could yield avian recovery. Source: USGS-PIERC

Identifying & Refining Tools for Landscape-scale Detection, Removal, and Monitoring of Brown Treesnakes

Location: AAFB **Period of Performance**: AUG2022 – JAN2024

Project Objective

To evaluate tools and methods for BTS control and monitoring including improving the effectiveness and reducing the costs of tools for BTS suppression and monitoring. Tasks include 1) evaluating whether abiotic factors such as moonlight, temperature, humidity, and rainfall affect BTS activity levels; 2) assessing whether BTS produce recognizable images in thermographic cameras and can improve detection in the environment; 3) evaluating a variety of market available cameras to help standardize technology and reduce costs; 4) continuing genetic evaluation of acetaminophen impacts to avian species.

Conservation Benefit

Brown treesnakes are difficult to detect and manage. Current standard tools i.e., visual surveys, camera traps can be improved with improve/alternate technology e.g., thermal, infra-red, night-vision, however, this technology needs to be properly evaluated to determine suitability and methods improvement. Deploying multiple cameras in the field is expensive and finding low-cost models with similar image quality is an important cost reduction. Data are available on abiotic factors such as moonlight, humidity, and rainfall, but the influence of these factors on BTS activity has not been evaluated. Knowing movement related to weather and moonlight could help refine management techniques. Collecting further data on acetaminophen impacts to avian species is important to improving predictions to which bird species on Guam may be sensitive to acetaminophen, where testing potential species for reintroduction is not feasible.

FY23 Status

- Hired personnel and purchased equipment
- Commenced evaluating effects of weather and moonlight on movement of fed and unfed snakes
- Commenced gene expression for metabolism of acetaminophen in non-target birds

EPR: No EPR number, funded with DPRI funds for Marine Relocation

2019 JRM INRMP Reference: TIS-2, TIS-3; TPS-6, 5-85, 6-43; 7-52, 8-50-51, 9-71, 9-77.



Figure 40. Twelve wide-angle trail cameras acquired for comparison

Optimization and evaluation of ground-based Brown Treesnake removal tools

Location: AAFB **Period of Performance**: JUN2023 – NOV2024

Project Objective

To evaluate and adapt existing and new BTS control and monitoring tools. Tasks include 1) adaptation and optimization of cage traps with live lures; 2) evaluation of a self-resetting multi-kill trap; 3) evaluation of a nontarget-proof bait station; and 4) presentation of an alternative ground-based toxic bait station (hanging bait station).

Conservation Benefit

Current tools for ground-based management of BTS i.e., standard traps with mouse lures and PVC-tube bait stations can be enhanced with improved/alternate technology e.g., traps with live bird lures, elevated traps, self-resetting multi-kill traps, and nontarget-proof bait stations however, this technology needs to be properly evaluated to determine performance and effectiveness. If effective, new inexpensive control tools could be adopted to increase nontarget exclusion and BTS capture rates. Live trapping is labor intensive, as they need to be visited regularly to remove snakes for euthanasia, while kill traps automate immediate euthanasia and reset for future kills. Additionally, nontarget consumption of baits in PVC tubes negatively impacts BTS control efforts, by interfering with baits making them unavailable for BTS and by increasing uncertainty in the numbers of snakes removed when consumption by a BTS can't be confirmed.

FY23 Status

- New project for FY23
- No data available at this time

EPR: 1 RP JRM Brown Tree Snake Eradication and Control to Support Recovery of ESA-Listed Species; 61128NR202

2019 JRM INRMP Reference: TIS-2, TIS-3; TPS-6, 5-85, 6-43; 7-52, 8-50-51, 9-71, 9-77.



Figure 41. Prototype ant-proof tipping bait station design. Source: USDA-NWRC

When to declare eradication: Evaluating search effort required to declare eradication if detection is density dependent

Location: MCBCB **Period of Performance**: JUN2023 – NOV2024

Project Objective

To complete the eradication in Closed Population (CP) and determine the level of search time or effort required to declare a bounded, forested area eradicated. Tasks include: 1) Continuing snake removal efforts in CP and monitoring reintroduction outcomes; 2) Quantifying whether capture probability is density dependent; and 3) Determining search effort required to declare eradication in low density locations.

Conservation Benefit

Data will be essential in informing managers when they can declare BTS eradication based on a pre-determined level of acceptable risk in making an incorrect decision. There has been a significant investment in assessing whether BTS eradication can occur within bounded areas, such as the Habitat Management Unit, using ADS in combination with other suppression techniques. However, a major hurdle for managing BTS remains within their low capture probabilities. Whether eradication is possible or not, a matter that will be important in the final assessment of feasibility is the duration and intensity of monitoring required to declare eradication a success.

FY23 Status

- New project for FY23
- Complimentary OIA proposal to introduce sterilized snakes to tests strategies for control in a snake-suppressed landscape with high prey availability
- No data available at this time

EPR: 1 RP JRM Brown Tree Snake Eradication and Control to Support Recovery of ESA-Listed Species; 61128NR202

2019 JRM INRMP Reference: TIS-2, TIS-3; TPS-6, 5-85, 6-43; 7-52, 8-50-51, 9-71, 9-77.

NATURAL RESOURCES EDUCATION AND OUTREACH

Natural Resources Education and Outreach at NBG

Location: NBG Period of Performance: AUG2023 – AUG2024

Project Objective

This project focuses on education, outreach, and awareness to DoD uniformed staff and civilian staff, their dependents, contractors, school students, and the general public. The objectives are to develop, design, and produce customized outreach folders, stickers, posters, and booklets for use and distribution on NBG. The goal is for targeted audiences to be informed of protected marine species on JRM-submerged lands at NBG, including *Acropora globiceps*, oceanic whitetip shark (*Carcharhinus longimanus*), scalloped hammerhead shark (*Sphyrna lewini*), green turtle (*Chelonia mydas*), and hawksbill turtle (*Eretmochelys imbricata*). Educational materials will include: species characteristics, behavior, and habitat; conservation measures; federal and local regulations; and/or best practices.

Conservation Benefit

The conservation benefit of this project is to ensure no loss of marine species range, particularly those protected on JRM-administered lands at NBG. This project supports the USMC Relocation 2017 BO, which contains amendments to the 2015 BO (USFWS 2017).

FY23 Status

- POP: AUG 2023 to AUG 2024
- Promote environmental education and awareness
- Focus on ESA-listed marine species
- Target audience: DoD personnel, families, contractors, students
- Design, develop: posters, booklets, stickers, folders

EPR: Threatened and Endangered Species Outreach Signage; 61755NR305; Listed Species Outreach Materials; 61755NR306

2019 JRM INRMP Reference: MEDU-1 (5-104)



Figure 42. Outreach sign at Gab Gab Beach. Photo: Navy.

Outreach and Education – NBG

Location: NBG **Period of Performance:** SEP 2022 - Ongoing

Project Objective

Develop, design, and produce custom outreach materials for use by Public Works EV and NBG to educate incoming military personnel, their families, and civilian employees on the importance of conserving and protecting natural resources.

Conservation Benefit

Educational material provides military and civilian personnel and base visitors the ability to understand their role in protecting Guam resources.

FY23 Status

- NRMAC FY2022 with Sundance EA (awarded end of FY2022)
  - 60% completed with production of 2 to 4 minute outreach video for use across JRM AOR
  - No Cost Extension through December 2023 to account for delays from Typhoon Mawar

EPR: Listed Species Outreach Material; 61755NR306

2019 JRM INRMP Reference: TEDU-1; 5-91, MEDU-1; 5-104

JRM Natural Resources Stewardship Outreach & Public Engagement Program

Location: JRM **Period of Performance**: VARIOUS

Project Objective

To develop outreach products to effectively and efficiently implement a NR stewardship engagement program. This program aims to better educate uniformed and civilian staff, their dependents, JRM contractors, and the general public in order to improve NR stewardship and awareness within JRM AOR.

Conservation Benefit

The development and production of NR education materials and training is a beneficial support to increasing awareness of T&E species, proper stewardship behavior, and threats to local ecosystems.

FY23 Results

- Closed FY2022 CESU with Micronesian Conservation Coalition
  - Completed Public Access Plan (PAP) site descriptions and photos
  - Completed 360 degree camera photos of 3 PAP sites to be featured on Environmental Stewardship Website
  - Final report available
- NRMAC FY2022 with Sundance EA (awarded end of FY2022)
  - 60% completed with production of 2 to 4 minute outreach video for use across JRM AOR
  - No Cost Extension through December 2023 to account for delays from Typhoon Mawar
- New CESU Awarded AUG2023 to UOG SeaGrant
  - Continuing production of Environmental Stewardship Website
  - Continuing production of outreach swag items to support Tinian Art Contest and Turtle Educational Outreach Project
  - Planning and Implementation of Tinian Art Contest and Turtle Educational Outreach Project

EPR: 61128NR962 JRM Natural Resources Stewardship Outreach and Public Engagement Program

2019 JRM INRMP Reference: TEDU-1; 5-91, MEDU-1; 5-104

PACFLT Funded JRM Natural Resources Stewardship Outreach & Public Engagement Program

Location: JRM **Period of Performance:** SEP2020 - Ongoing

Project Objective

Improve NR stewardship and awareness within JRM AOR.

Conservation Benefit

The development and production of NR education materials and training is a beneficial support to increasing awareness of T&E species, proper stewardship behavior, and threats to local ecosystems.

FY23 Results

- Ongoing implementation and expansion of Young Environmental Stewards (YES!) youth educational program
- Ongoing CNMI outreach initiative in conjunction with EPR 61128NR962 JRM Natural Resources Stewardship Outreach and Public Engagement Program
- Native Terrestrial Species and Migratory Bird Nature Journals and Passports delivered OCT2022
- Final version of Invasive Terrestrial Nature Journal and Passport approved JUL2023, currently in production
- Marine Invasive Species Nature Journal and Passport in draft review
- Ongoing development of sea turtle interactive classroom game

EPR: NA- Funding from PACFLT Stewards of the Sea Initiative

2019 JRM INRMP Reference: TEDU-1; 5-91, MEDU-1; 5-104

MIGRATORY BIRD MANAGEMENT

Migratory Bird Surveys on NBG-Administered Lands

Location: NBG; NMS **Period of performance: SEP2022 – AUG2023**

Project Objective

Conduct monthly bird surveys on NBG-administered lands; examine trends in abundance and habitat preference of migratory birds.

Conservation benefit

To improve long-term understanding of species protected by the MBTA and their preferred habitats and migratory patterns, in support of military readiness, and to avoid and minimize impacts to migratory birds.

FY23 Status

- Bird abundance was monitored at 18 NBG/NMS sites
- Bi-monthly surveys during nesting season
- 45 in-house surveys conducted
- Common occurrence of golden plovers, ruddy turnstones, brown noddies, and whimbrels.
- Migrants prefer grass fields and paved surfaces

EPR: In-house only

2019 JRM INRMP Reference: MIG-1, 5-90; MIG-1, 6-48; MIG-1, 7-40

TERRESTRIAL HABITAT MANAGEMENT

Carbon Stock Assessment, Restoration Planning, and Monitoring of Ecosystems at NBG

Location: NMS, NBG **Period of Performance:** JUL2023 – JUL2028

Project Objective

This project focuses on assessing and understanding baseline and long-term carbon storage of upland vegetation, wetlands, mangroves along the coastline, and seagrass at NBG. This project covers the carbon sequestration element of prior and ongoing terrestrial habitat management actions to enhance watershed habitats, particularly through the installation of vegetation in an effort to reduce runoff/siltation and protect the reef. The expected outcomes of this project include: total carbon stock estimates by ecosystem/habitat type; carbon stock change over five years by habitat type; spatial extent, health, biodiversity and productivity of seagrass; and habitat suitability model for seagrass beds to inform restoration.

Conservation Benefit

The conservation benefits of project include: (a) protect and manage sufficient habitats by identifying landscapes and nearshore habitat needed for species conservation; (b) maintain ecological function, services, and diversity through management focused on maintaining and restoring marine and terrestrial ecosystems; and (c) ensure self-sustaining, resilient populations to include the use of novel techniques in the adaptive management of species populations.

FY23 Status

- Interagency Agreement with USGS WERC
- POP: JUL 2023 to JUL 2028
- SEP/OCT 2023: Planning/scoping meeting
- Carbon storage: upland vegetation, mangroves, seagrass
- Seagrass monitoring and restoration plan

EPR: Soil and Water Conservation: Erosion Management – Carbon Sequestration; 61755NR832

2019 JRM INRMP Reference: THM-1 (5-83); MHM-2 (5-99)

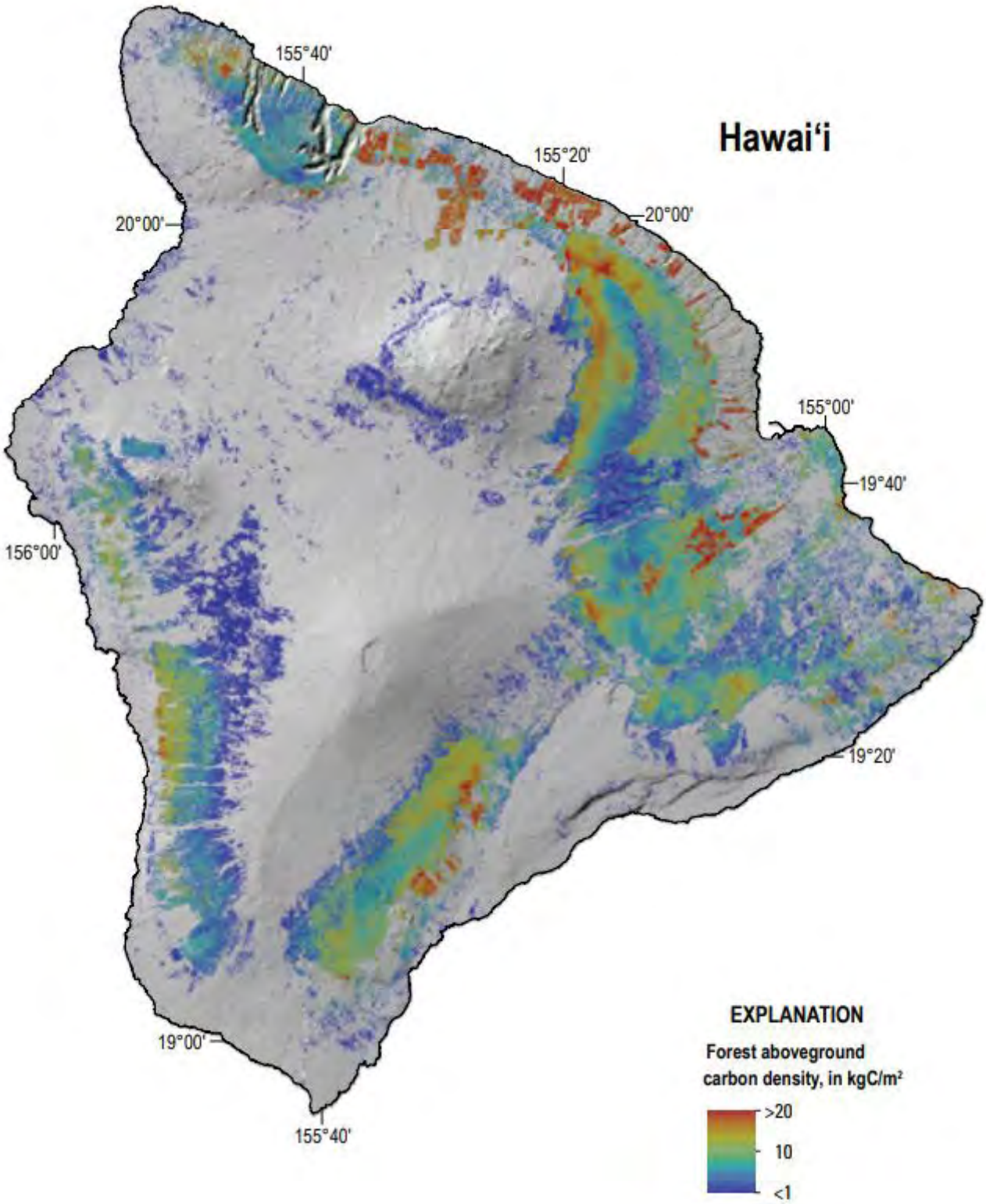


Figure 43. Shown as an example: Aboveground carbon density for Hawai'i in kgC/m2. Photo: USGS.

Listed Plant and Invertebrate Surveys 1

Location: NMS; AAFB; Off-DoD **Period of Performance:** AUG2019- Ongoing

Project Objective

To conduct surveys for ESA-listed plant and invertebrates. Information collected adds to the baseline data for each the species.

Conservation Benefit

Identifying locations of ESA-listed plant and invertebrate species will allow for management actions to reduce habitat fragmentation, enhance and restore habitat, buffer protected areas, and implement new conservation strategies.

FY23 Status

- Acres surveyed AAFB NWF(173), NBGNMS (110), South FES (187), South Taguac (135)
- Species found: *Bulbophyllum guamense, Cycas micronesica, Dendrobium guamense, Tabernaemontana rotensis*, and *Tuberolabium guamense*

EPR: Listed plant surveys, Propagation, planting, and Establishment in the Wild; 61128NR209 and 1 S JRM AAFB - Monitoring and Surveys for Listed Tree Snails, Butterfly, Plants; M5240CN048

2019 JRM INRMP Reference: THM-2; 6-39, TPS-1; 7-55, TPS-5; 9-77

Table 5. Counts of ESA-listed species found during surveys between OCT 2022- AUG 2023

Species Scientific Name	Naval Magazine	AAFB NWF	South FES	South Taguac
Bulbophyllum guamense	11,115	0	34	8
Cycas micronesica	56	1,021	5	0
Dendrobium guamense	4,386	0	3	0
Eugenia bryanii	0	0	0	0
Hedyotis megalantha	0	0	0	0
Heritiera longipetiolata	0	0	0	0
Maesa walkerii	0	0	0	0
Nervilia jacksoniae	0	0	0	0
Phyllanthus saffordii	0	0	0	0
Serianthes nelsonii	0	0	0	0
Solanum guamense	0	0	0	0
Tabernaemontana rotensis	2	25	127	9
Tinospora homosepala	0	0	0	0
Tuberolabium guamense	3,395	0	1,249	1,760
Hypolimnas octocula marianensis	0	0	0	0
Vagrans egistina	0	0	0	0
Partula gibba	0	0	0	0
Samoana fragilis	1,896	0	0	0
Partula radiolata	1	0	0	0

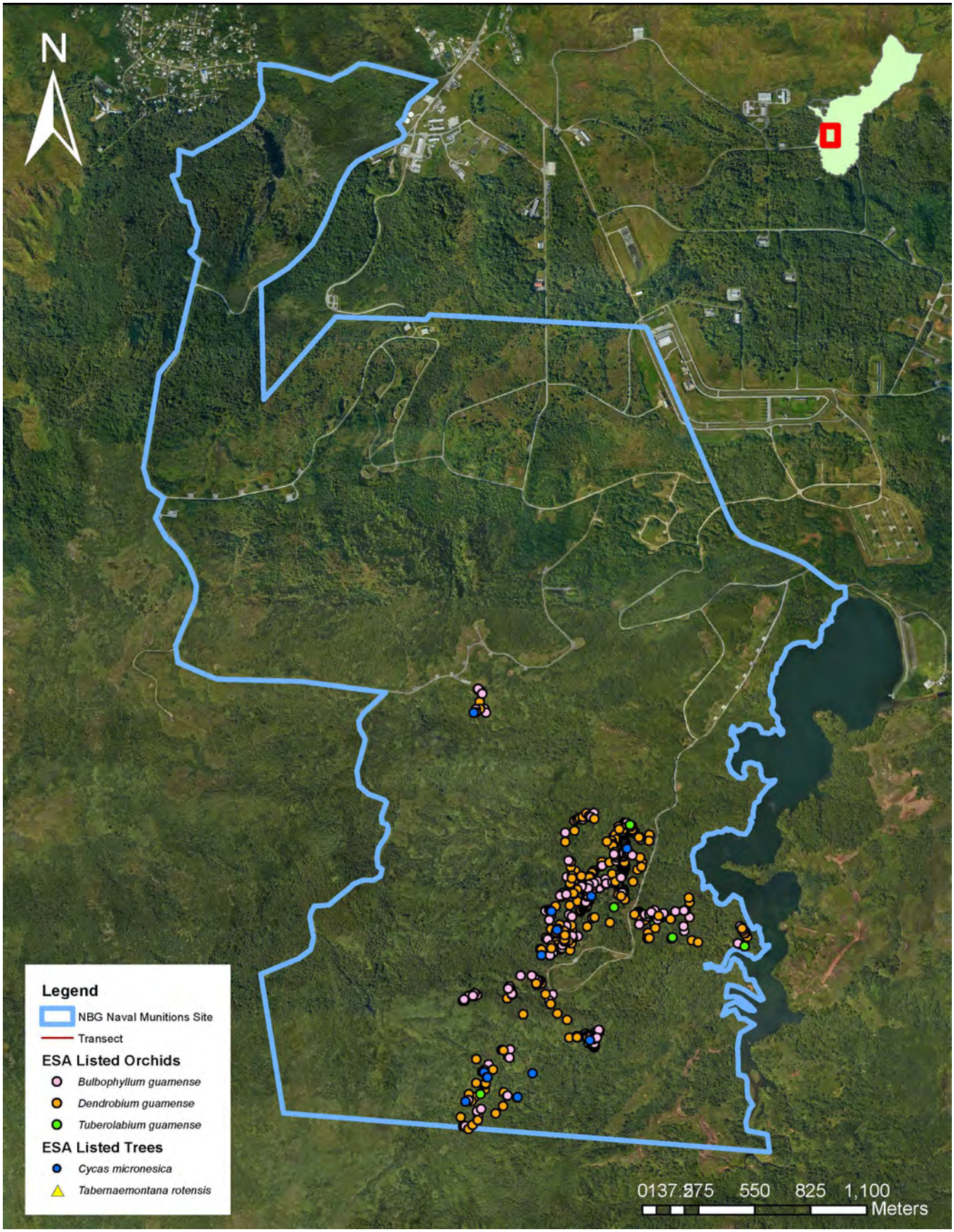


Figure 44. ESA-listed species found during surveys at AAFB NWF

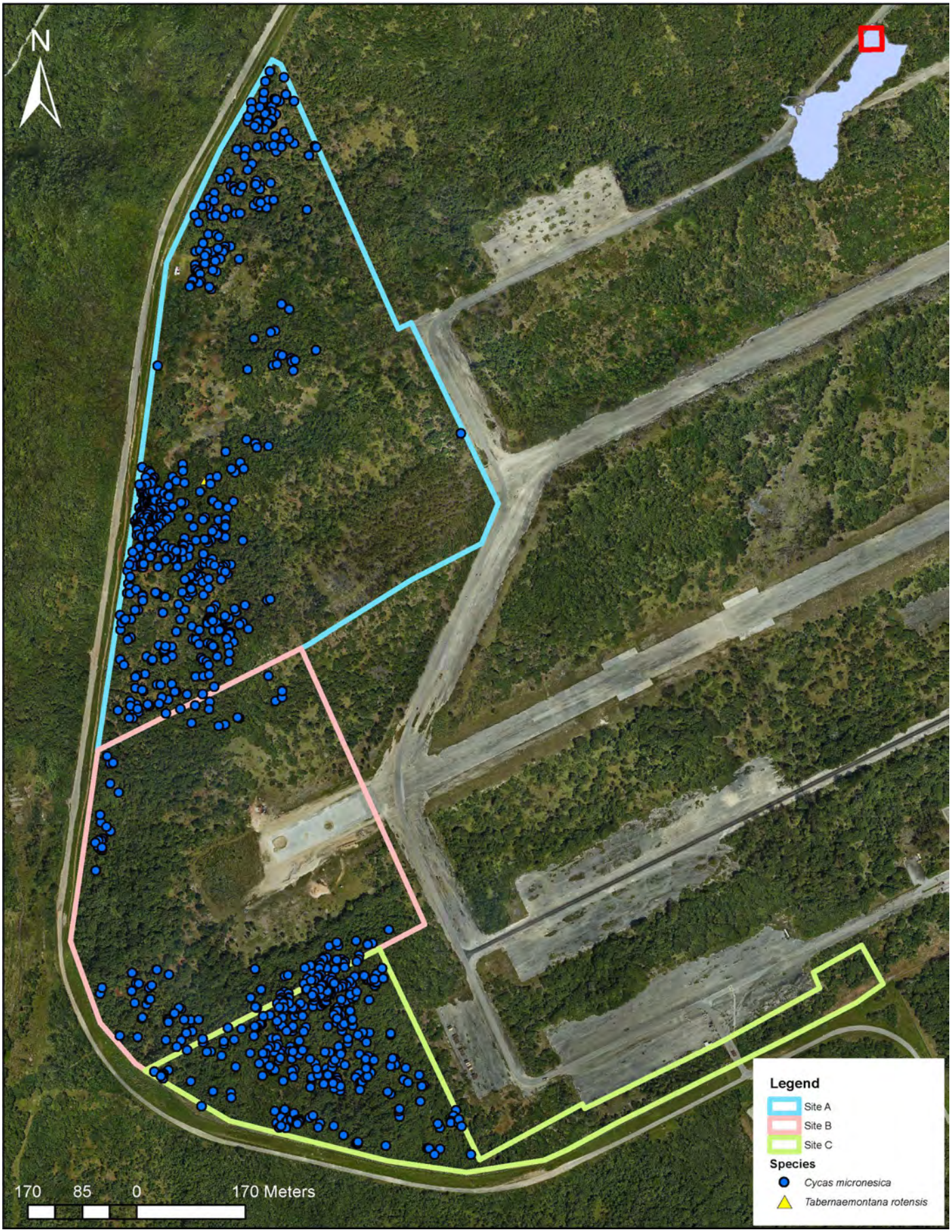


Figure 45. ESA-listed species found during surveys at NBGNMS

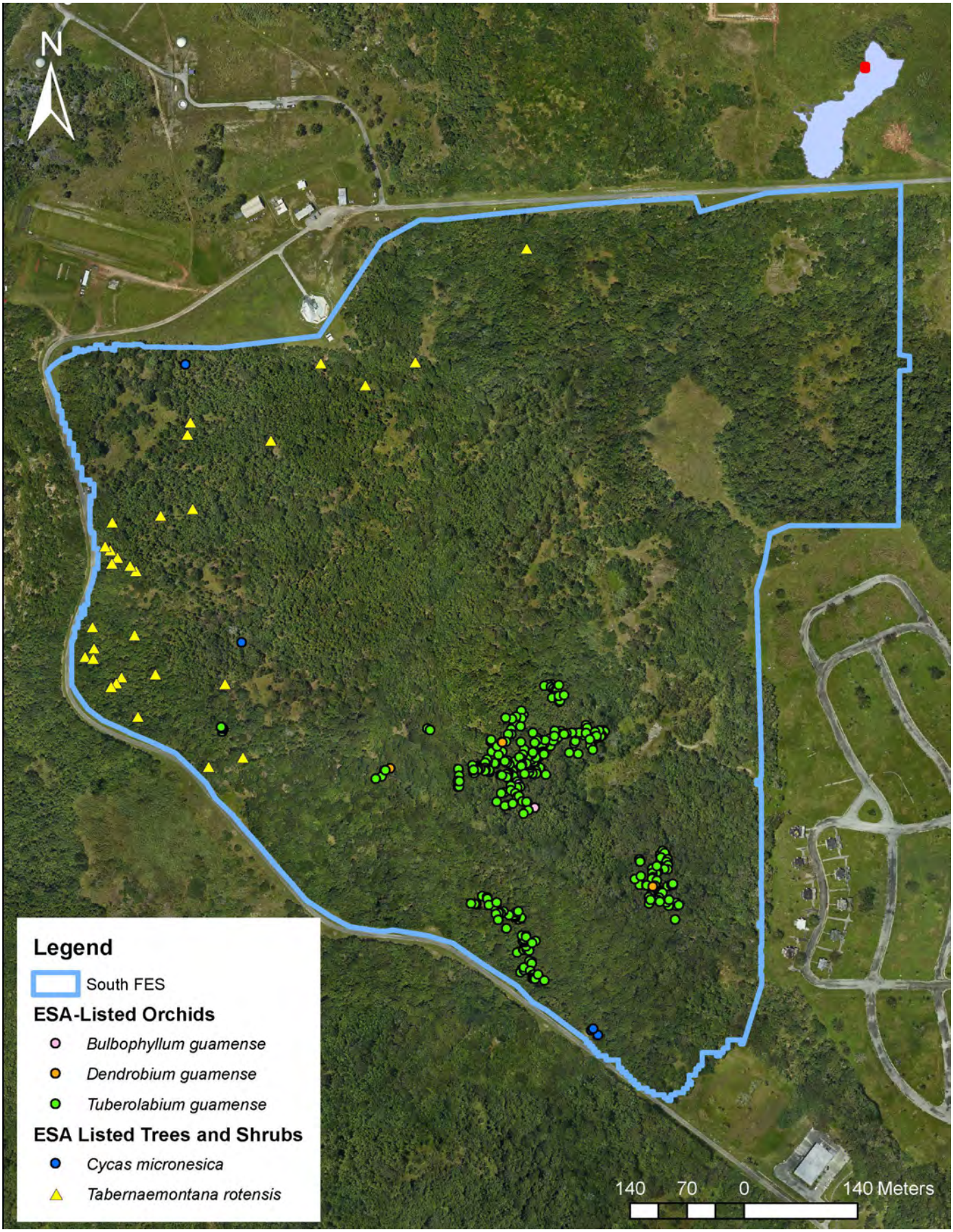


Figure 46. ESA-listed species found during surveys at South FES

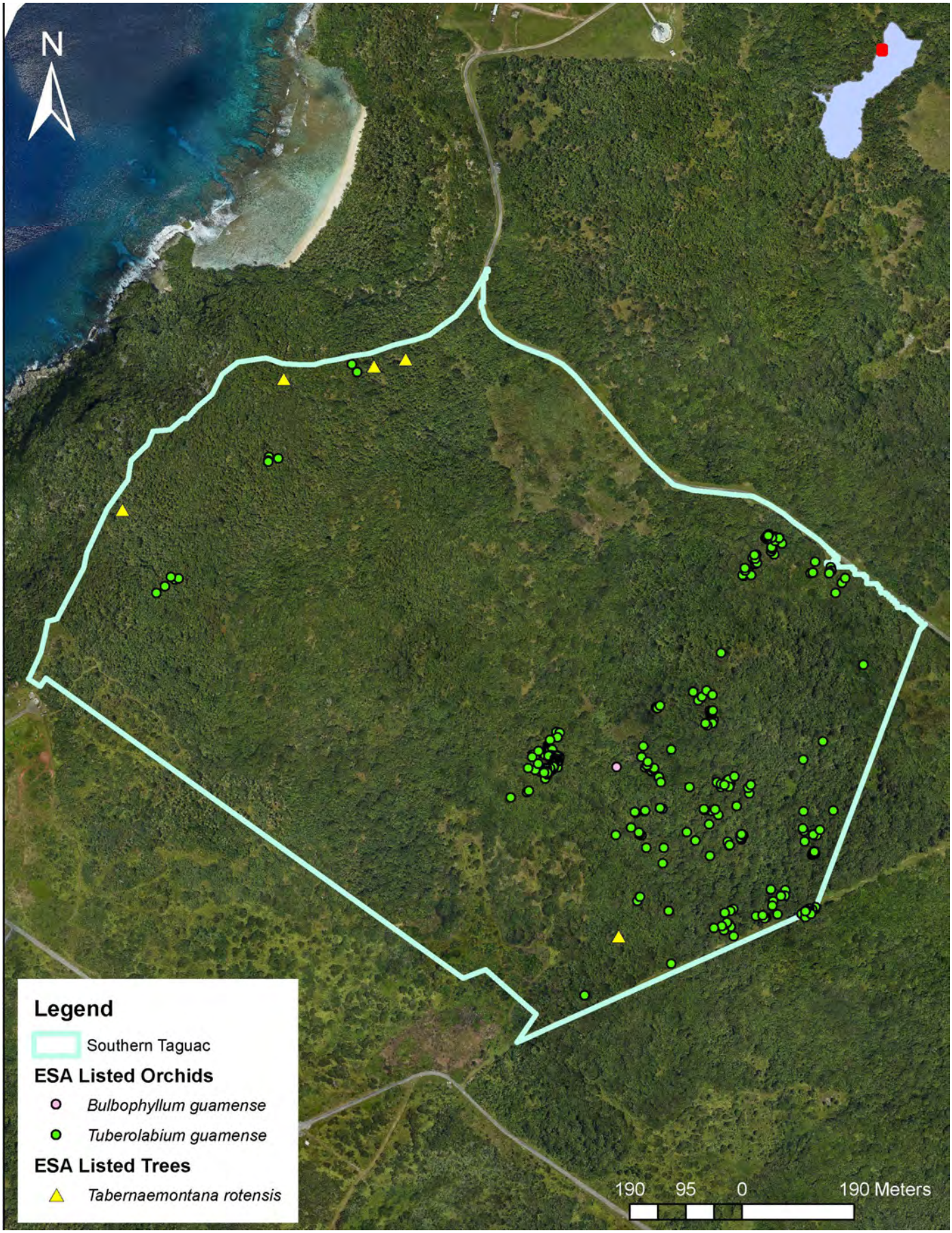


Figure 47. ESA-listed species found during surveys at South Taguac

Listed Plant and Invertebrate Surveys 2

Location: NMS **Period of performance:** JUL2023 - 2024

Project Objective

To conduct surveys for ESA-listed plant and invertebrates. Information collected adds to the baseline data for each the species.

Conservation benefit

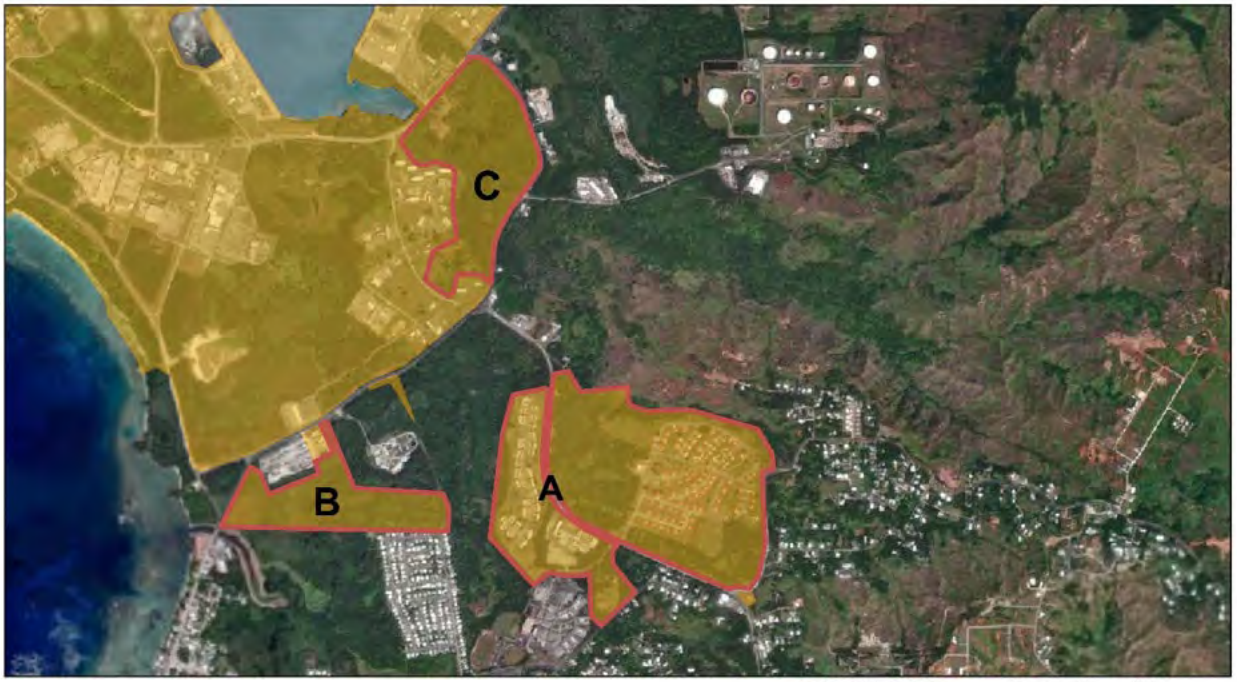
Identifying locations of ESA-listed plant and invertebrate species will allow for management actions to reduce habitat fragmentation, enhance and restore habitat, buffer protected areas, and implement new conservation strategies.

FY23 Status

- Surveys ongoing in NBG at Apra Heights (118 acres), Tenjo Vista (209 acres), NBG main base (92 acres), and NBGNMS training area (208 acres)
- Additional monitoring of naturally occurring ESA-listed epiphytic orchids at NBGNMS that were previously monitored in wet and dry seasons in 2020-2021

EPR: Listed plant surveys, Propagation, planting, and Establishment in the Wild; 61128NR209 (Surveys at all locations except Tenjo Vista and orchid monitoring) and 1 S MAR NBG MBTA and ESA-Listed Species Surveys; 61755NR142 (surveys at Tenjo Vista)

2019 JRM INRMP Reference: THM-2; 6-39, TPS-5; 9-77



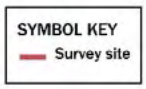


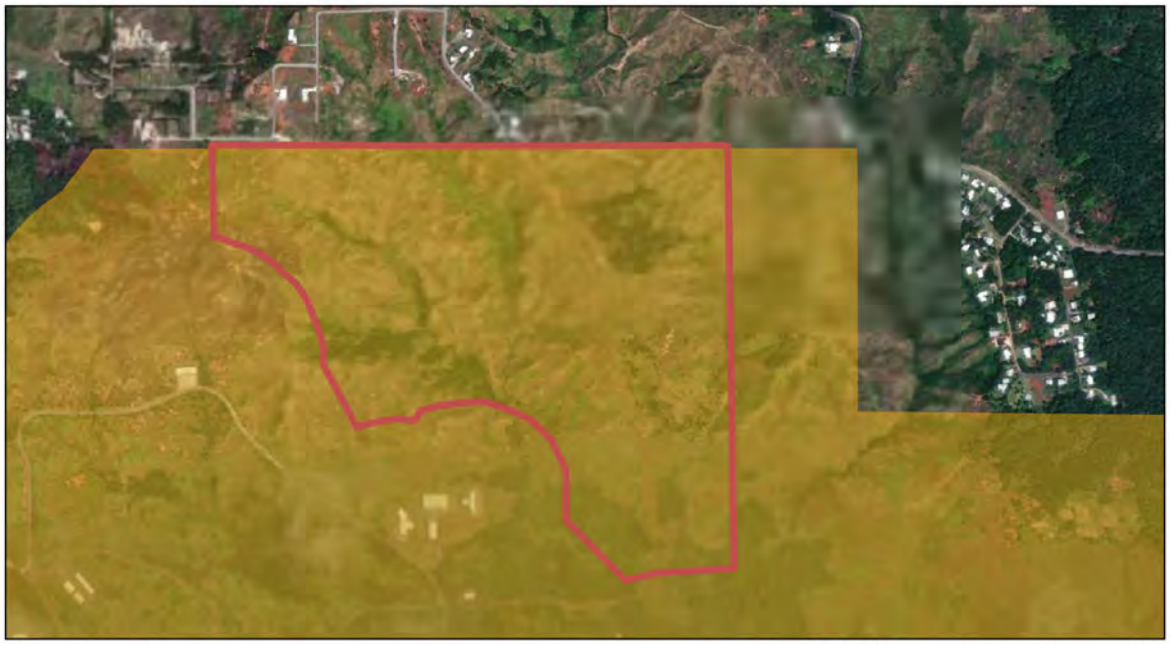






Figure 2 Survey site in Naval Base Guam Tenjo Vista Fuel Farm

Figure 48. Survey locations



GRX Map Export

SYMBOL KEY
Survey Site

INSTALLATION LOCATION

0 375 750 1500 ft
0 115 230 460 m

U.S. NAVY GEOREADINESS PROGRAM
NAVFAC
FOR OFFICIAL USE ONLY

Created on: 2/13/2023 at 1858 Pacific
Generated on GeoReadiness Explorer

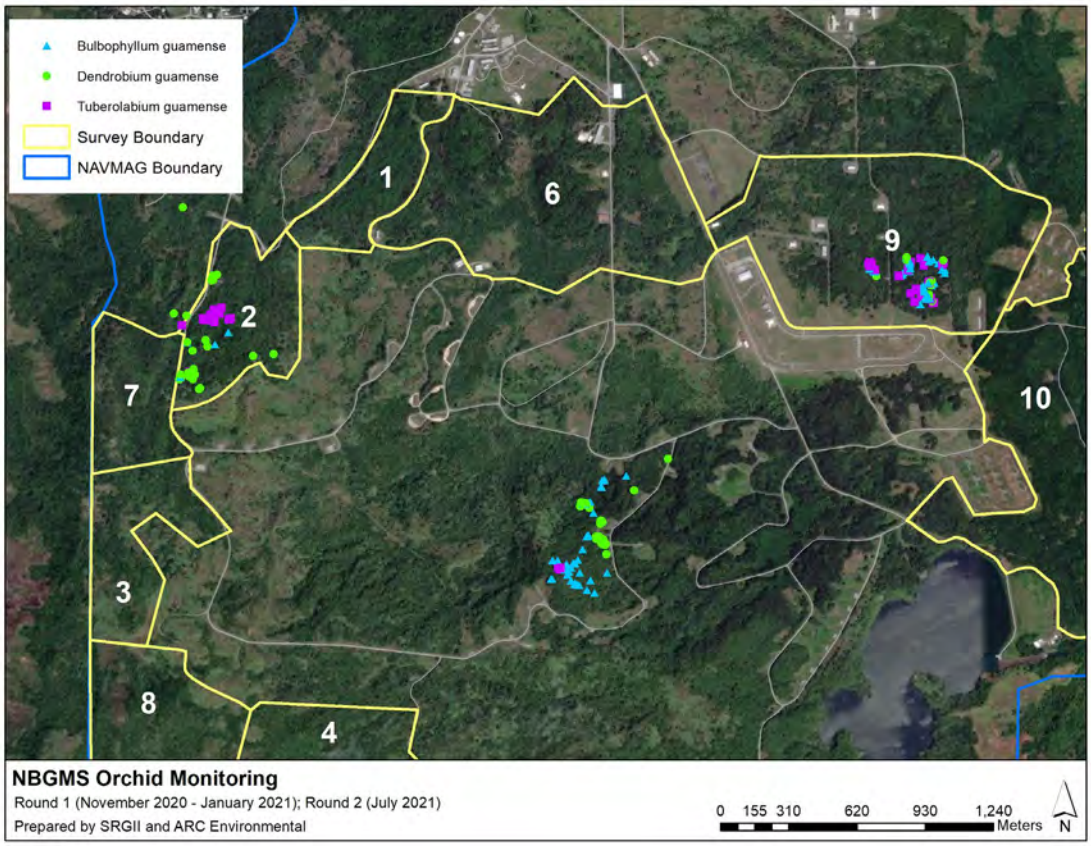


Figure 49. Orchid monitoring locations

Forest Restoration Plan Implementation- Forest Restoration Unit (FRU) 2

Location: NMS **Period of Performance:** SEP2017 – DEC2022

Project Objective

To manage invasive species within the FRU 2 and restore native habitat.

Conservation Benefit

Increasing native forest habitats would improve native species survival, particularly threatened and endangered species, enhance native habitat for listed animals, increase the biodiversity of native species, and contributes to the connectivity with surrounding communities in ways that support improved ecosystem functionality. It also contributes to the goals of the Guam NWR as an overlay unit the NMS.

FY23 Status

- Final report received December 2022

EPR: SIKES MAR NBG Native Forest Habitat Restoration – Climate; 61755NR856

2019 JRM INRMP Reference: THM-2; 6-39

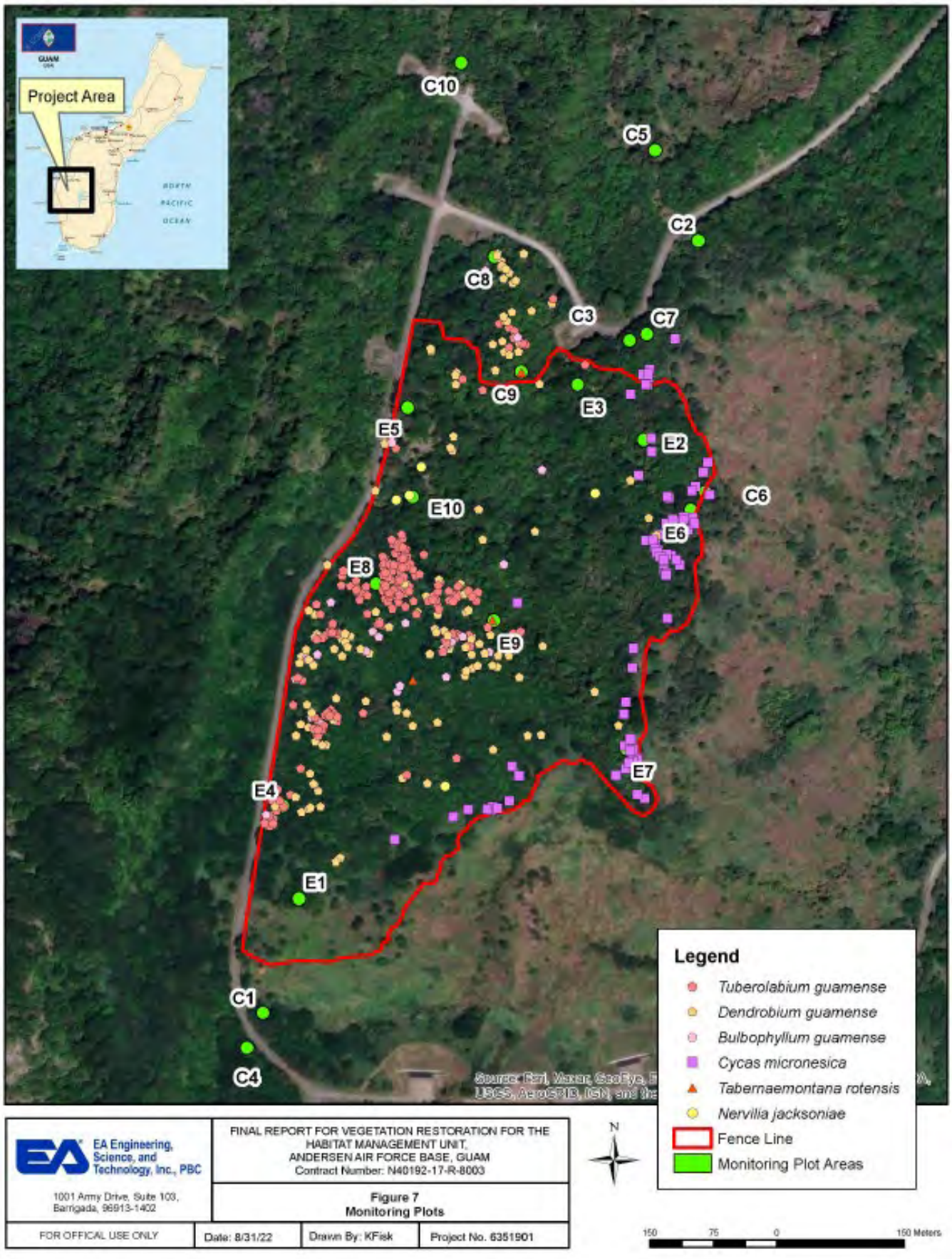


Figure 50. Monitoring plot locations

Vegetation Restoration on NBGNMS

Location: AAFB **Period of Performance:** JUL2023 - 2024

Project Objective

To reduce invasive species within the Forest Restoration Unit 2 (FRU2) and increase native plant species

Conservation Benefit

Increasing native forest habitats would improve native species survival, particularly threatened and endangered species, enhance native habitat for listed animals, increase the biodiversity of native species, and contributes to the connectivity with surrounding communities in ways that support improved ecosystem functionality. It also contributes to the goals of the Guam NWR as an overlay unit the NMS.

FY23 Status

- Project awarded in July 2023
- Seed collection and propagation ongoing

EPR: SIKES MAR NBG Native Forest Habitat Restoration – Climate; 61755NR856

2021 JRM INRMP Reference: THM-2; 6-39

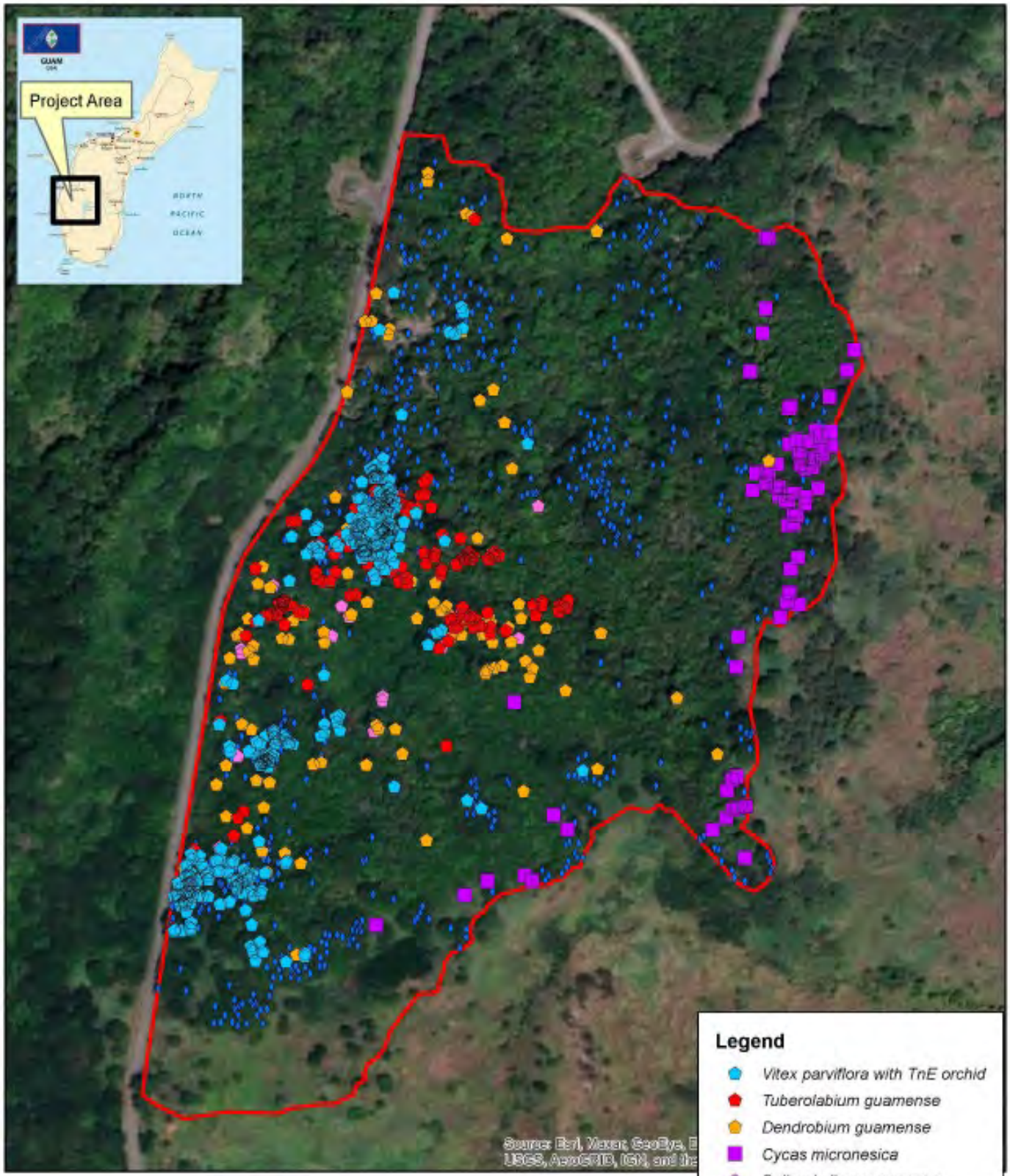


Figure 51. FRU2

Forest Restoration at Achae Point

Location: AAFB **Period of Performance:** JUL2022 – Ongoing

Project Objective

Restore native vegetation component to limestone forest rehabilitation site.

Conservation Benefit

Enhance and restore habitats, reduce habitat fragmentation, increase populations of native species, and buffer protected areas.

FY23 Status

- 27 *Serianthes nelsonii* trees out of 56 total have survived typhoon, 20 were severely damaged but alive, 9 were declared lost.
- Typhoon uprooted / destroyed 70% of existing native plants
- Perimeter fence was not damaged, site will receive MILCON outplantings
- Soil samples analyzed at UOG lab for determining best nutrient application

EPR: 1 CR MAR AFB Native Forest Habitat Restoration; M5240NR067

2021 JRM INRMP Reference: THM-1; 9-6



Figure 52. Forest Restoration before Typhoon Mawar



Figure 53. Forest Restoration post Typhoon Mawar

Vegetation Restoration for the Habitat Management Unit (HMU)

Location: AAFB **Period of Performance:** JUL2022 - JUL2023

Project Objective

Implement vegetation restoration within the Habitat Management Unit (HMU) utilizing the 2017 HMU Vegetation Restoration Plan.

Conservation Benefit

Enhance and restore habitat and maintain or increase populations of threatened and endangered species, including those extirpated from Guam and potentially reintroduced within the HMU.

FY23 Status

- Ongoing project with UOG CESU.
- Experimental edge plots and 30m x 30m plots being monitored.
- Experimental 1 acre plot is being monitored.
- Initiated restoration on 21, 1 acre plots.
- Out planted species includes species to increase habitat quality for Marianas fruit bats, e.g. *Artocarpus mariannensis* and *Ficus* sp
- Number of Vitex removed varied with the plot due to presence of listed orchid species and percentage of native trees present. This ensures optimum survival of orchid transplants and native tree out-plantings.
- Initiation of pre - formal section 7 consultation discussions with FWS for transplanting listed orchid species from non-native to native trees.
- Complete reforestation can be completed in 3-5 years.
- Removal of Triphasia, Cestrum and excess coconut trees will be implemented this year in Tarague fenced areas.
- Assessment of damage to out-plantings from Typhoon is ongoing but it appears that survival rates were roughly 77%.

EPR: 1 CR MAR AAFB Native Forest Habitat Restoration; M5240NR067

2019 JRM INRMP Reference: THM-1; 9-68

Table 6. HMU, 1 acre plot out-plantings

Species and numbers planted on the 21 HMU reforestation plots.

Aglaia mariannensis	20	*Intsia bijuga*	6
Aidia cochinchinensis	37	*Ixora triantha*	46
Artocarpus mariannensis	66	*Melanolepis multiglandulosa*	10
Casuarina equisetifolia	1	*Ochrosia oppositifolia*	2
Eugenia reinwardtiana	11	*Pandanus dubius*	21
Eugenia thompsonii	1	*Pandanus tectorius*	75
Ficus prolixa	21	*Premna serratifolia*	42
Ficus tinctoria	21	*Timonius nitidus*	40
Hibiscus tiliaceus	69		



Figure 54. HMU 1 acre plots

Fire Management Plan Implementation - NBG

Location: NMS **Period of Performance**: SEP 2021 – SEP2022

Project Objective

Protect natural resources on NMS by reducing habitat degradation (*i.e.* soil erosion and vulnerability to invasive plant establishment) resulting from wildland fires.

Conservation Benefit

Controlling fuels (*i.e.* swordgrass) in strategic locations creates buffers/ fuel breaks and to protects sensitive natural resource areas and enhance existing conservation areas.

FY23 Status

- Identified 5 acre fuel treatment parcel
  - Adjacent to NMS Fire Break 5 and Cotal Forest Reserve
  - Site part of Fire MU #1
- Fuels Treatments:
  - Initial, mechanical removal of flammable grasses
  - Chemical/herbicide applications to limit re-sprouting
- Final Report received: June 2023
- Future site use: support Acacia/native savannah out-plantings

EPR: 1 RP MAR NBG Wildland Fire Management Plan (2015) Implementation through Habitat Management; 61755NR857

2019 JRM INRMP Reference: THM-3; 6-41

Table 7. Herbicide Treatments/Sword grass Transect Data. Photo: Sundance-EA Associates

Transect	Before Treatment (observations)	After Treatment (observations)
1	38	0
2	33	0
3	3	0
4	20	0
5	9	0
6	31	0
7	30	0
8	2	0
9	2	0
10	1	0

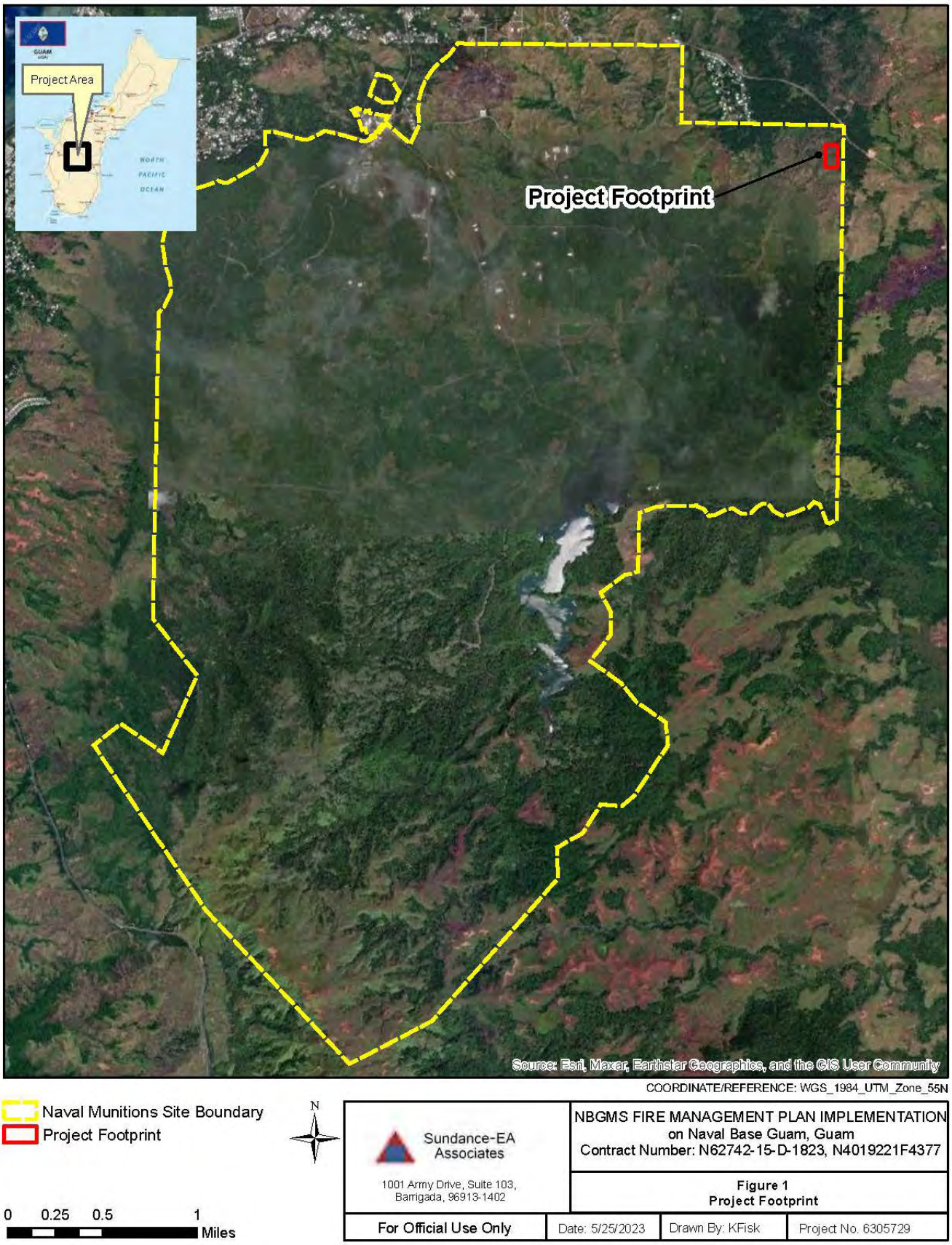


Figure 55. Project location for implementing NBG Fire Management Plan fuels reduction. Photo: Sundance EA Associates

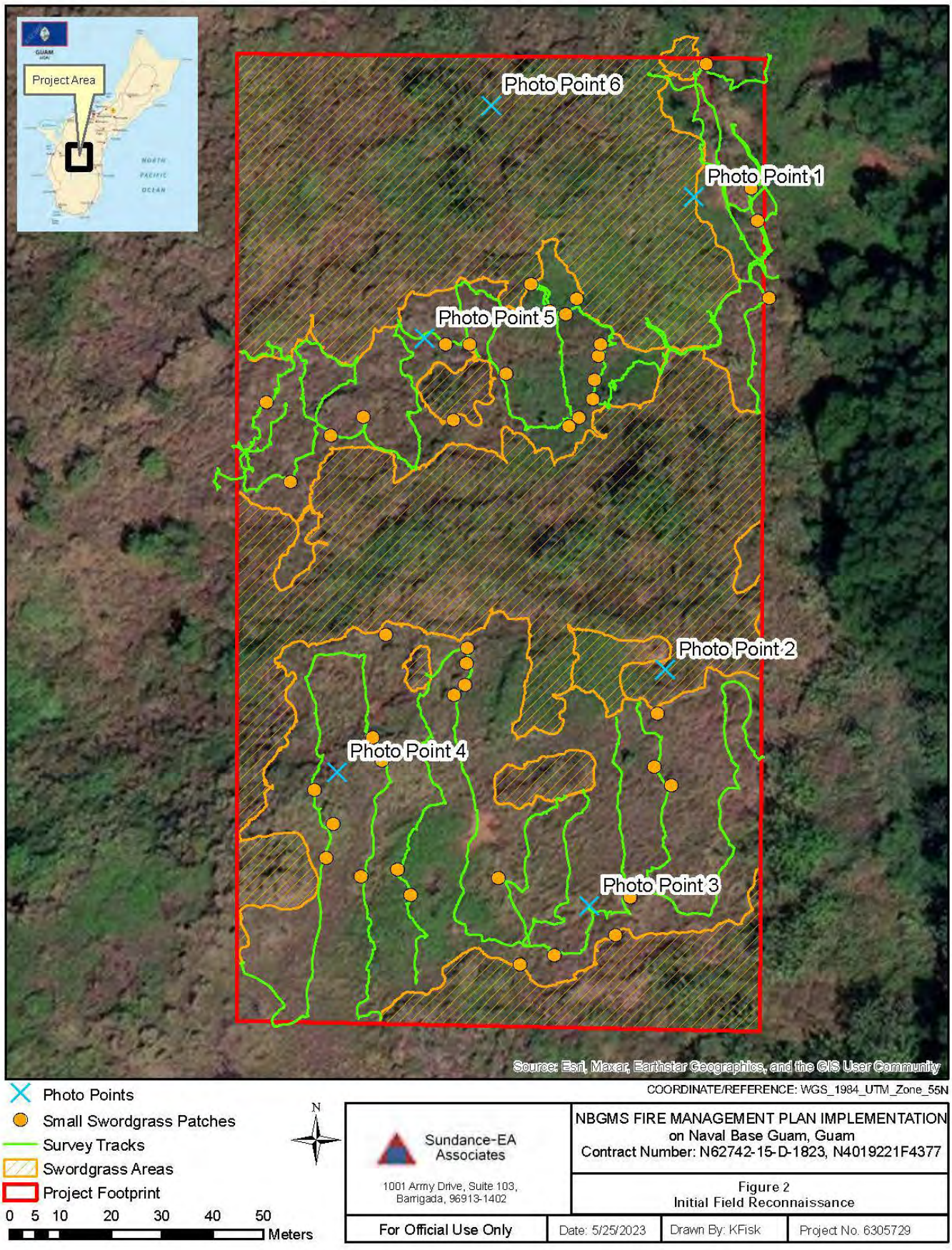


Figure 56. Initial Field Reconnaissance. Photo: Sundance-EA Associates.



Figure 57. Field Biologist Cutting Sword Grass and Applying Herbicide. Photo: Sundance-EA Associates

Soil and Water Conservation - NBG

Location: NMS **Period of Performance**: AUG 2020 – SEP2023

Project Objective

Maintain, protect, and enhance water quality and contain/minimize runoff into watersheds and ultimately marine waters.

Conservation Benefit

Stabilization of soils in erosion prone areas reduces sediment runoff into watersheds and benefits supports a ridge-to-reef ecosystem approach. Identification and stabilization of areas with high erosion rates will ultimately reduce sediment loads that drain to coastal waters and minimize potential impacts to coral reefs.

FY23 Status

- Stabilize soil and improve quality of terrestrial plant habitats
- Reduce sediment loads that drain into the ocean
- Focus on south of Fena Reservoir
- Shrubs: 60% survival rate (n=2,310 planted)
- Vetiver grass slips: 63% survival rate (n=10,380 planted)
- Lessons learned

EPR: CHS JRM NBG Soil and Water Conservation: stabilization of eroding streambanks and cliff/ravine; 61755NR832

2019 JRM INRMP Reference: THM-1; 6-39



Figure 58. Robust growth of outplanted vetiver in eroded area at NMS. Photo: Sundance-EA Associates Joint Venture.

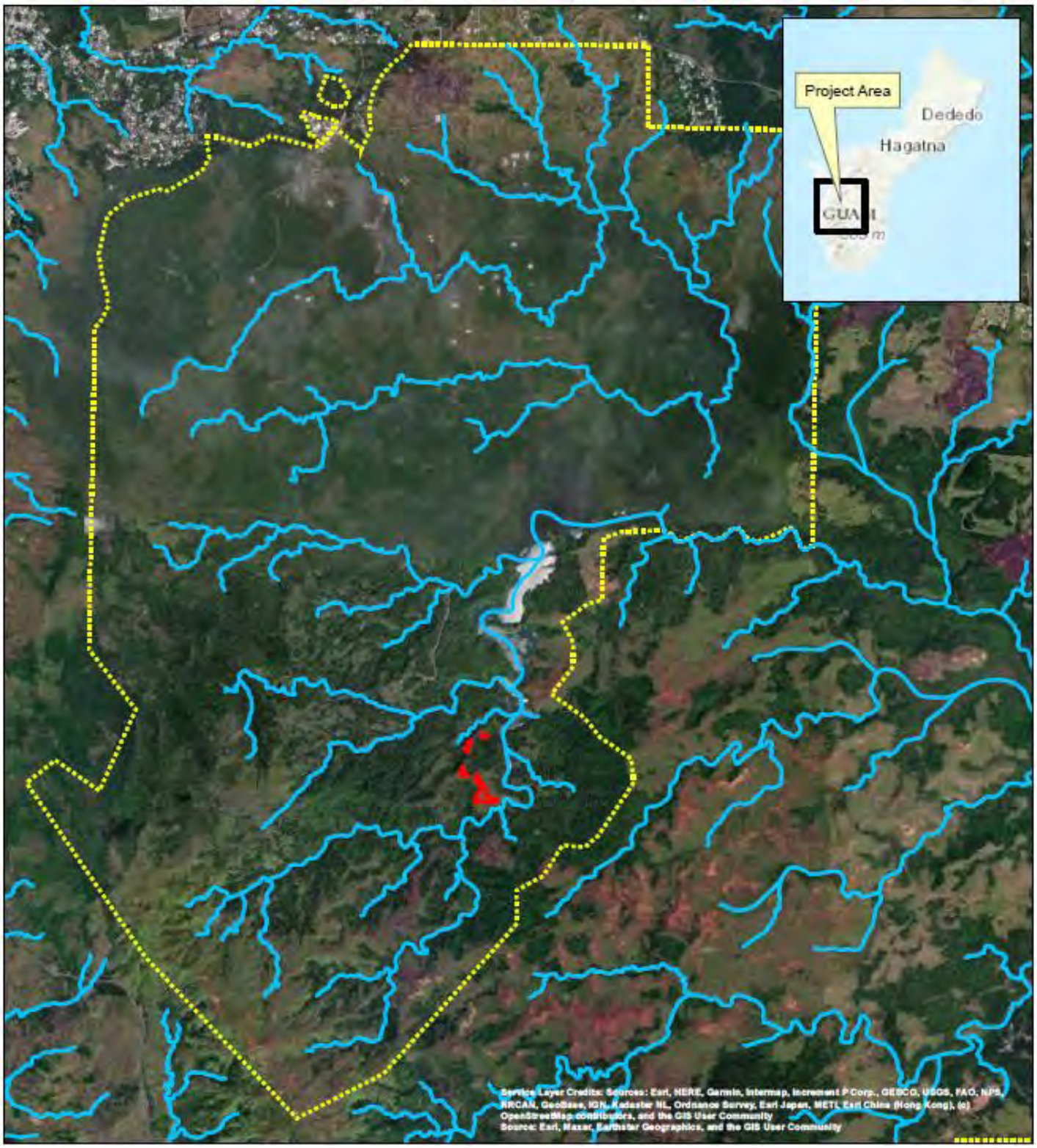


Figure 59. Erosion control project footprint with hydrologic features. Photo: Sundance-EA Associates Joint Venture.

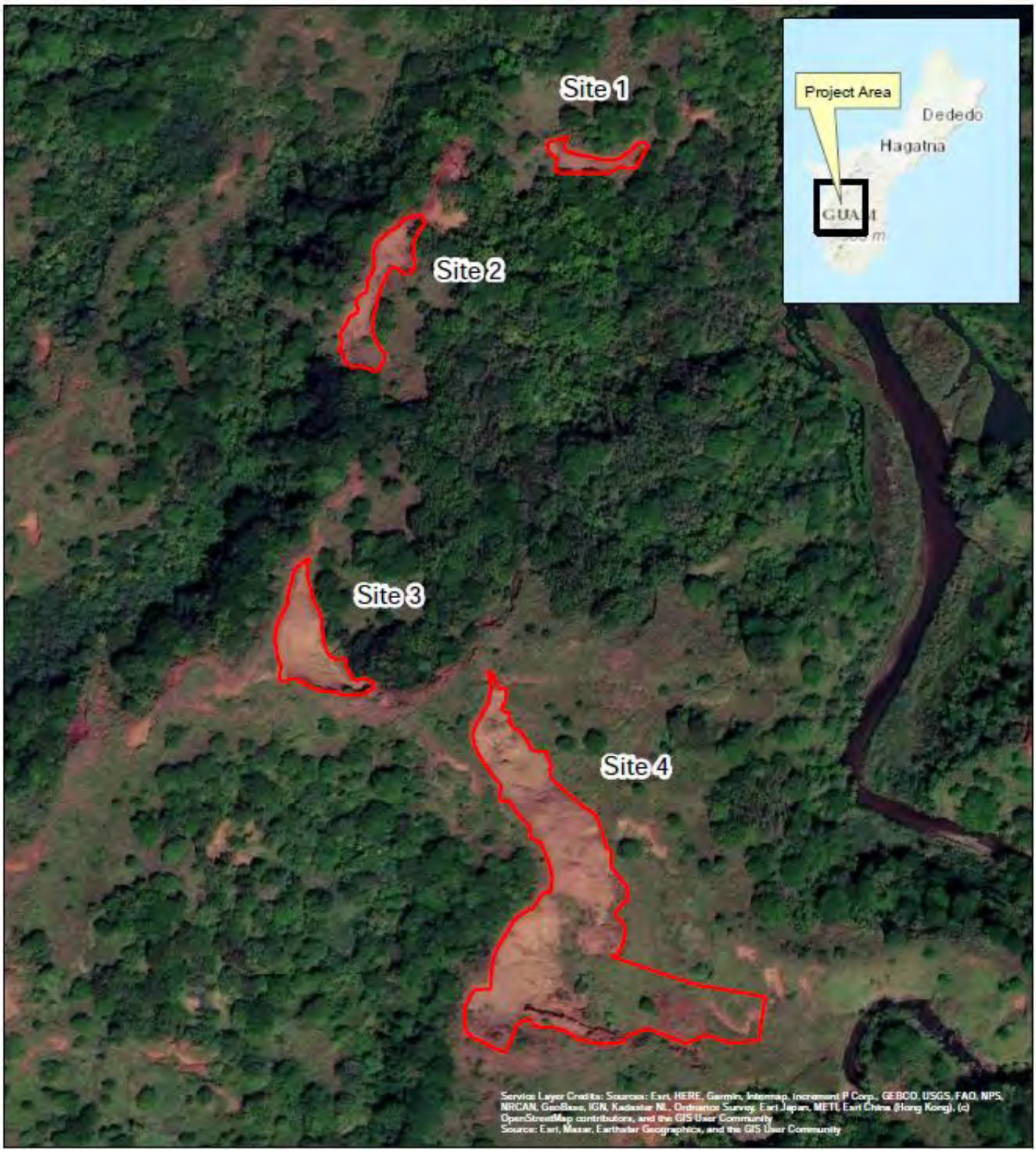


Figure 60. Erosion control sites in upland areas above Fena Reservoir, NMS. Photo: Sundance-EA Associates Joint Venture.

Ungulate Fencing on NBG-Administered Lands

Location: NMS **Period of performance:** SEP2021 - Ongoing

Project Objective

The objective is to protect and manage sufficient habitats by securing and managing unprotected areas or rare or unique habitats.

Conservation benefit

The installation effort facilitates the revitalization of native habitats that support viable populations of native and ESA-listed species, increases biodiversity, and promotes ecosystem health. Ungulate fence construction is the first step of the applied ecosystem approach to resource management, as defined in the INRMP.

FY23 Status

- UF #3 construction postponed due to Category 4 Typhoon Mawar
  - Enclosed area approx. 64 acres.
- UF #4 construction completed (FEB 2023)
  - Enclosed area approx. 70 acres
- UF #5 construction to begin SEP 2023
  - Enclosed area will be approx. 150 acres
- Quarterly monitoring of NMS ungulate fence
  - CEMML and White Buffalo inspections following Typhoon
  - Breaches temporarily patched
  - Fallen trees removed from fenceline
  - Ungulate monitoring and removal, as needed
- As of Sept 1, 2023, 455 acres constructed and contracted

EPR: 1 RP MAR NBG Ungulate Fencing; 61755NR894

2019 JRM INRMP Reference: THM-2; 6-39

Table 8. NMS ungulate fence status overview.

	NMS Region	Name	Hectares/Acres
FY17	Alifan Ridge	Alifan Conservation Fence #1	32/80
FY18	East of High Road	NMS Conservation Fence #2	29/71
FY19	Alifan Ridge South	Alifan South Conservation Fence #3	30/3
FY21	Central NMS	Parsons Road Conservation Fence #4	28/70
FY22	Central NMS	Parsons Road North Conservation Fence #5	62/155
FY23	Eastern NMS	TBD/ Maemong River Fence	TBD

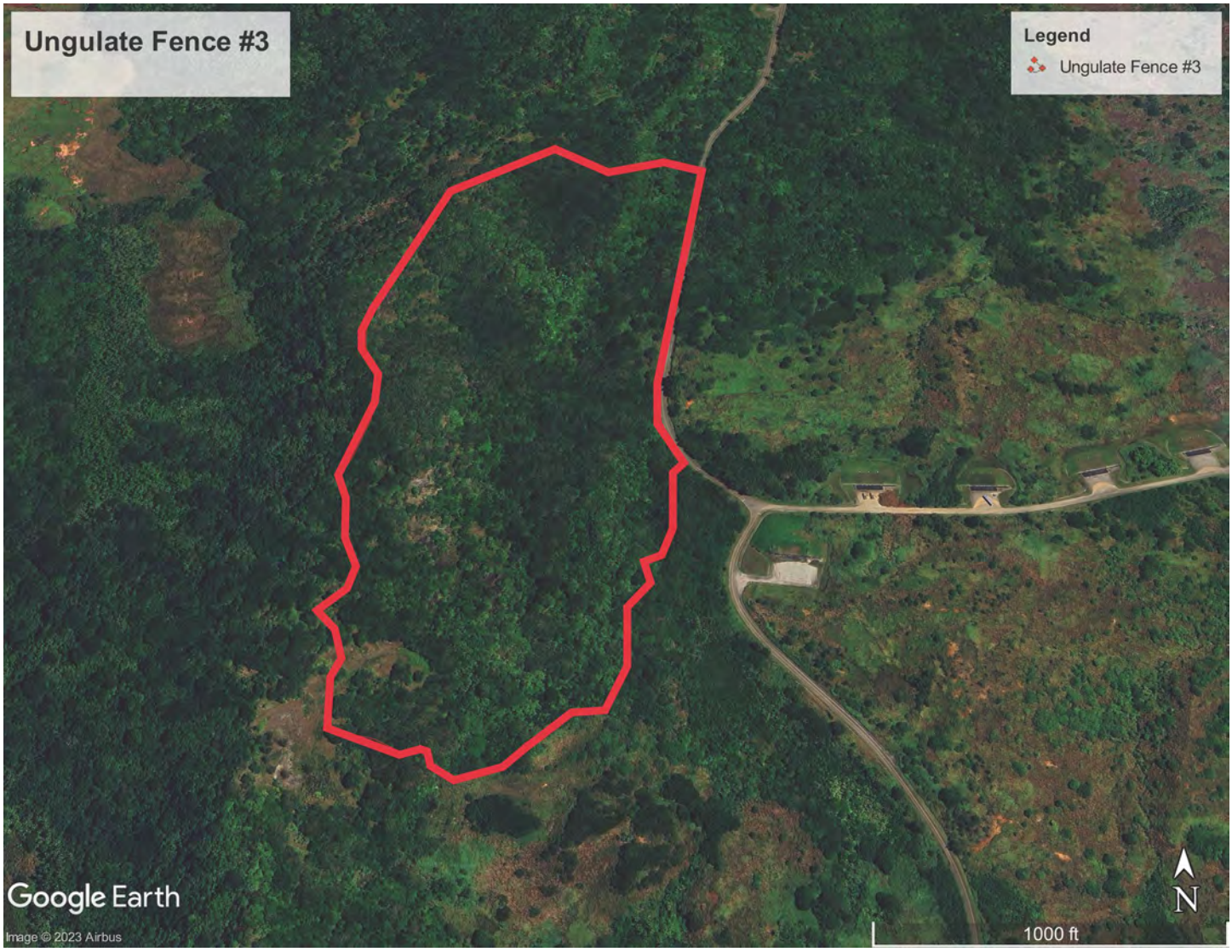


Figure 61. NMS ungulate fence #3 location.



Figure 62. NMS ungulate fence #4 location.

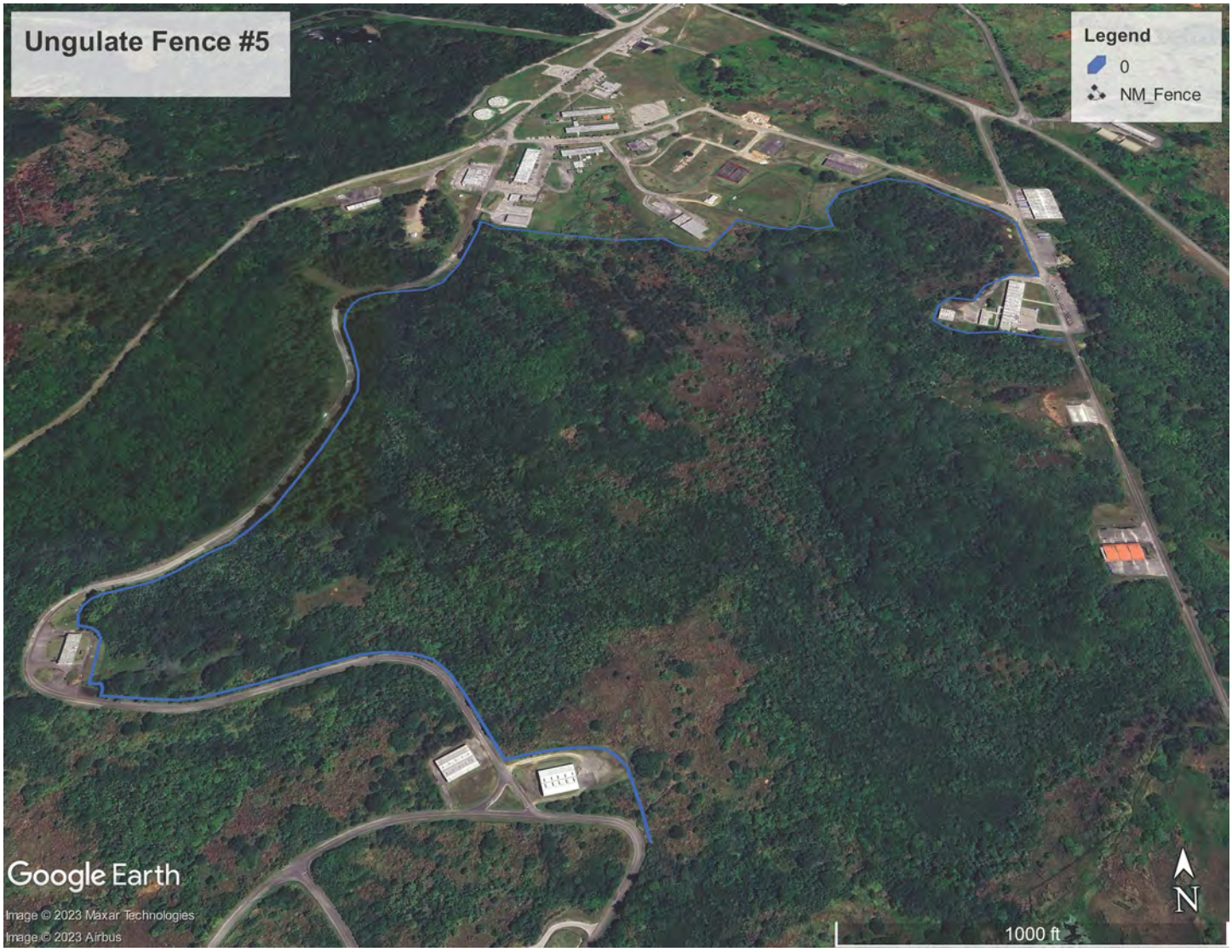


Figure 63. NMS ungulate fence #5 location.

Ungulate Control and Eradication on NBG-Administered Lands

Location: NBG; NMS **Period of performance:** SEP2021 - Ongoing

Project Objective

Maintain or enhance ecological function and diversity through control and eradication of established invasive species, particularly ungulates.

Conservation benefit

To allow for multiple INRMP projects to commence, reducing a primary stressor from multiple habitats and ESA-listed species.

FY23 Status

- Late start in FY23 due to Category 4 Typhoon Mawar
- Methods: Canine detection dogs and net partition
  - Re-clearing of UF #1 and #2 (AUG 2023)
  - Re-clearing of UF #4 (SEP 2023)
- Removed one carabao from UF #4 (AUG 2023)

EPR: 1 RP MAR NBG Ungulate Management Population Control; 61755NR807

2019 JRM INRMP Reference: TIS-2, TIS-3; 5-85, 6-43

Table 9. Ungulate control density estimates on NBG.

	Alifan Conservation Fence #1	NMS Conservation Fence #2	Naval Base Guam	Polaris Point
Number of Days	8	15	4	3
Acres	78	64	346	47
Deer Removed	0	41	0	0
Deer Density	0/ac.	0.64/ac.	0/ac.	0/ac.
Pigs Removed	3	0	34	36
Pig Density	0.04/ac.	0.64/ac.	0.10/ac.	0.77/ac.
Ungulate Density	0.04/ac.	0.64/ac.	0.10/ac.	0.77/ac.

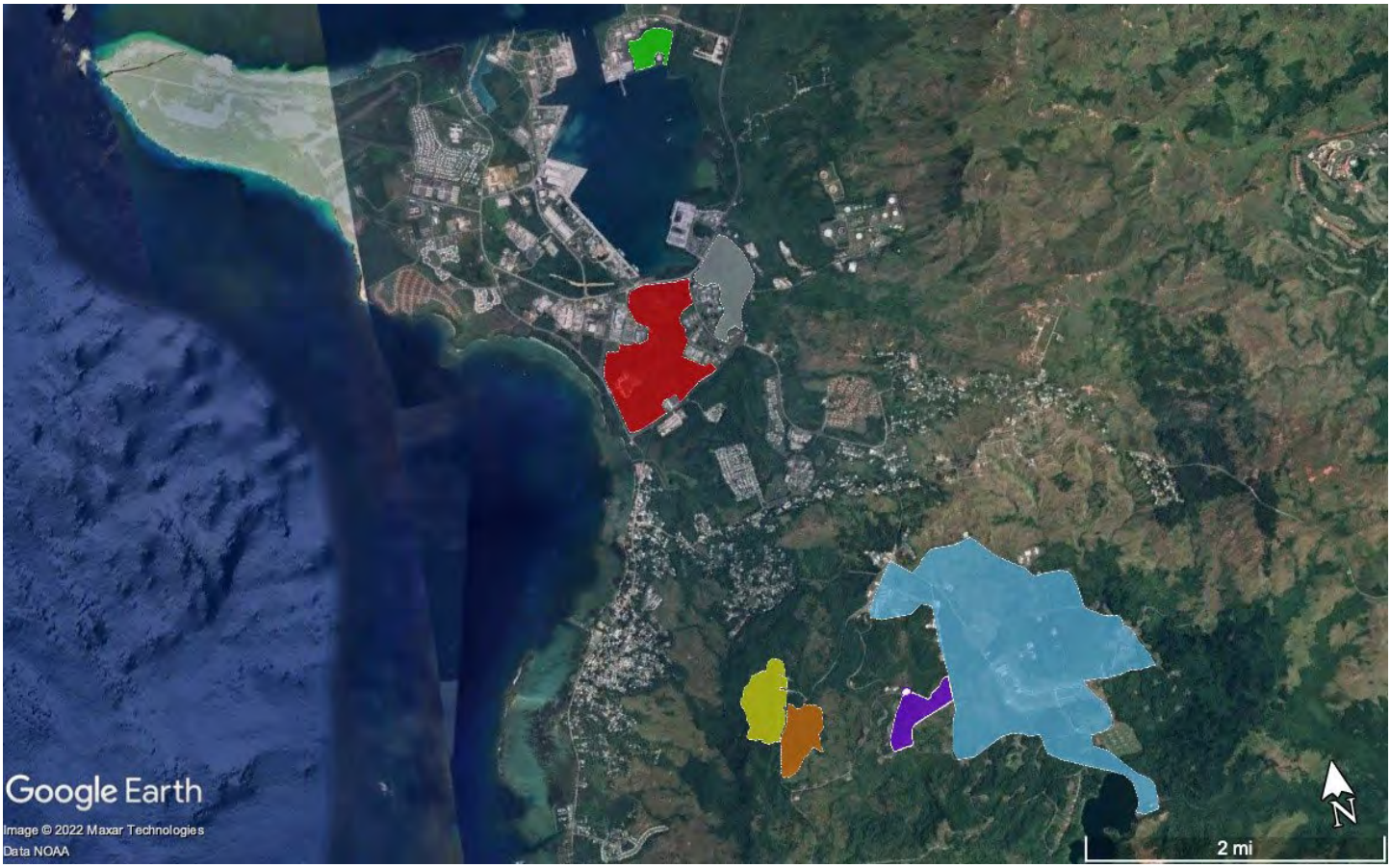


Figure 64. FY21 Ungulate control and eradication locations on NBG.

Ecological Monitoring In Ungulate Exclusion Plots

Location: NBG **Period of Performance:** JUL2023 – AUG2024

Project Objectives

Monitor herpetofauna and insect/invertebrate fauna in ungulate free fenced areas and suitable control areas on NMS. Design and implement surveys to monitor change in gecko, skink and brown treesnake populations over time. Detect any change in insect/invertebrate communities.

Conservation Benefit

The conservation benefits of this project are to ensure self-sustaining, resilient populations to maintain and increase native species and diversity; using novel techniques in the adaptive management of “target” species populations; reintroduce extirpated species; and with no loss of current species range.

FY23 status

- Monitor changes to herpetofauna and insect/invertebrate fauna inside ungulate free fenced areas and suitable control areas on the NMS. At present, this will be the Forest Restoration Unit 2 (FRU 2) on the NMS
- Document changes in the vegetation, reptile, and insect/invertebrate communities in ungulate free fenced areas, areas to be fenced in future years and areas where ungulate control work is ongoing, on Naval Munitions Station at Navy Base Guam (NMS).
- Project was funded and awarded. Waiting for kickoff meeting.

EPR: 1 S MAR NBG Ecological Monitoring in Ungulate Exclusion Plots

2019 JRM INRMP Reference: THM-1 (5-83)



Figure 65: Map depicting Naval Munitions Station, Navy Base Guam



Figure 66. FRU-2 occupies an estimate of 73 acres of land in the NMS

Ungulate Fencing

Location: AAFB **Period of Performance:** AUG2022 – JUL2023

Project Objective

Construct ungulate fencing on AAFB to facilitate eradication of feral pigs (*Sus scrofa*) and Philippine deer (*Rusa marianna*) as well as prevent immigration of ungulates within fenced areas.

Conservation Benefit

Supports ungulate eradication goals within fenced areas (Figure 76). Ungulate eradication facilitates the revitalization of native habitat that supports viable populations of native species, increases the biodiversity of native species, and contributes to the connectivity with surrounding communities in ways that support improved ecosystem functionality. Contributes to the goals of the Guam NWR as an overlay unit on AAFB.

FY23 Status

- Tarague II fence completed May 2023, eradication work in progress.
- Encloses approximately 74 acres (30 hectares) of conservation area.
- Fence sustained damages due to typhoon Mawar. Patches have been installed to prevent any ungulate ingress.
- Tarague III fence was postponed due to typhoon Mawar
- Plans in FY24 includes (1) reinitiate Tarague fence III with FY24 funds
- (2) Complete full repairs to Tarague fences I and II

EPR: 1 RP MAR AAFB Ungulate Fencing; M5240NR043

2019 JRM INRMP Reference: THM-1; 9-68



Figure 67. Tarague Basin Conservation Area Fence II.

Monitor Ungulate Populations with Trail Camera Distance Sampling

Location: AAFB **Period of Performance:** OCT2021 – OCT2022

Project Objective

Develop an efficient monitoring method utilizing trail cameras to capture data and analyze using distance sampling methodology in order to estimate ungulate densities and monitor the populations on AAFB.

Conservation Benefit

This will allow the assessment of the efficacy of ungulate control programs; what percentage of the population is being removed on an annual basis and assess recolonization rates after ungulate control in unfenced areas. Frequency and intensity of ungulate control in unfenced areas can then be decided upon.

FY23 Status

- Performed by Pacific Islands Ecosystems Research Center, 39 cameras deployed for 2-3 months.
- Analyze data using distance sampling methodology, produce density estimates and estimate the ungulate populations on AAFB
- Deer density estimates were 0.54/ha (0.18-1.05) above the cliff line and 0.49 (0.20-1.08) in the Tarague basin.
- Pig density estimates were 0.66/ha (0.21-1.73) above the cliff line and 0.20/ha (.05-0.82) in the Tarague basin.
- These densities extrapolate to base population estimates of 2,057 deer (701-4,055) and 2,382 pigs (753-6,345).
- We believe that the deer density is a little low and true density would be at the higher end of the confidence interval. We base this in number of deer harvested the previous year in FY21 (1035) and the number of deer harvested in FY 22 (1898).
- The estimates can be improved along with precision if more camera stations are sampled (either at same time or moving cameras to other stations) or with 2 cameras per station.
- On AAFB, deploying cameras for 2 weeks should ensure enough detections (~60 for each species) for analyses. This would be longer if moving cameras to the other stations.
- The method is viable for deer and pig population monitoring on AAFB and will be used to assess the efficacy of the base ungulate control programs.
- Anticipate doing trail camera distance sampling for ungulates every 2-3 years, subject to funding.

EPR: 1 CP MAR AAFB Ungulate Eradication and Control; M5240NR069

2021 JRM INRMP Reference: THM-1; 9-68



Figure 68. Trail Cam Footage

Ungulate Eradication and Control

Location: AAFB **Period of Performance:** AUG2022 – JUL2023

Project Objective

To remove feral pigs (*Sus scrofa*) and Philippine deer (*Rusa marianna*) from AAFB to reduce risk to mission activities, human safety, protection of government property and natural resources conservation with a focus on the DoD mission.

Conservation Benefit

Enhance and restore habitats to increase populations of native species, particularly threatened and endangered species, as well as promote biodiversity of native plants. Reduce ground disturbance from ungulates to improve soil stabilization and reduce suitability of invasive plant species.

FY23 Status

- Ungulate Management Program removed a total of 1,471 deer and 275 pigs from Main A/B, MSA 1, NWF, Tarague and Upi (Figure XX)
- Volunteer Conservation Officer program and other Depredation teams removed 1228 deer and 160 pigs
- White Buffalo, Inc. removed 243 deer and 115 pigs from Main A/B, NWF and Tarague Basin
- Plans in FY24 includes (1) continue status quo for ungulate removal (2) work with the Command to reopen recreational hunting on base to eligible personnel

EPR: 1 CP MAR AAFB Ungulate Eradication and Control; M5240NR069

2019 JRM INRMP Reference: THM-1; 8-69

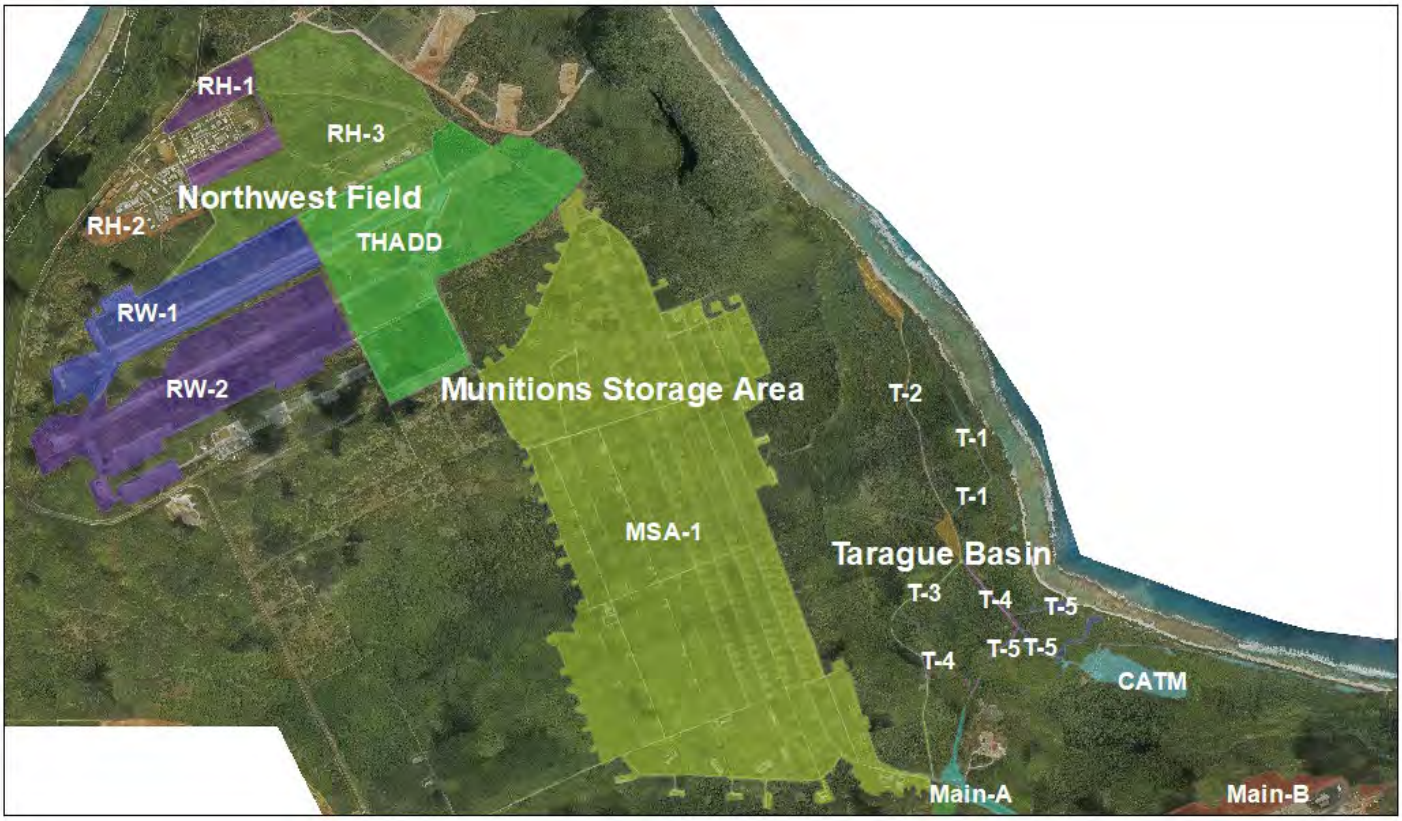
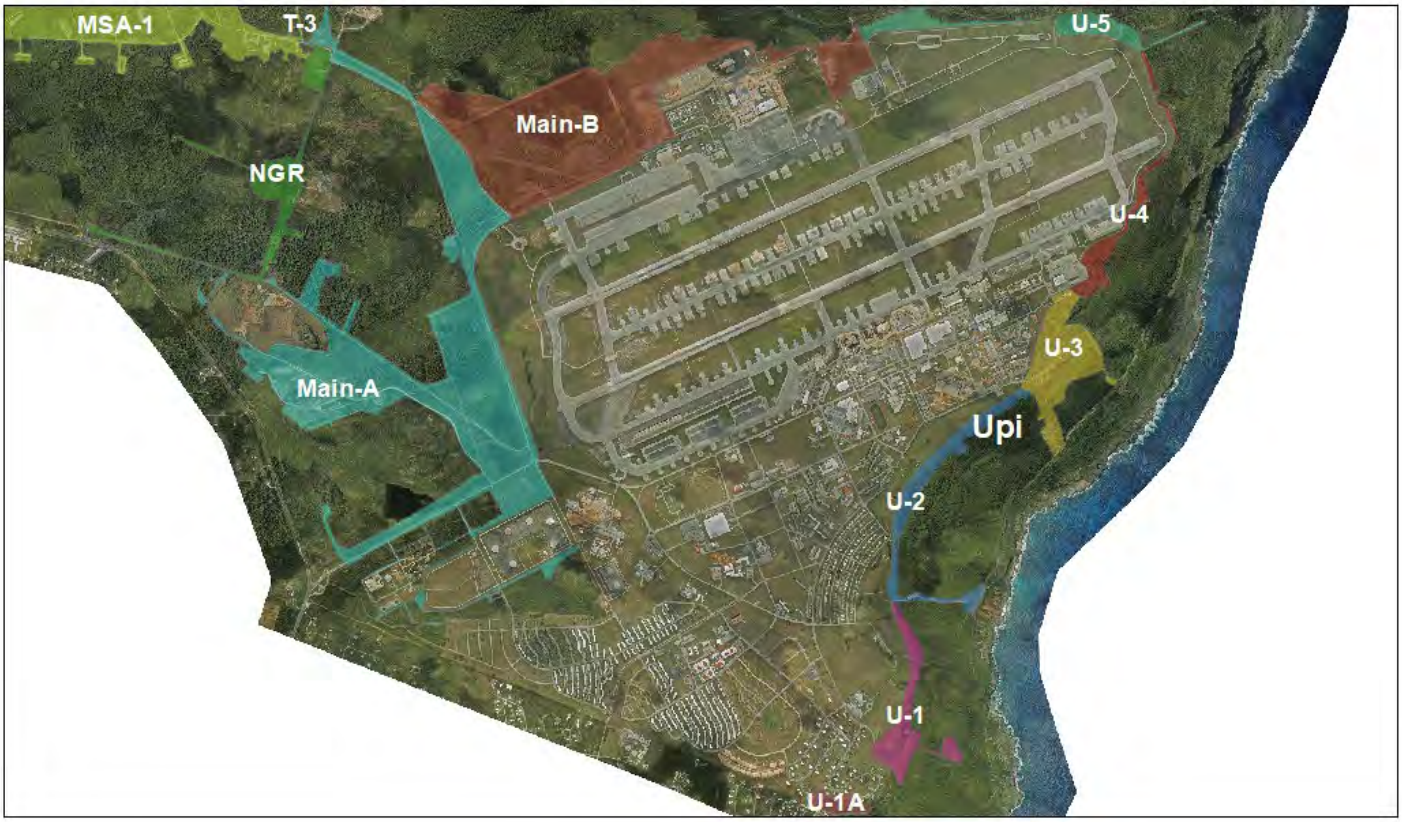


Figure 69. Map of Current AAFB Depredation Areas North



Depredation Areas South AAFB

N
W
E
S

Legend

0 1,450 2,900 5,800 Feet

Figure 70. Map of Current AAFB Depredation Areas South

Maintenance of Ungulate Exclosures

Location: AAFB **Period of Performance:** AUG2022 – JUL2023

Project Objective

Maintain a three-foot buffer, clear of vegetation, on each side of the fence to reduce the possibility of damage. Conduct inspections quarterly and immediately after any high wind events (≥39 mph or ≥34 knots wind speed) on foot or via vehicle where applicable. Perform minor maintenance and repairs to prevent ingress of fence as needed.

Conservation Benefit

The routine maintenance and repair of ungulate exclosures will enhance the longevity of the ungulate barrier. Regular fence monitoring and repair also has the benefit of early detection to any possible immigration of ungulates into fenced eradicated areas. Monitoring, maintenance and repair all support the purpose of facilitating ungulate-free areas to enhance native forest ecosystem regeneration.

FY23 Status

- Vegetation was removed along the three-foot buffer and minor repairs were completed until typhoon Mawar. Typhoon Mawar toppled many trees (majority being Cocos nucifera) inside of the Tarague I/II enclosures. Fallen tress damaged the perimeter fences in multiple places as represented in the maps. All of the fallen trees have been trimmed back and the damaged areas have been plugged to not allow ungulate ingress at least.
- Plans in FY24 include (1) complete clearing of fallen trees and branches along fence line; (2) complete all of the fence repair work; (3) continue status quo for maintenance and monitoring

EPR: 2 BO MAR AAFB Maintenance of Ungulate Exclosure; M5240NR045

2021 JRM INRMP Reference: THM-1; 9-68



Figure 71. Tarague Basin Conservation Area Fence I

Maintenance of BTS Barrier at the HMU

Location: AAFB **Period of Performance:** AUG2022 – JUL2023

Project Objective

Monitoring and maintenance of the Brown Tree Snake Barrier in order to maintain its efficacy. Project includes: 1) Inspections, via walking or driving, weekly and immediately after any high wind events (≥39 mph or ≥ 34 knots wind speed). 2) Maintaining three-foot vegetation buffer on each side of the fence. 3) Removing any type of objects (praying mantis egg cases, mud wasp nests, dried slugs, crabs, chunks of mud, vines, etc.) that have adhered to the exterior of the barrier wall. 4) Conducting minor maintenance and repairs as needed. 5) Conducting barrier wall replacement and painting of vertical (lower) and upper (bulge) mesh sections due to damage or corrosion and pressure-wash sections of the mesh and concrete base. (Figure 80)

Conservation Benefit

The routine maintenance and repair of the BTS barrier shall enhance the longevity of its efficacy. Monitoring, maintenance and repair all support the purpose of facilitating BTS-free areas to protect Mariana fruit bat (*Pteropus mariannus*) pups and possible future reintroduction of other endangered bird species.

FY23 Status

- All of the monitoring and maintenance requirements were completed until typhoon Mawar. Typhoon Mawar toppled hundreds of Vitex parviflora inside of the HMU enclosure. Fallen tress damaged the perimeter fence in multiple places as represented in the map. A majority of the fallen trees have been trimmed back and the damaged areas have been plugged to not allow ungulate ingress at least.
- Plans in FY24 include (1) complete clearing of fallen trees and branches along fence line; (2) complete all of the fence repair work; (3) continue status quo for maintenance and monitoring

EPR: 1 CR MAR AAFB BTS Barrier Maintenance in HMU; M52401000

2021 JRM INRMP Reference: THM-1; 9-68



Figure 72. HMU fence replacement and power-washing

TERRESTRIAL PROTECTED SPECIES MANAGEMENT

ESA-Listed Snail Survey and Monitoring

Location: NMS; MCBCB **Period of Performance:** AUG2022 – NOV2023

Project Objective

To delineate and monitor known ESA-listed snail colonies at one site in NBGNMS (*Samoana fragilis)* and one at MCBCB (*Partula gibba*).

Conservation Benefit

Delineation and counts help make management decisions in the areas where the snails occur. Data collected during monitoring efforts will enhance what is known for each of the species and aid in tracking population changes.

FY23 Status

- Baseline survey completed
- Follow on monitoring completed (photo mark recapture plots)
- Photo mark recapture analysis on going
- Final report expected Oct 30 2023

EPR: CP JRM Conservation Management of ESA-listed Invertebrates; 61128NR203

2019 JRM INRMP Reference: TPS-2, 6-46; TPS-1, 8-54

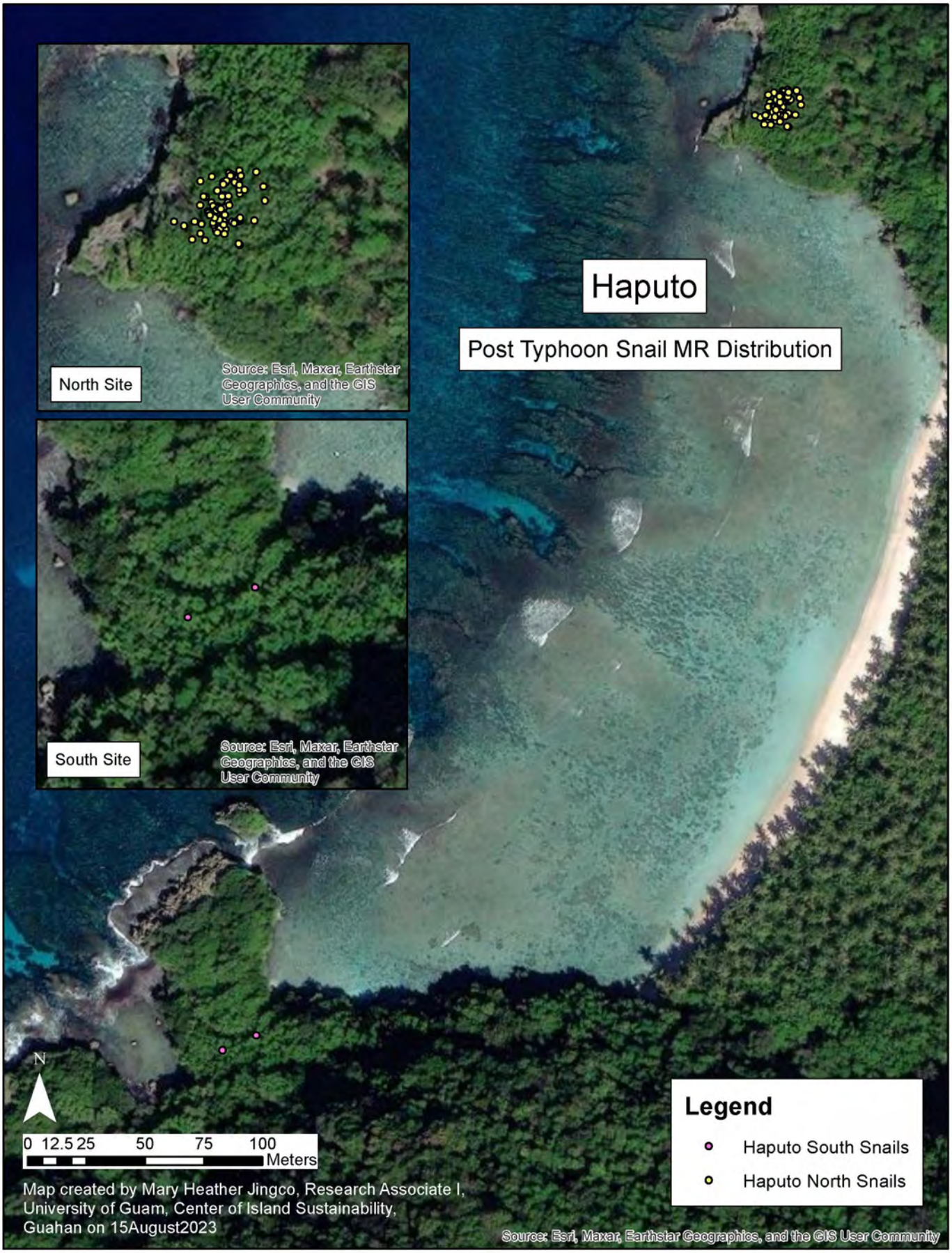


Figure 73. Haputo Plots Post Typhoon



Figure 74. Naval Magazine Plots Post Typhoon

Mariana Eight Spot Butterfly Rear and Release

Location: MCBCB **Period of Performance:** DEC2022 - 2023

Project Objective

Rear and release *Hypolimnas octocula marianensis* at as many sites as feasible on the JRM AOR

Conservation Benefit

Increased numbers of *Hypolimnas octocula marianensis* as well as life history data collected during rearing and post release monitoring activities.

FY23 Status

- USFWS permit application in progress

EPR: CP JRM Conservation Management of ESA-listed Invertebrates; 61128NR203

2019 JRM INRMP Reference: TPS-2, 6-46; TPS-1, 8-54

Monitoring of Butterfly Host Plant Sites and Tarague Snail Colony

Location: AAFB **Period of Performance:** AUG2022 – AUG2023

Project Objective

Monitor populations of the listed snail *Partula radiolata* and the Marianas eight-spot butterfly (*Hypolimnas octocula marianensis*).

Conservation Benefit

Collect baseline data on population abundances for snails and the numbers of eggs, larva, chrysalids and adults for butterflies.

FY23 Status

- Ongoing project with UOG CESU.
- Population abundances estimated for snails on 4 mark recapture plots in rainy and dry seasons at the Tarague colony.
- A snail colony was documented at the AAFB golf course and 3 mark recapture plots are now being monitored. The colony covers 4,339 square meters. The initial population estimate is 30,984 (26,682-35,305) snails.
- The Tarague snail colony has had a large decline which has somewhat stabilized. Predatory flat worms are suspected as the reason for the decline.
- There are very few snail recaptures between seasons. This points to either high mortality and reproduction rates, high movement (horizontal and vertical) or some combination of these.
- Typhoon effects on snail number appear to have been minor.

- Three plots monitored for, butterfly egg, larvae, chrysalids and adults. There was a break in monitoring this year but resumed in April.
- Typhoon effected butterfly numbers and reproduction by defoliation and/or elimination of host plants. However some areas retained host plants due to protective terrain.
- Butterfly eggs appear to be parasitized in high numbers.
- Does not appear to be a distinct breeding season for butterflies. Each site is unique.

EPR: Monitoring and Surveys for Listed Tree Snails, Butterflies, and Plants; M5240CN048

2019 JRM INRMP Reference: TPS-1; 7-5



Figure 75. AAFB Snail and Butterfly Monitoring Site



Figure 76. AAFB Tarage Snail Colony Delineation



Figure 77. AAFB Golf Course Snail Colony Delineation

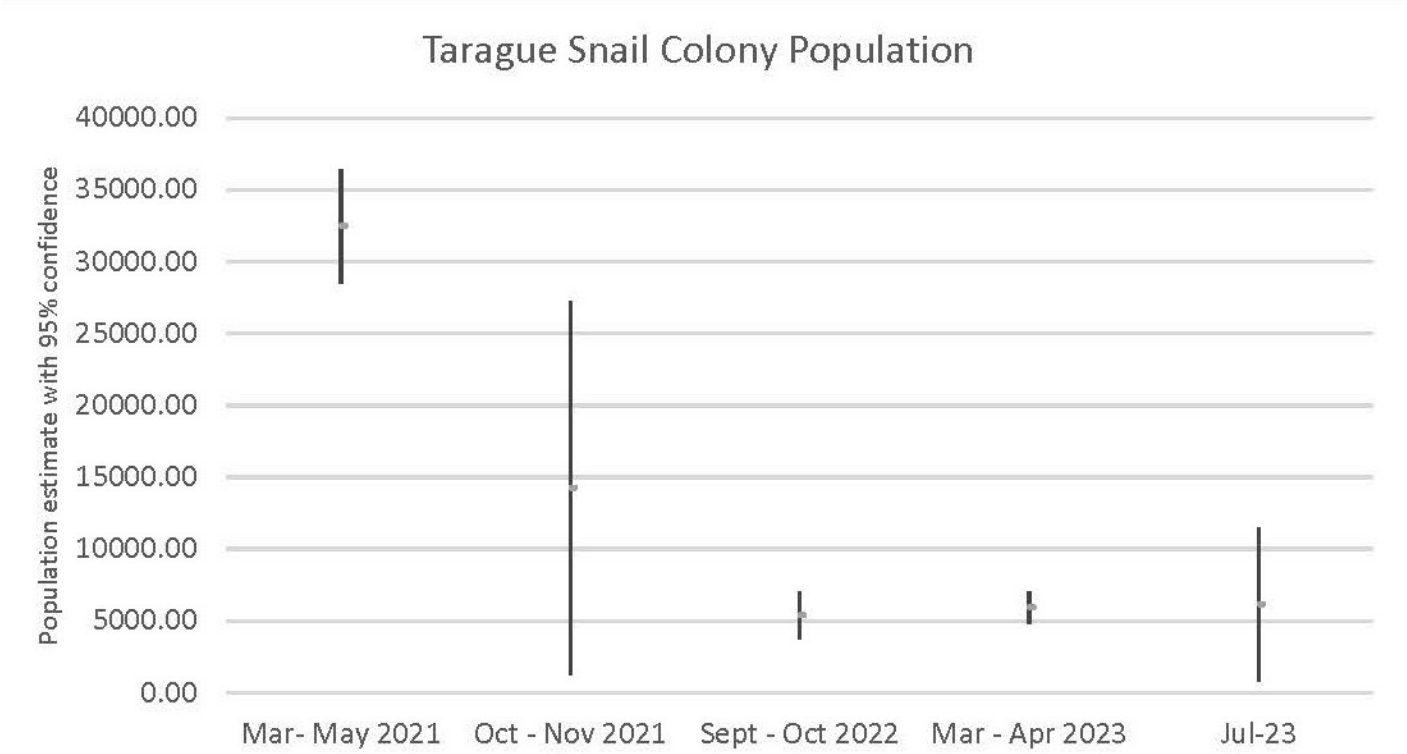


Figure 78. AAFB Tarage Snail Colony Population Estimates

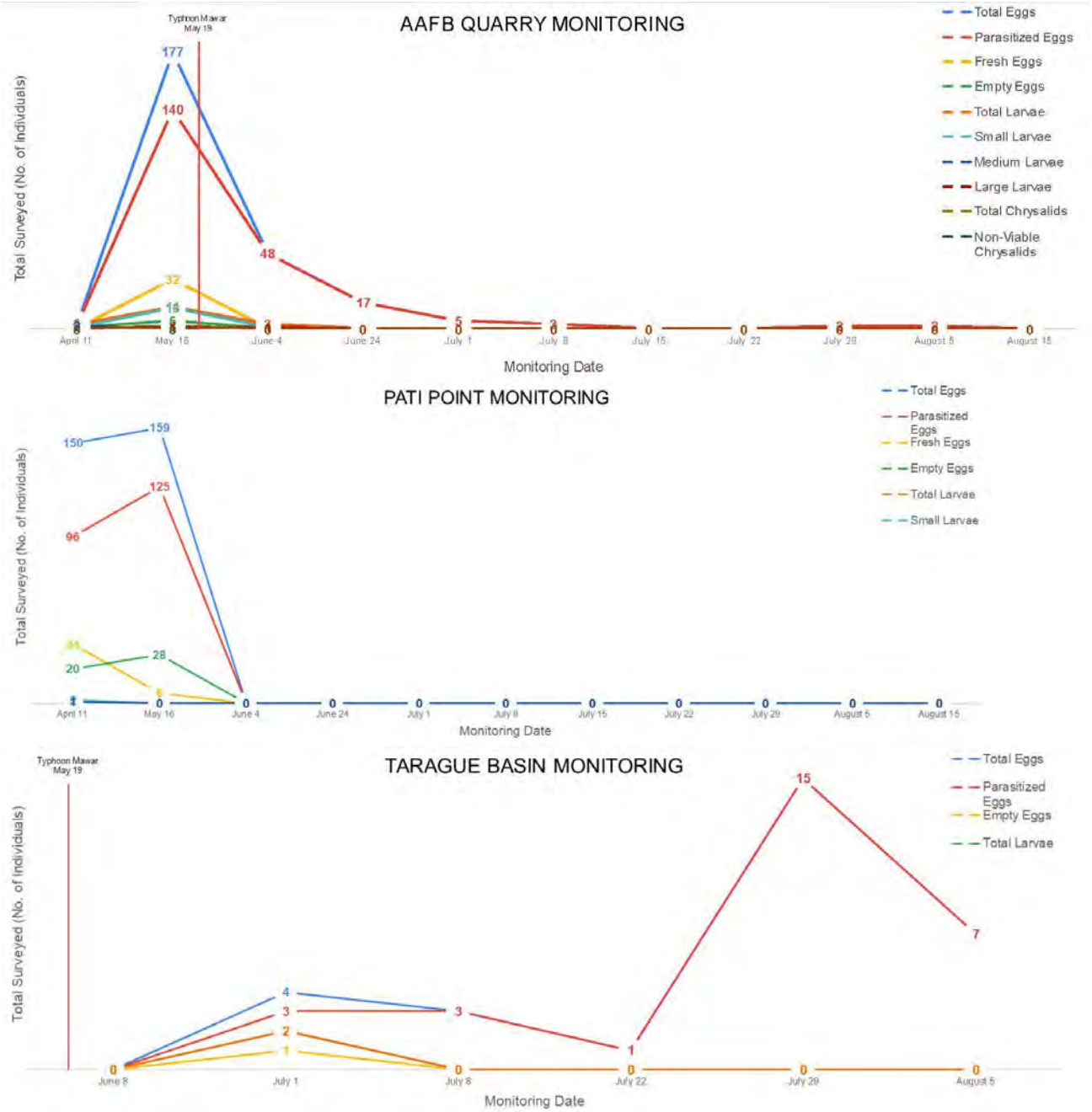


Figure 79. AAFB Butterfly Monitoring on 3 sites

Native Plant Propagation and Carbon Sequestration

Location: NBGNMS **Period of Performance**: JUL2023 - 2027

Project Objective

Conduct a baseline assessment of the forest's current carbon stocks and sequestration potential. Collect, propagate, and outplant species native to the Marianas. Monitor and maintain outplantings while verifying the carbon sequestration performance of the forest over time.

Conservation Benefit

Ecosystem benefits include increased species diversity and richness, erosion reduction, and increased wildlife habitat. Tree plantings also have the long-term benefit of capturing CO2 from the atmosphere.

FY23 Status

- Contract awarded in July 2023
- Initial carbon stock assessment in September
- Seed collection and propagation for plantings

EPR: SIKES MAR Forest Restoration and Monitoring Native Ecosystems – Climate; 61128NR210

2019 JRM INRMP Reference: THM-3; 8-49



Figure 80. Restoration location

JRM *Serianthes nelsonii* Propagation, Outplanting, and Maintenance

Location: AAFB **Period of Performance**: JUL2021-2024

Project Objective

This project is to propagate, outplant, and maintain subpopulations of the federally endangered *Serianthes nelsonii* (tree) on Joint Region Marianas (JRM) managed lands.

Conservation Benefit

Increasing the number of *Serianthes* trees would improve species survival, enhance native habitat, increase the biodiversity of native species, and contributes to the connectivity with surrounding communities in ways that support improved ecosystem functionality.

FY23 Status

- 60 seedlings propagated now nearly 10 feet tall
- Outplanting planned for AAFB in September
- Vegetative propagation of the Ritidian mature tree

EPR: 1 RP MAR JRM *Serianthes nelsonii* Propagation, Outplanting, and Maintenance; 61128NRSNI

2019 JRM INRMP Reference: TPS-5; 9-77



Figure 81. Serianthes seedlings

Serianthes nelsonii Outplanting and Monitoring within Joint Region Marianas Area of Responsibility

Location: NWF, MCBCB **Period of Performance**: JUL2023-2024

Project Objective

Monitor and maintain the mature S. nelsonii tree located on Marine Corps Base Camp Blaz, including the seedlings and saplings growing underneath the mature tree and maintenance of the ungulate exclosure fence surrounding the site of the mature S. nelsonii tree.

Conservation Benefit

Continue to protect and conserve the last mature reproducing S. nelsonii tree on Guam and provide future opportunity for outplanting in the Forest Enhancement Areas on Camp Blaz through husbandry of salvaged seedlings.

FY23 Status

- Mod#4 was awarded on July 2023
- Mod includes:
- Maintain and monitor S. nelsonii tree and seedlings
- Maintain S. nelsonii exclosure fence
- Seed collection, processing, and storage
- Salvage geminated seedlings; grow in nursery

EPR: 2 LC MAR AAFB Serianthes nelsonii Monitoring and Management; M5240CN039

2019 JRM INRMP Reference: TPS-5; 9-76



Figure 82. A *Serianthes nelsonii* seedling beneath the adult tree at the MCBCB LFTRC.

Cycas micronesica Conservation

Location: AAFB **Period of Performance:** MAY2021 - Ongoing

Project Objective

Maintenance and monitoring of six, 1-acre, permanent fenced cycad (*Cycas micronesica*) plots (Achae Point, Ritidian, Tarague Basin, Golf Course, Tarague North, and Tarague South).

Conservation Benefit

Research and monitoring on management actions that directly benefit *Cycas micronesica*. The intent is to identify which management actions most benefit the plant and if possible, implement on a broader scale.

FY23 Status

- 613 C. micronesica seeds collected for ex-situ propagation, 190 seeds germinated at UOG nursery between June 2022 to June 2023.
- UOG plant nursery has 328 cycad seedlings survive typhoon, 4 were lost
- UOG field plots had 36 cycad trees knocked down and 346 cycads severely defoliated.
- Majority of defoliated cycads grew new shoots and leaves by July 2023.
- Coordinated with Dr. Patrick Griffith (Montgomery Botanical Center) and Ben Deloso (Missouri Botanical Garden) for genetic fingerprinting

EPR: 3 SAR JRM, AAFB – *Cycas micronesica* Management for Conservation; M5240NR061

2019 JRM INRMP Reference: TPS-5; 9-77



Figure 83. Group photo provided by Dr. Griffith, UOG



Figure 84. Downed cycad post Typhoon Mawar



Figure 85. Cycad nursery before Typhoon Mawar



Figure 86. Cycad nursery before Typhoon Mawar

Cycad Monitoring and Management – Pollination and Propagation

Location: AAFB **Period of Performance:** MAR2023 - 2024

Project Objective

Study reproduction of *Cycas micronesica* to include DNA analysis, hand pollination, seed harvest, and propagation protocols

Conservation Benefit

Better understanding of pollination and propagation will increase efficiency of producing more plants for reintroduction into the forest.

FY23 Status

- DNA markers that can be used to sex *C. micronesica* plants was confirmed.
- Pollen collection, storage, and viability studies ongoing

EPR: 1 CP JRM AAFB Conservation of *Cycas micronesica*; M5240NR061

2019 JRM INRMP Reference: TPS-5; 9-77

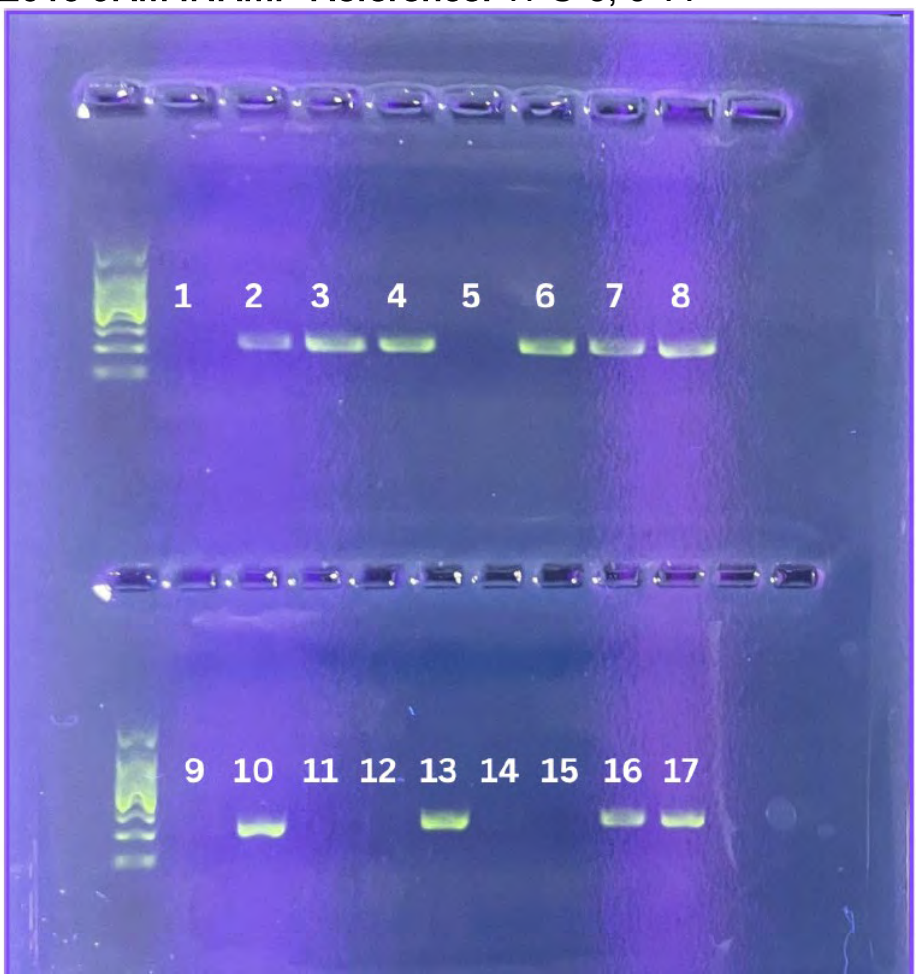


Figure 87. Cycad DNA results

Green and Hawksbill Sea Turtle Nesting Habitat

Location: NBG **Period of performance:** AUG2022 – AUG2023

Project Objective

In an effort to protect and enhance sea turtle nesting population on NBG, suitable habitats are monitored and protected throughout the year. Data collected through regular surveys determine hatching success, emergence success and effectiveness of predator control measures, as well as identify threats to nests (e.g. tidal inundation, roots of invasive vegetation; and marine debris). Understanding the spatial and temporal distribution of sea turtle activity ensures their nesting habitat is maintained.

Conservation Benefit

The conservation benefits of project are to (a) sustain and enhance the sea turtle population; (b) maintain sea turtle species range and distribution; and (c) increase the use of adaptive management techniques for sea turtles.

FY23 Status

- Located, protected, and evaluated sea turtle nests
- Maintained data on hatching and emergence success
- Monitor lizard control with wire mesh
- Removed invasive vegetation (12 lbs)
- Released 50 trapped hatchlings
- At least 10 nests washed away (Typhoon Mawar)

EPR: 1 RP MAR NBG Green and Hawksbill Sea Turtle Nesting Habitat – Invasive Plant and Predator Control; 61755NR808

2019 JRM INRMP Reference: TPS-2; 5-89

Table 10. Green sea turtle nest inventories.

Nest Inventories

	Clutch Size	Hatching Success (%)	Emergence Success (%)
FY 21	85	51.7	51.0
FY 22	79	59.4	54.3
FY 23	75	93.1	82.8

Table 11. Green sea turtle activity observances.

Turtle Activity Observances

	Nests	Non-Nesting Emergences	Total
FY 20	22	0	22
FY 21	41	4	45
FY 22	34	8	42
FY 23	28	0	28



Figure 88. Release of 50 green sea turtle hatchlings at Spanish Steps beach. Photo: US Navy.



Figure 89. Trail cameras deployed at Spanish Steps beach. Photo: JTS.



Figure 90. Nest inventory at Spanish Steps. Photo: JTS.

Sea Turtle Monitoring, Protection, and Educational Outreach - AAFB

Location: AAFB **Period of Performance:** JUL2023 - Ongoing

Project Objective

To implement management techniques and methodologies to monitor nesting sea turtles on AAFB. These methodologies include but are not limited to: collection of consistent data to determine population demographics, reduce mortality and increase natural survivorship, increase sea turtle awareness of AAFB units and beach stakeholders, and create/maintain a robust database for long-term monitoring data that can support future research and detect trends.

Conservation Benefit

Implement recovery actions by conducting long-term monitoring to determine population estimates and abundance; provide protection of sea turtles and their nesting habitats; and conducting outreach and education to the public on sea turtles and their habitats.

FY23 Status

- Total 161 emergences from August 2022 to present; 108 nests and 53 false crawls.
- 11 nesting females have been flipper tagged and 1 was satellite tagged in an effort by both UOG Sea Grant and NOAA researcher/PhD student Josefa Munoz.
- New activities include Munoz's research on AAFB involving rigorous night surveys to tag all encountered nesting turtles, collecting skin samples for genetic analysis, deploying data loggers during oviposition, and sample hatchling skin tissue to determine genetic lineage.
- A total of 14 nests were lost during Typhoon Mawar as the egg chambers were unable to be located due to compacted sand and flattening of the nesting patterns. Those nests are no longer being monitored and status has been deemed "Unknown."
- 6 nests laid pre-typhoon completed nest inventories with 3 being successful and 3 unsuccessful. In the unsuccessful nests, only a few shredded pieces of shells were located, therefore hatching and emergence success rates are unknown.
- Clutch data collected on previously marked nests located successfully after 70 days incubation; hatching and emergence success 88% and 86.1% respectively.
- Outreach events: September 2022 International Coastal Cleanup and April 2023 Earth Day EOD Beach Cleanup; presentations to local public schools and community events (over 1,500 in attendance); in-briefs with key stakeholders such as EOD, Outdoor Rec, Security Forces, and Marine Patrol.
- Project Final Report due December 2023.

EPR: 1 LC MAR AAFB Sea Turtle Monitoring; M5240CN037

2019 JRM INRMP Reference: TPS-1; 9-75

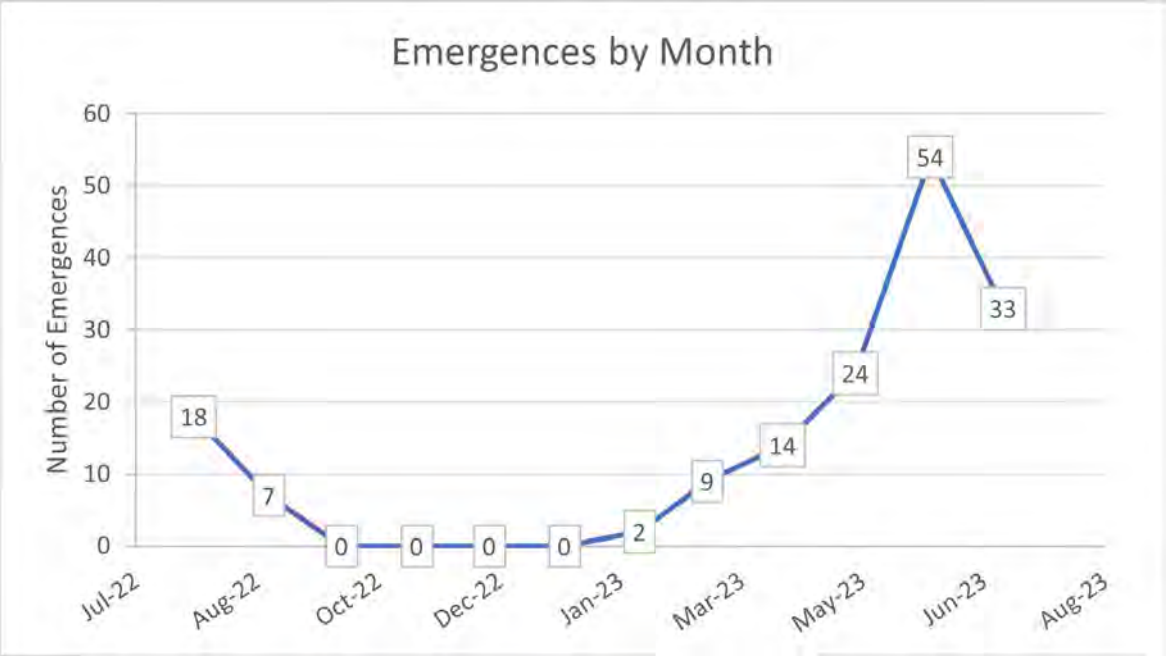


Figure 91. Total number of emergences by month from August 2022–July 2023, with a total of 161 emergences and 108 true nests.



Figure 92. Morphometric measurements taken from emerged hatchling on EOD Beach in July 2023.

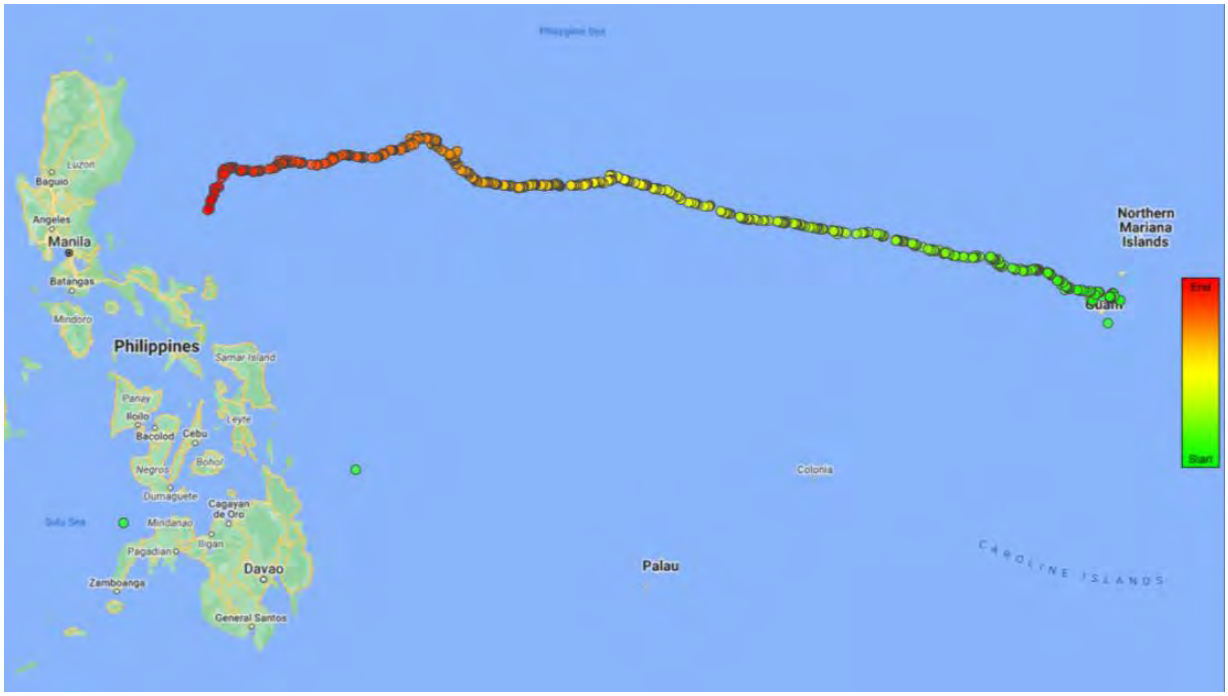


Figure 93. Satellite tracks of turtle tagged 1 July 2023 whose location was tracked to an island east of the Philippines as of 3 August 2023.



Figure 94. 18 eggs laid outside of the egg chamber on EOD Beach. Eggs were retrieved and buried inside with the nest after the nesting female returned to the sea.

Sea Turtle Nesting Beach Monitoring within Joint Region Marianas Area of Responsibility

Location: NWF, MCBCB **Period of Performance:** SEP2022 – MAR2024

Project Objective

Monitor Haputo Beach for signs of green sea turtle or hawksbill turtle nesting. Collect nesting data including egg count, hatching rates, and emergence. Install education signage within Haputo Ecological Reserve Area.

Conservation Benefit

Understand sea turtles' use of Haputo Beach for nesting. Protect and enhance nesting beaches.

FY23 Status

- Contract awarded in September 2022 for 12 months of monitoring, data collection, and installation of educational signage
- First monitoring event in January 2023; one old nest was found
- No other nests found since initial monitoring event
- Six weekly monitoring events were missed due to Typhoon Mawar

EPR: 1 CP MAR NBG Sea Turtle Distribution and Habitat Use; 61755NR815

2019 JRM INRMP Reference: TPS-1; TPS-2; TEDU-1



Figure 95. Leilani Sablan, of UOG Sea Grant, checks a nest at Haputo Beach.



Figure 96. Sand mound associated with an old sea turtle nest.



Figure 97. Possible sea turtle egg nest chamber at Haputo Beach.

Monitoring of Mariana Swiftlets

Location: NMS **Period of Performance:** AUG2021 - Ongoing

Project Objective

Monitor population trends of Mariana swiftlets (*Aerodramus bartschi*) at three caves on NMS: (Maemong, Mahlac, and Fachi).

Conservation Benefit

The conservation benefits will ensure self-sustaining, resilient populations of native species and prohibit loss of current species range.

FY23 Status

- Quarterly counts conducted
- Removed vegetation from Maemong entrance
- Currently partnering with DAWR Biologists on update of SOP for quarterly counts

EPR: 1 S MAR NBG Endangered Species Monitoring; 61755NR142

2019 JRM INRMP Reference: TPS-4; 6-47

Table 12. Swiftlet Counts for FY2023

Mariana Swiftlet Recovery and Habitat Use

Location: NMS **Period of Performance:** MAR2022 – MAR2024

Project Objective

To provide an understanding of Mariana swiftlet (*Aerodramus bartschi*) habitat use, movement, reproductive success, and breeding site selection to inform management actions and meet specific objectives identified in the USFWS Recovery Plan for the Mariana Swiftlet.

Conservation Benefit

To ensure self-sustaining, resilient populations of native species and prohibit loss of current species range.

FY23 Status

- Deployed high resolution thermal and near infrared (NIR) cameras at roost locations and cave entrances
    - Reviewing footage to estimate roosting population sizes in Mahalac and Maemong for April 2019, November 2019, March 2022, and November 2022, April 2023
        - 2-4 days of video recorded from each cave to assess roost site occupancy over a 24 hour period for multiple days
    - Ongoing analyzation of imagery from Fachi April 2019 and April 2023
        - Fachi cave was too flooded for access during our other visits).
    - Expected report on roost population size from April 2019-April 2023 in Q4
    - Ongoing refining of computer vision algorithm parameters, expected development of cave entrance population counts by the end of Q5
    - Future comparison of cave entrance and roost site counts to come to assess agreement between approaches
- Deployed low-power, time-lapse thermal and NIR cameras to visualize roost locations and nests within caves over time for the purpose of documenting the roosts/nests, seasonal roosting changes, and BTS interaction/control changes
    - Tested new fully functional prototype in April 2023
    - Generated hundreds of hours of video, assessment ongoing
- Deployed time-lapse thermal and/or NIR cameras to estimate breeding periods and nesting success
    - Ongoing development of automated approaches to record long periods of nesting behavior without manual review
    - BTS detected by the cameras, which can help in assessing predation risks to nesting and roosting birds
- Identify movement patterns within caves and surrounding landscapes using lightweight radio transmitters
    - 10 individuals March 2022 tracked to assess techniques and safety

        - Tracked for 2 – 3 weeks with antennae at cave entrances and below the roost
    - 20 individuals August 2022
    - 30 individuals April 2023
        - Begin inquiry into movement away from the caves
    - Preliminary assessment of our in-cave tracking indicates a highly variable pattern of activity, both among individuals and within individuals from day to day.
- Tracking movement of swiftlets across the landscape
    - 30 individuals tracked April 2023
        - To evaluate the feasibility of tracking birds away from the caves across the landscape, we placed several automated (24/7) tracking stations in multiple places on the Naval Munition Site where we thought birds may fly.
        - These locations included areas along Firebreak 3 Road and areas around Fena Reservoir.
        - Based on preliminary analysis of radio signals received, we detected multiple individuals at these landscape tracking stations, with directional antennas indicating birds are flying outside of the NMS boundaries.
        - Future work to determine where birds leaving the Naval Magazine lands are flying to will help to understand what areas are needed to support the swiftlet colonies on Naval lands.

EPR: 1 RP MAR NBG Mariana Swiftlet Habitat Use; 61755NR303

2019 INRMP References: TPS-4; 6-47



Figure 98. Custom built low-power programable camera system being tested in Mahalac Cave, April 2023. Photo: USGS-PIERC



Figure 99. Brown Treesnake detected near roosting and nesting swiftlets at Mahalac Cave in April 2022. Photo: USGS-PIERC

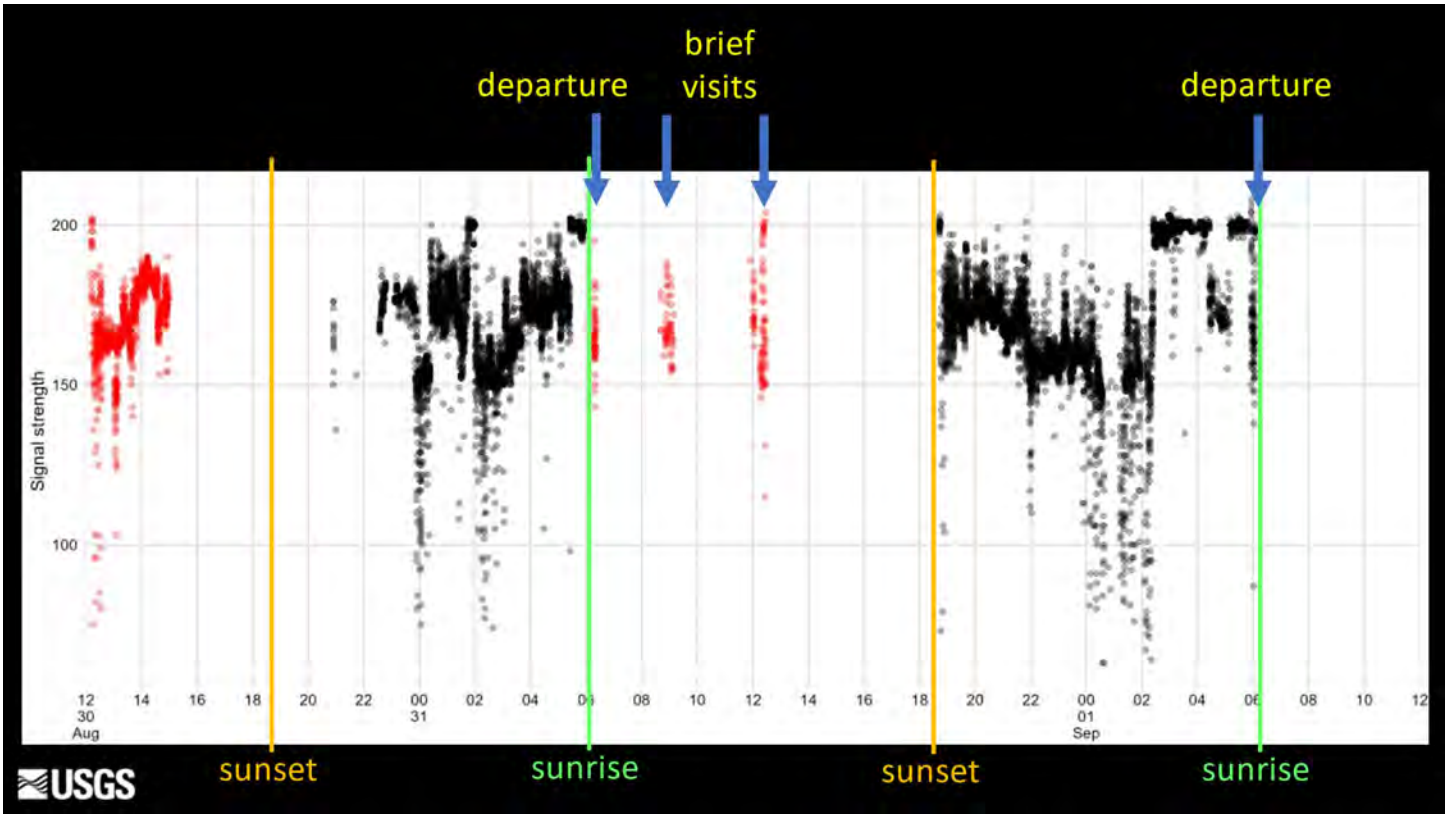


Figure 100. Results of tracking one individual swiftlet with radio telemetry tag attached for several days at Mahalac Cave, August 2022. Detections inside the cave during the day (red dots) and night (black dots) show variable patterns over time for just one individual. Source: USGS-PIERC



Figure 101. Automated radio telemetry landscape tracking station positioned along Firebreak 3 Road on the naval Munitions Site.

Monitoring Survival and Demography of Micronesian Starlings

Location: AAFB **Period of Performance:** MAR2022 – FEB2023

Project Objective

To monitor and analyze for Micronesian starling (*Aplonis opaca* [Sali]) nest success and fledgling survival using telemetry, nest monitoring, and survey methods in relation to BTS control efforts. Through monitoring fledging survival and population recruitment efficacy of BTS control techniques can be assessed. This project is one of four projects that will, collectively, further develop information on BTS behaviors related to predation and movement in the presence of abundant avian species.

Conservation Benefit

The Micronesian Starling is a useful proxy for understanding Guam forest bird ecology in the presence in of BTS. Behavior, survivorship, and population demographics could be useful for supporting future avian restoration projects and controlling BTS in low density with competing food sources in the presence of control regimes.

FY23 Status

- Monitored 70 nest boxes & 43 natural nests (2019-2022)
- Monitored 461 fledglings [100 fledglings (22%) alive at the end of the monitoring period; 291 confirmed mortalities (52%); 71 fledglings (16%) with unknown fate]
- 54% of mortalities due to BTS, 30% due to cats
- Population estimates ranged from 1442 to 1969 (mean=1685)
- No statistical indication of increased survival time in BTS treated vs untreated areas
- Future work: nest box maintenance, annual surveys, and cat control

EPR: 1 RP JRM Brown Tree Snake Eradication and Control to Support Recovery of ESA-Listed Birds; 61128NR202

2019 JRM INRMP Reference: TIS-2, TIS-3; 5-85, 6-43; 7-52, 8-50-51, 9-71

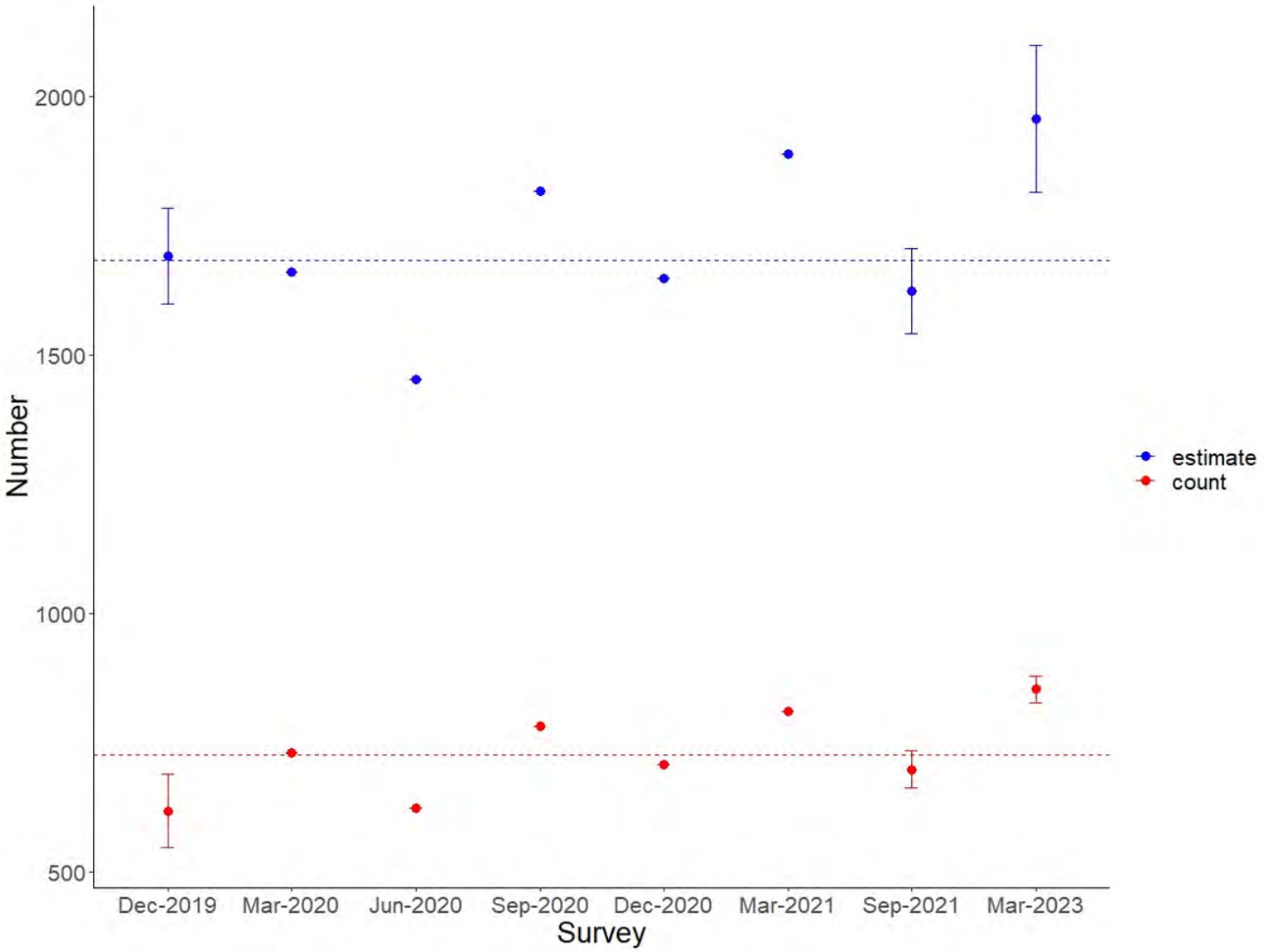


Figure 102. Graph showing raw counts (mean value for 3-week surveys; ± SD [SD = 0 for single-week counts]; red) and population estimates (mean value for 3-week surveys; ± SD [SD = 0 for single-week counts]; blue) for census surveys conducted during the project period. Source: Iowa State University.

Mariana Fruit Bat Monitoring - AAFB

Location: AAFB **Period of Performance:** JAN2022 – DEC2023

Project Objective

Conduct surveys for Mariana fruit bats (*Pteropus mariannus mariannus*) at AAFB as part of long-term population monitoring and to provide analysis on the effects of aircraft overflights and behavior of Mariana fruit bats at Pati Point.

Conservation Benefit

Monitoring will allow for management actions to enhance and restore habitat and increase efforts to recover Mariana fruit bat populations in Guam.

FY23 Status

- Addresses three of the recovery criteria in the 2009 U.S. Fish and Wildlife Service (USFWS) Draft Revised Recovery Plan for the Mariana Fruit Bat or Fanihi by implementing seven of the Recovery Actions outlined in the Draft Plan.
- The 10th Annual Base-wide Count occurred on 18 August, 2023. Data is presently being analyzed.
- Data shows an increasing trend.
- A consistent AAFB roost area and flyway still being utilized even after typhoon.
- Pati Point surveys continue to occur on a quarterly basis. There has been no sign of fruit bats present at the historic roost site.
- In the last 3 years large temporary population increases, in the Jan./Feb. to Mar/Apr time frame, have been documented, with the assumption that these are migrants from Rota.
- In 2021 the population increase was ~200 bats, in 2022 it was ~1300 bats and in 2023 it was ~150 bats.
- There is the distinct possibility that this is a frequent occurrence that was not noticed in the past.
- Sign transect monitoring has begun. Transects are 300 meters long and 3 meters wide. Number of transects might need to be increased.
- While not on DoD lands, it is noteworthy that there is now a large colony in south/central Guam with ~270 bats (unofficial count by T. Mildenstein). It is quite possible that there is movement of bats between AAFB and the central Guam colony.

EPR: 2 MAR AAFB Fruit Bat Monitoring; M5240CN041

2019 JRM INRMP Reference: TPS-2; 9-75

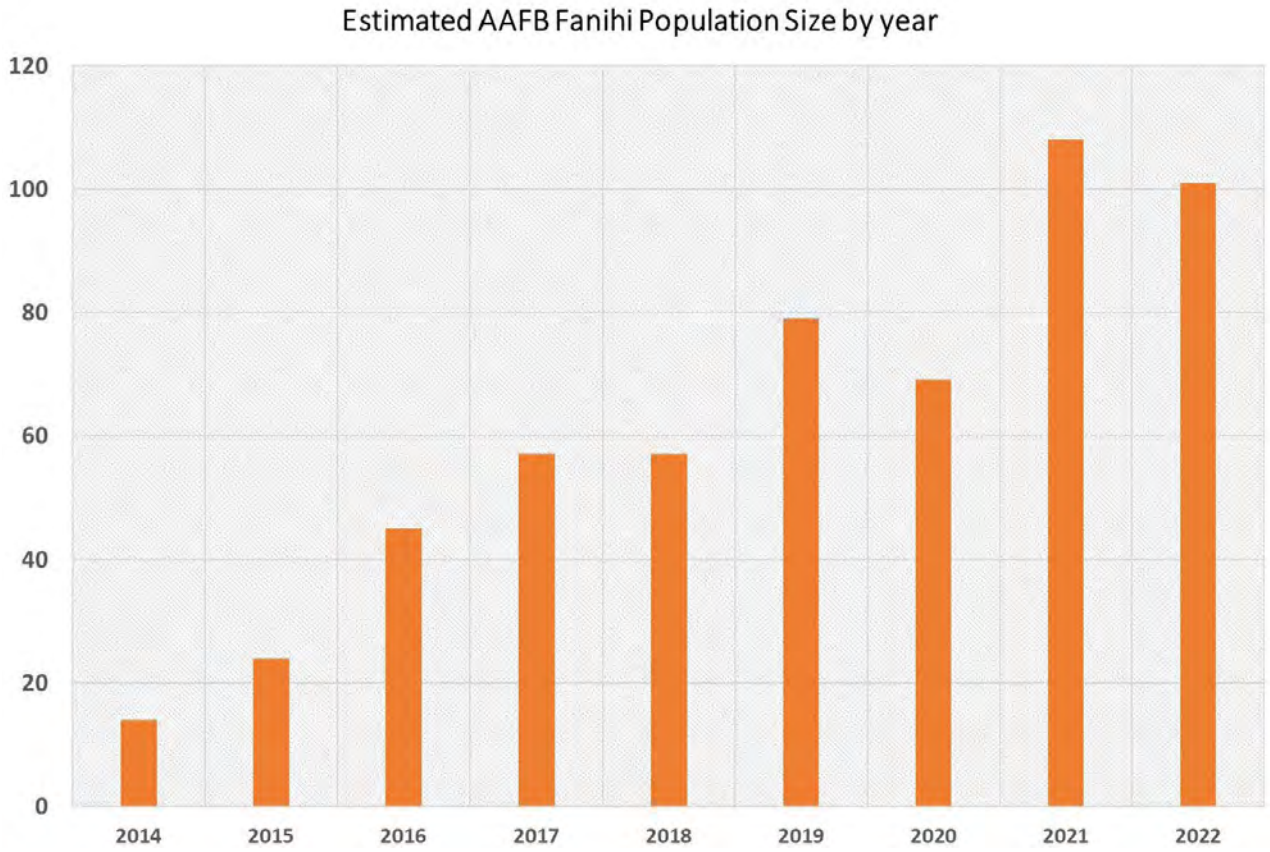


Figure 103. AAFB Bat Population Estimates

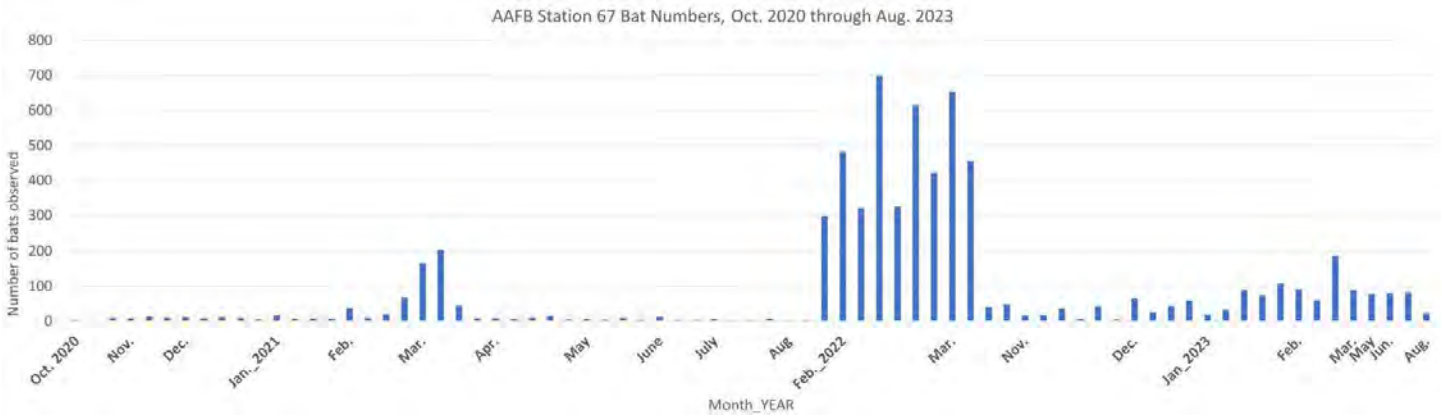


Figure 104. AAFB Sta 67 counts Oct 2020 – Aug 2023



Figure 105. Fruit Bat scat and ejecta



Figure 106. Fruit Bat sign transects

Mariana Fruit Bat Monitoring – NMS

Location: NMS **Period of Performance:** AUG2022 – MAY2024

Project Objective

To conduct a large-scale Mariana fruit Bat (*Pteropus mariannus marianuus*) population count to monitor changes and population trends on the NMS; to perform and analyze habitat quality and bat sign surveys; and to maintain a database and map of all fruit bat sightings.

Conservation Benefit

The project addresses three of the recovery criteria in the US Draft Revised Recovery Plan for the Mariana Fruit Bat or Fanihi (USFWS 2009) by implementing seven of the Recovery Actions outlined in the Draft Plan. The results of the project promote fanihi recovery by: using monitoring to identify fanihi conservation priorities, establishing a method of determining when population recovery criteria are met, and building local support for fanihi conservation. It is anticipated that results from this project will be incorporated in the next revisions of the Recovery Plan.

FY23 Status

- Conducted large scale NMS survey on Dec 16, 2022
- 7 observation stations: 5 on NMS and 2 along Cross Island Road
- 50 bat observations (25 outside NMS, 25 inside NMS)
- 2019: 0 observations , 2020: 4 observations, 2021: 14 Observations

EPR: RP MAR JRM Mariana Fruit Bat Monitoring: 61128NRFBM

2019 JRM INRMP Reference: TPS-7; 6-48, TPS-7; 11-67.

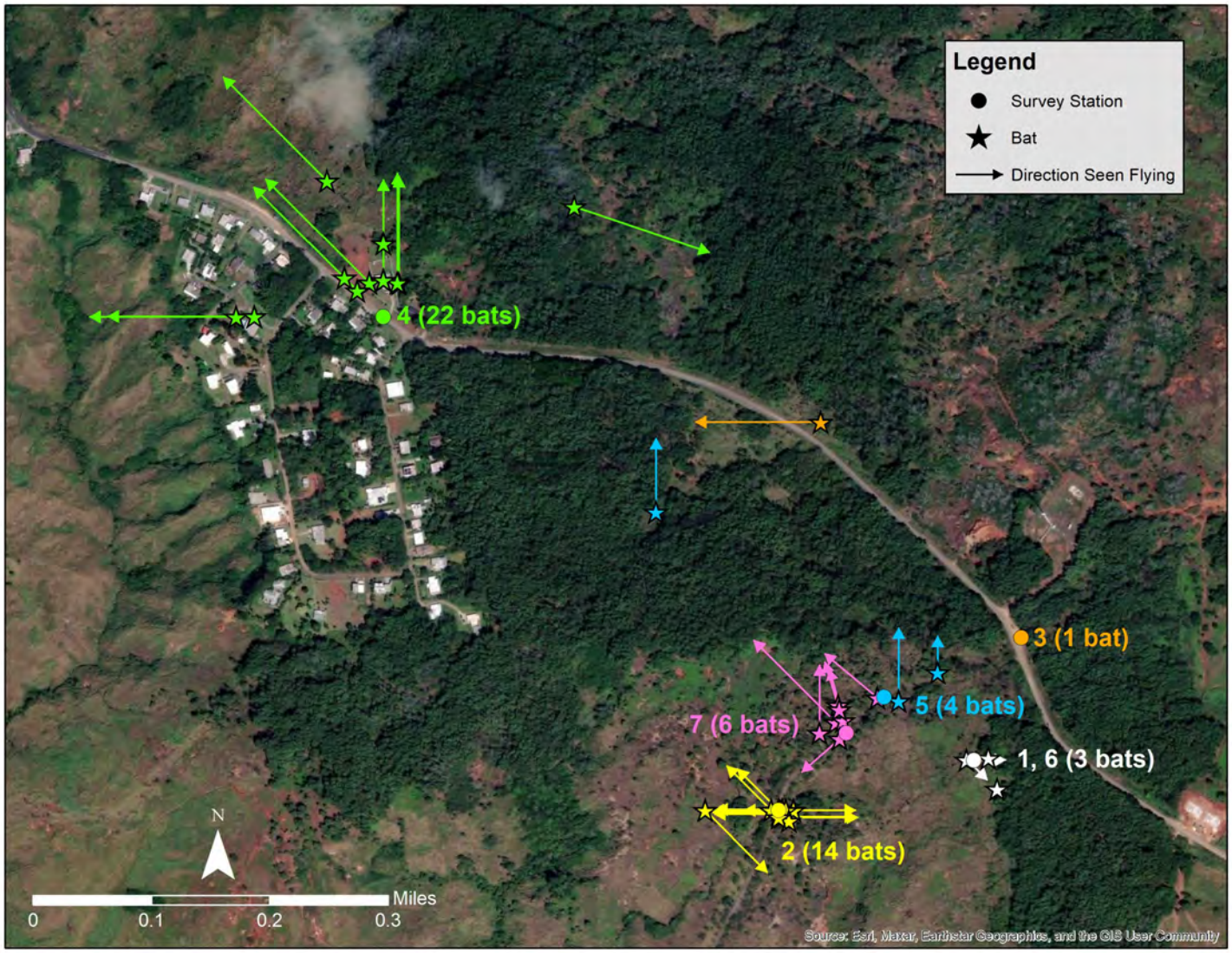


Figure 107. Map of fanihi sightings during 2022 NMS large-scale survey. Source: UOG



Dr. Tammy Mildenstein preparing for 2023 fanihi count, Dump Coke, Tinian
Photo: Jill Liske-Clark

Joint Region Marianas Integrated Natural Resources Management Plan Summary of 2023 Projects

CNMI REPORT

NAVFAC
Naval Facilities Engineering Systems Command
NAVFAC Marianas

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ACRONYMS AND ABBREVIATIONS

ACRONYM	DESCRIPTION
AAFB	Andersen Air Force Base
AFPMB	Armed Forces Pest Management Board
AOR	Area of Responsibility
BTS	Brown Treesnake
CESU	Cooperative Ecosystem Studies Units Network
CEMML	Center for Environmental Management of Military Land
CGAPS	Coordinating Group on Alien Pest Species
CNMI	Commonwealth of the Northern Mariana Islands
PACFLT	U.S. Pacific Fleet
COTS	Crown-of-thorns Seastar
CRB	Coconut Rhinoceros Beetle
CSU	Colorado State University
DFW	Division of Fish and Wildlife
DLNR	Department of Lands and Natural Resources
DoD	Department of Defense
DON	Department of the Navy
ESA	Endangered Species Act
FDM	Farallon de Medinilla
Ft	foot/feet
FY	Fiscal Year
GIS	Geographic Information System
GISAC	Guam Invasive Species Advisory Committee
GISC	Guam Invasive Species Council
ha	hectare(s)
INRMP	Integrated Natural Resources Management Plan
JRM	Joint Region Marianas
LFA	Little fire ant
M	meter(s)
MEDU	Marine Natural Resources Educational Outreach

MGIS	Marine GIS and Data Management
MHM	Marine Habitat Management
MIG	Marine Bird Management
MIS	Marine Invasive Species
MISMP	Marine Invasive Species Management Plan
MLA	Military Lease Area
MPS	Marine Protected Species Management
NAVFAC	Naval Facilities Engineering Systems Command
NBG	Naval Base Guam
NMCB	Navy Mobile Construction Battalion
NOAA	National Oceanic and Atmospheric Administration
SOP	Standard Operating Procedure
TEDU	Terrestrial Natural Resources Educational Outreach
THM	Terrestrial Habitat Management
TIS	Terrestrial Exotic and Invasive Species Management
TLAW	Terrestrial Natural Resources Law Enforcement
TPS	Terrestrial Protected Species Management
RBP	Regional Biosecurity Plan for Micronesia and Hawaii
RISC	Micronesian Regional Invasive Species Council
UOG	University of Guam
USDA-WS	United States Department of Agriculture- Wildlife Services
WERI	Water and Environmental Research Institute
YES!	Young Environmental Stewards

MARINE HABITAT MANAGEMENT

Joint Region Marianas Marine Invasive Species Management Plan (JRM MISMP)

Location: Guam & Tinian MLA **Period of Performance:** AUG22 – OCT2023

Project Objectives

To develop standard operating procedures (SOP) and protocols to avoid and minimize: (1) the spread of new marine invasive species (MIS) into the Department of Defense (DoD) submerged lands within the JRM Area of Responsibility (AOR), and (2) the transfer of any MIS from DoD submerged lands within the JRM AOR to the Pacific region.

Conservation Benefit

The development of SOPs and protocols for a MISMP shall support natural resource managers to monitor, detect, respond, control, eradicate, and prevent the risk of MIS incursions into, out of, and within the JRM AOR, thus maintaining marine biodiversity and ecosystem functions within JRM's AOR.

FY23 Status

- Resource partners provided comments and feedback on draft chapters
- Revisions for Draft Final JRM MISMP copy currently ongoing
- Final JRM MISMP document scheduled to be completed by OCT 2023

EPR: 1 S MAR JRM Marine Ecosystem Monitoring and Coral Reef Indicators (CHS); 61128NR168

2019 JRM INRMP Reference: MIS-1; 5-102, MIS-2; 5-102, MIS-1; 8-64, MIS-2: 8-65, MIS-1; 9-88, MIS-2; 9-88, MIS-1; 11-75, MIS-2; 11-75

Identification and Removal of Non-Permitted Buoys on Joint Region Marianas

Location: JRM & Tinian MLA **Period of Performance:** AUG2023 – Ongoing

Project Objectives

To remove non-permitted buoys (NPBs) on Joint Region Marianas (JRM) submerged lands in Tinian, Commonwealth of the Northern Mariana Islands (CNMI). Primary objectives will be to identify NPBs, survey seafloor/coral reef resources in the immediate vicinity of the identified buoys, and remove the NPBs on JRM submerged lands in Tinian.

Conservation Benefit

Mitigates further damage to the marine resources and assists with navigational requirements occurring on, or around JRM submerged lands. It reduces adverse impacts from commercial and recreational boating to coral reef habitat due to improper vessel anchoring within JRM submerged lands.

FY23 Status

- Awarded to Naval Information Warfare Center Pacific (NIWC Pacific)
- Kick-off meeting planned for Nov 2023

EPR: EO 13751 MAR JRM Monitoring and Control of Acute Impacts on Coral Reefs – Climate; 61128CN222: Coral Habitat Enhancement

2019 JRM INRMP Reference: MIS-2; 8-65, MHM-1; 8-62, MHM-2; 8-63, MHM-3; 8-63, MGIS-1; 8-68, MHM-1; 11-73, MHM-2; 11-74, MHM-3; 11-74, MIS-2; 11-75, MPS-1; 11-76

Water Quality Monitoring on JRM Submerged Lands

Location: Tinian MLA & Harbor **Period of Performance:** JUN2021 – Ongoing

Project Objectives

To quantify the conductivity, temperature, depth, pH, chlorophyll A, dissolved oxygen, nitrate, and phosphate concentrations in shallow reef systems. This project aims to provide water quality data for the Tinian Harbor and Tinian MLA.

Conservation Benefit

This quantitative data will assist in determining the parameters associated with climate change that may be impacting coral reefs in order to avoid, minimize, or mitigate potential adverse effects to the marine resources within these areas, especially marine protected species and habitats.

FY23 Status

- Ongoing project with UOG WERI
- ESA and EFHA document prepared for NOAA
- Trained subcontractor to maintain sensors, retrieve collected data, and provide retrieve data to UOG WERI
- NAVFAC NR specialist conducted weekly water sampling activities in Tinian Harbor from December 2022 to February 2023; weekly reports submitted to CNMI BECQ/DEQ
- UOG WERI conducted water quality tests, statistical analyses, and prepared water quality and sediment report
- Nation Wide Permit #5 acquired from Army Corps of Engineers (USACE)
- Five (5) sensors undergoing maintenance
- CNMI DFW permit request to deploy sensors in Tinian Harbor
- Completed sensors to be installed in Tinian MLA (2 sites) and Tinian Harbor (3 sites)

EPR: EO 13751 MAR JRM Monitoring and Control of Acute Impacts on Coral Reefs – Climate; 61128CN222: Coral Habitat Enhancement

2019 JRM INRMP Reference: MIS-2; 8-65, MHM-1; 8-62, MHM-2; 8-63, MHM-3; 8-63, MGIS-1; 8-68, MHM-1; 11-73, MHM-2; 11-74, MHM-3; 11-74, MIS-2; 11-75, MPS-1; 11-76



Figure 1. Proposed deployment locations for water quality sensors in Tinian, CNMI (Photo by Dr. Chris Yeo, UOG WERI).

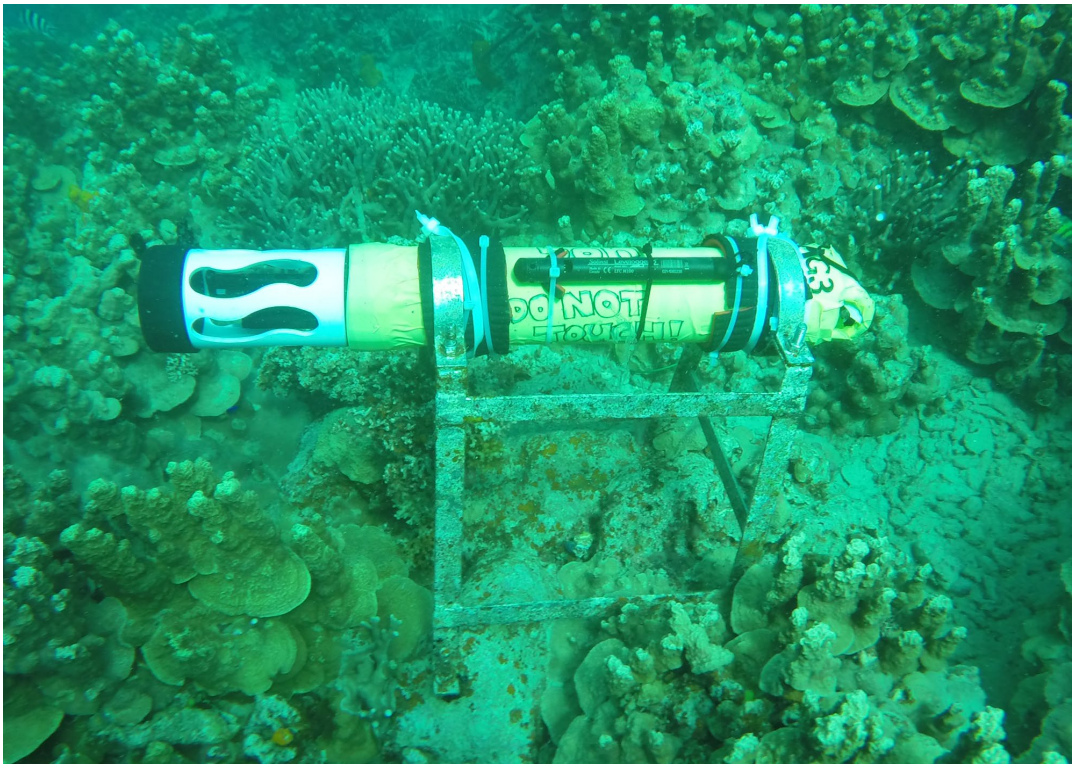

Figure 2. Example of the OTT HydroMet HL7 water quality sensor to be installed in Tinian, CNMI (Photo by Dr. Chris Yeo, UOG WERI).

Coral Bleaching and Crown of Thorns Starfish (COTS) Monitoring on JRM Submerged Lands

Location: CNMI **Period of Performance:** JUN2021 – NOV2023

Project Objective

To quantify the coral bleaching and abundance distribution of COTS, and if necessary conduct COTS culling.

Conservation Benefit

These quantitative data will assist in determining the parameters associated with coral bleaching and COTS outbreak events that may be impacting coral reefs in order to avoid, minimize or mitigate potential adverse effects to the marine resources within these areas, especially marine protected species.

FY23 Status

- Ongoing project with UOG Sea Grant
- Fieldwork delayed due to shipping delays from Typhoon Mawar
- 4 sites on Tinian west side surveyed NOV-DEC 2022
- COTS Training Workshop conducted at Northern Marianas College MAR 2023
- 3 sites surveyed MAR 2023 – Long Beach, Unai Babui, and Unai Chulu
- Tinian Harbor sites planned for future surveys

EPR: 1 S MAR JRM Marine Ecosystem Monitoring and Coral Reef Indicators (CHS); 61128NR168

2019 JRM INRMP Reference: MIS-1; 5-102, MIS-2; 5-102, MIS-1; 8-64, MIS-2: 8-65, MIS-1; 9-88, MIS-2; 9-88, MIS-1; 11-75, MIS-2; 11-75

MARINE PROTECTED SPECIES MANAGEMENT

Sea Turtle Aerial Surveys in Farallon de Medinilla (FDM)

Nearshore Waters

Location: FDM, CNMI **Period of Performance**: AUG2020 – FEB2024

Project Objective

To design and conduct aerial transect surveys to determine sea turtle and marine mammal identification, abundances, and distributions in the nearshore waters surrounding FDM. To analyze sea turtle and marine mammal identification, abundances, and distributions; and examine spatial and/or temporal (seasonal) variations in the nearshore waters surrounding FDM.

Conservation Benefit

Provide baseline data on the abundance and distribution of sea turtles and marine mammals such that mission-essential training activities can be conducted to avoid and/or minimize potential impacts to these species and/or their habitat. These metrics can be modeled to help improve conservation and management actions to protect sea turtles inhabiting the nearshore waters surrounding FDM.

FY23 Status

- Ongoing project with UOG Sea Grant
- October 2022 survey yielded 50+ turtle sightings on west side of Saipan, four whales at FDM, two whales between FDM and Saipan, and no turtle sightings at FDM or east side of Saipan
- Surveys delayed due to Typhoon Mawar relief efforts performed by the airlines

EPR: EO 13751 MAR JRM Monitoring and Control of Acute Impacts on Coral Reefs – Climate; 61128CN222

2019 JRM INRMP Reference: MPS-1 (12-41)

TERRESTRIAL EXOTIC AND INVASIVE SPECIES MANAGEMENT

Implementation of the Regional Biosecurity Plan of Micronesia and Hawaii (RBP) – CNMI

Location: JRM **Period of Performance:** AUG2022-Ongoing

Project Objective

Implement priority actions from the RBP aimed at: 1) Preventing the spread of invasive species within and in/out of JRM Area of Responsibility (AOR); 2) Foster regional coordination and collaboration; 3) Invasive species management and control; and 4) Strengthening capacity for biosecurity.

Conservation Benefit

Protection of native species, particularly those that are threatened and endangered, from the threat of invasive species within the JRM AOR.

FY23 Status

- Implement arrival and/or pre-departure biosecurity inspections of non-training military equipment and cargo movements to and from the CNMI and inter-island movements to ensure Armed Forces Pest Management Board Technical Guide No. 31 (AFPMB TG-31) cleanliness standards, therefore devoid of biomaterial. Biosecurity inspections conducted by Colorado State University Center of Environmental Management of Military Lands (CSU CEMML) and pre-departure Brown treesnake (BTS) conducted by USDA-Wildlife Services (WS).
    - Navy Mobile Construction Battalion (NMCB) cargo and equipment to/from Tinian to support Seabee public works projects.

        - Eight (8) pre-departure biosecurity and BTS inspection events on Guam for movement to Tinian.
        - One pre-departure biosecurity inspection event on Tinian for movement to Guam
    - U.S. Air Force prepositioned equipment to/from Saipan.
        - One (1) pre-departure biosecurity and BTS inspection event on Guam for equipment movement to Saipan.
    - Farallon de Medinilla (FDM) Operational Range Clearance.
        - One (1) pre-departure biosecurity inspection event on Saipan for equipment movement to FDM.
- Early Detection Surveys (EDS) Conducted
    - Tinian MLA – 5 of 5 All-Taxa Survey sites (including LFA, no detections) (Figure 6)
    - All-Taxa Surveys – AAFB: 10 of 32 sites; NBG: 5 of 30 sites
    - Weed Surveys – AAFB: 3 of 29 sites; NBG: 4 of 34 sites
- Continued interagency coordination and consultation regarding invasive species management and biosecurity concerns within the region (CRB Working Group, LFA Working Group, GISC, GISAC, RISC, CNMI DLNR, Guam Biosecurity Division, CGAPS).

EPR: CHS NISA MAR JRM Implementation of the Regional Biosecurity Plan; 61128NR860

2019 JRM INRMP Reference: TIS-4; 5-85, TIS-5; 6-44, TIS-5; 7-53, TIS-4; 8-51, TIS-6; 9-73, TIS-1; 11-62, TIS-1; 12-32



Figure 3. All-taxa EDS locations within the Tinian MLA included the North Field Center Taxiway and Baker Runway cargo offload locations, Japanese Aircraft Parking Apron, North Parking Apron, and Camp Tinian.

Coconut Rhinoceros Beetle (CRB; *Oryctes rhinoceros*) Surveys, Interdiction, and Monitoring – CNMI (Tinian)

Location: JRM **Period of Performance:** AUG2022 – Ongoing

Project Objective

To implement CRB best management practices: 1) Conduct CRB Early Detection Surveys in Tinian MLA, 2) Implement interdiction/sentinel trapping in MLA, 3) implement CRB awareness for military personnel, and 4) Implement CRB interdiction measures on Guam and coordinate and collaborate with resources partners in the CNMI to prevent the movement of CRB to the CNMI via military cargo and transport.

Conservation Benefit

Prevention of movement and establishment of CRB into the CNMI during military training activities.

FY23 Status

- Deployed 24 CRB panel traps within the Tinian MLA in February 2023 and 9 CRB panel traps at the Tinian Divert construction site in May 2023 for long-term early detection monitoring on a monthly basis (Figure 7)
    - No CRB captures to date
- Provide military personnel with CRB awareness information and sighting protocols
- Pre-departure biosecurity inspections were conducted on all cargo and equipment prior to transport from Guam to the CNMI during military exercises to ensure all items were devoid of bio-material (including CRB)
- Coordination with regional partners (USDA-PPQ, GovGuam Dept. Ag., CNMI DLNR, Hawaii Dept. Ag.)

EPR: CHS NISA MAR JRM Implementation of the Regional Biosecurity Plan; 61128NR860

2019 JRM INRMP Reference: TIS-5; 5-86, TIS-6; 6-44, TIS-4; 7-53, TIS-5; 8-52, TIS-6; 8-52, TIS-5; 9-72, TIS-1; 11-62, TIS-1; 12-32

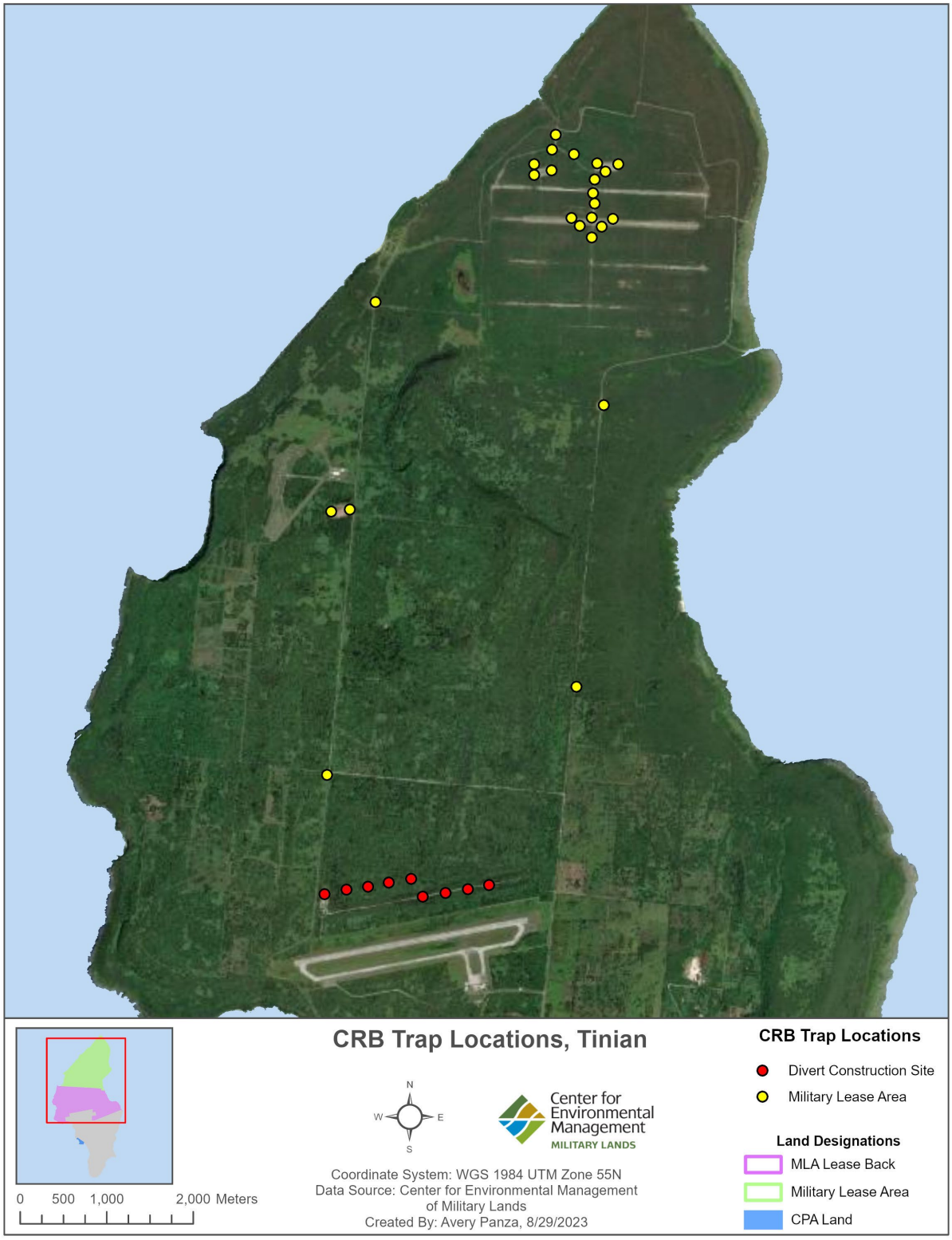

Figure 4. CRB sentinel/interdiction black panel trap deployment locations within the Tinian MLA (24 traps) and Tinian Divert construction site (9 traps).

TERRESTRIAL PROTECTED SPECIES MANAGEMENT

Mariana Fruit Bat Population Monitoring

Location: Tinian MLA **Period of Performance**: MAY2022 – Ongoing

Project Objective

To monitor Mariana fruit bat (*Pteropus mariannus mariannus*/fanihi) abundance and habitat use on the Tinian MLA.

Conservation Benefit

Knowledge of fanihi occurrence in the MLA and use patterns permits implementation of disturbance avoidance measures, and the ability to target habitat protection or enhancement measures.

FY23 Status

- 2nd annual island-wide fanihi count through NAVFAC/CNMI DFW partnership conducted March 9, 2023
- Two NAVFAC/DFW outreach events held in association with the annual count
- Bat colony found on MLA in May 2023; 52 bats counted in June
- Three transects were established to identify signs or evidence of fanihi presence such as dropping or ejecta

EPR: 1 RP MAR JRM Mariana Fruit Bat Monitoring; 61128NRFBM

2019 JRM INRMP Reference: TPS-7; 11-67



Figure 5. Tinian island-wide 2023 fanihi count participants

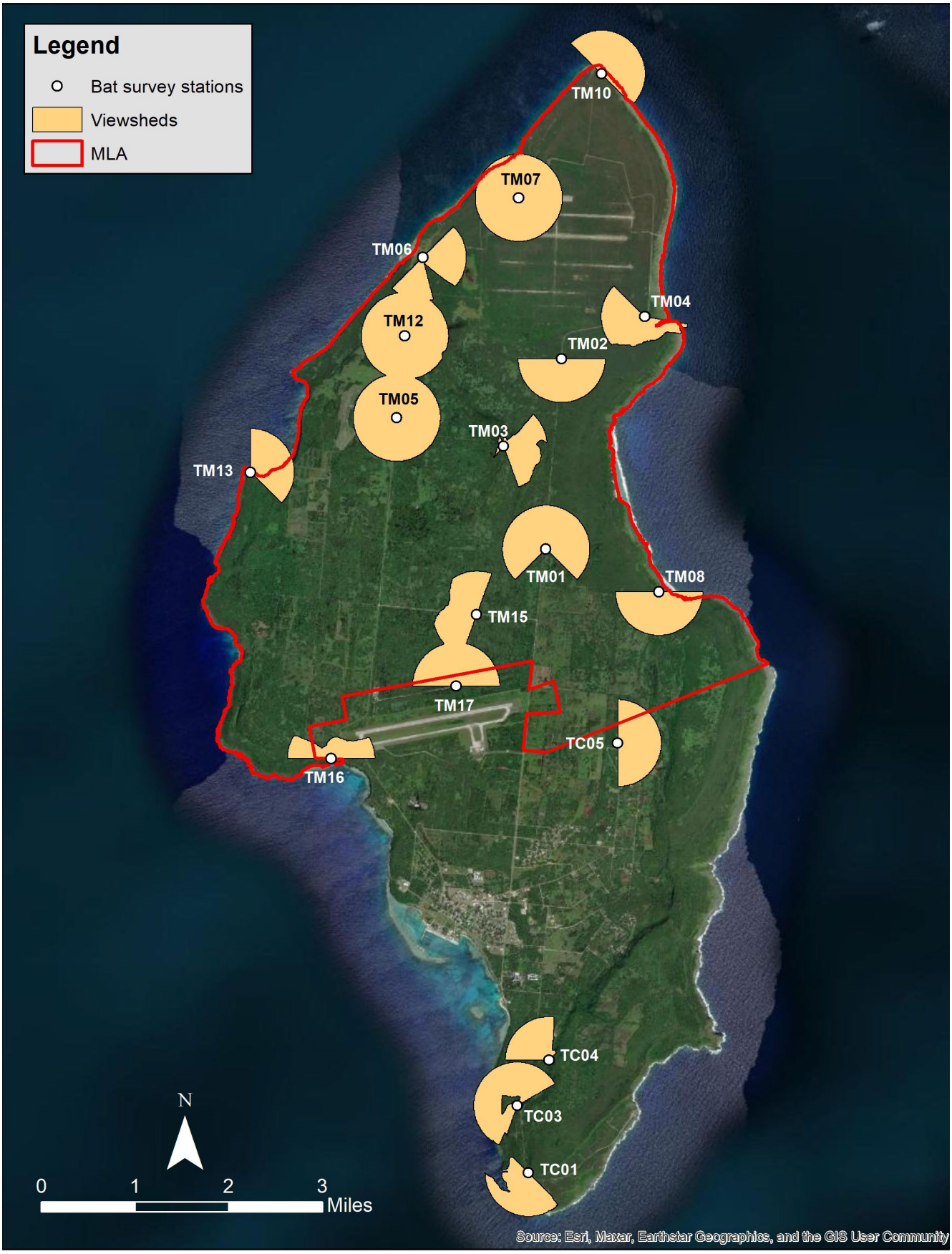

Figure 6. Tinian island-wide 2023 fanihi count station viewsheds

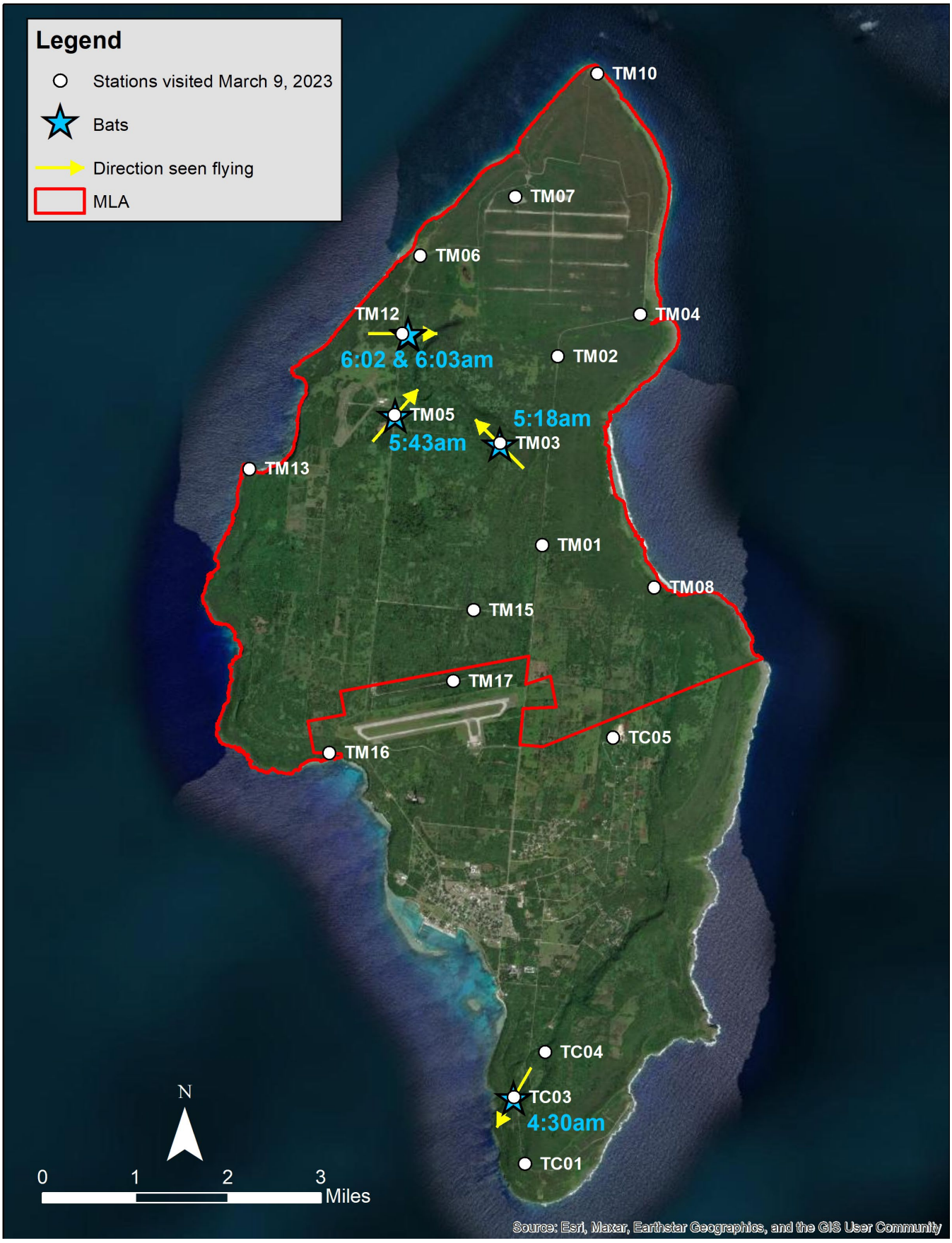

Figure 7. Tinian island-wide 2023 fanihi count detections

Conservation of Listed Invertebrates

Location: Tinian MLA **Period of Performance**: MAR2022 – MAR2023

Project Objective

Overall objective is to conserve and manage humped tree snail (*Partula gibba*) populations on the Tinian MLA. Specific objective is to determine if snails continue to occupy the Dump Coke site.

Conservation Benefit

Monitoring results inform decisions regarding the need or urgency for management.

FY23 Status

- Adult and juvenile humped tree snails detected at North Dump Coke site
- No snails detected at South Dump Coke site
- Final report “Endangered Snail Monitoring on the Tinian MLA”, March 2023

EPR: 1 CP JRM Conservation Management of ESA-listed Invertebrates; 61128NR203

2019 JRM INRMP Reference: TPS-5; 11-66

Table 1. Summary of Dump Coke snail search results, 2022.

Search Date	Dump Coke North	Dump Coke South
July 11, 2022	NA	0
August 29, 2022	0	NA
October 5, 2022	NA	0
November 2, 2022	35	NA
November 21, 2022	0	0
November 22, 2022	8	0

NA=site not searched

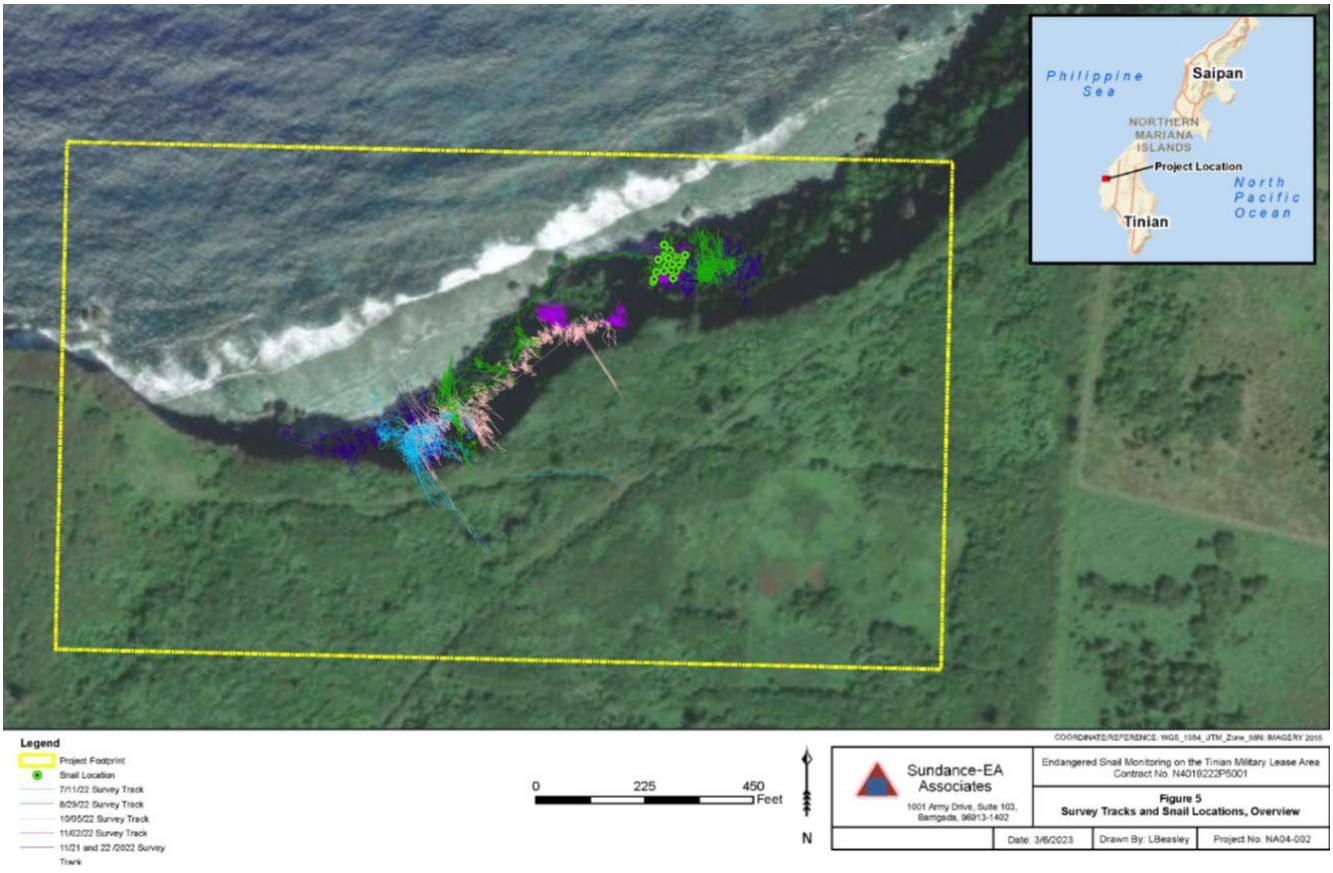

Figure 8. Dump Coke search tracks and snail detections, 2022.



Figure 9. Adult *Partula gibba* at North Dump Coke site, November 2022.

Tinian Forest Bird Monitoring

Location: Tinian MLA **Period of Performance**: MAR2022 – MAR2023

Project Objective

To monitor native forest bird populations with a focus on Tinian monarch (*Monarcha takatsukasae*) and Micronesian megapode (*Megapodius laperouse laperouse*)

Conservation Benefit

Monitoring informs management decisions for conservation of native bird populations. Understanding trends of the Tinian monarch, a single-island endemic species, and ESA-listed Micronesian megapode will indicate if there is a need for more focused management.

FY23 Status

- Micronesian megapode survey conducted May 2023; no megapodes detected.
- Final report "2023 Micronesian Megapode (Megapodius laperouse laperouse) Playback Surveys in the Tinian Military Lease Area", June 2023

EPR: CHS MAR JRM Tinian Forest Bird Monitoring; 61755NR303

2019 JRM INRMP Reference: TPS-4; 11-65



Figure 10. Micronesian megapode playback survey transects, Tinian MLA.

Tinian Monarch Research

Location: Tinian MLA **Period of Performance**: MAR2022 – Ongoing

Project Objective

To conduct ecological studies of Tinian monarch (*Monarcha takatsukasae*)

Conservation Benefit

Knowledge of Tinian monarch biology and ecology will enable effective and efficient management strategies. Results will guide development of future predator control and/or forest restoration and enhancement measures.

FY23 Status

- Preliminary results from MAR2022-MAY2023:
- Mean home range size 0.37 ha (range 0.14-1.10ha, n=25)
- Breeding density 3.85 pairs/ha native limestone forest; 3.1 pairs/ha secondary forest; 1.92 pairs/ha tangantangan
- Adult annual survivorship, 61% (n=162)
- Artificial nest and replica eggs prepped for future rat predation mitigation study
- Final report “Breeding Biology and Habitat Use of the Tinian Monarch (*Monarcha takatsukasae*)”, May 2023
- New Cooperative Agreement awarded to University of Washington in August 2023

EPR: CHS MAR JRM Tinian Forest Bird Monitoring; 61755NR303

2019 JRM INRMP Reference: TPS-4; 11-65

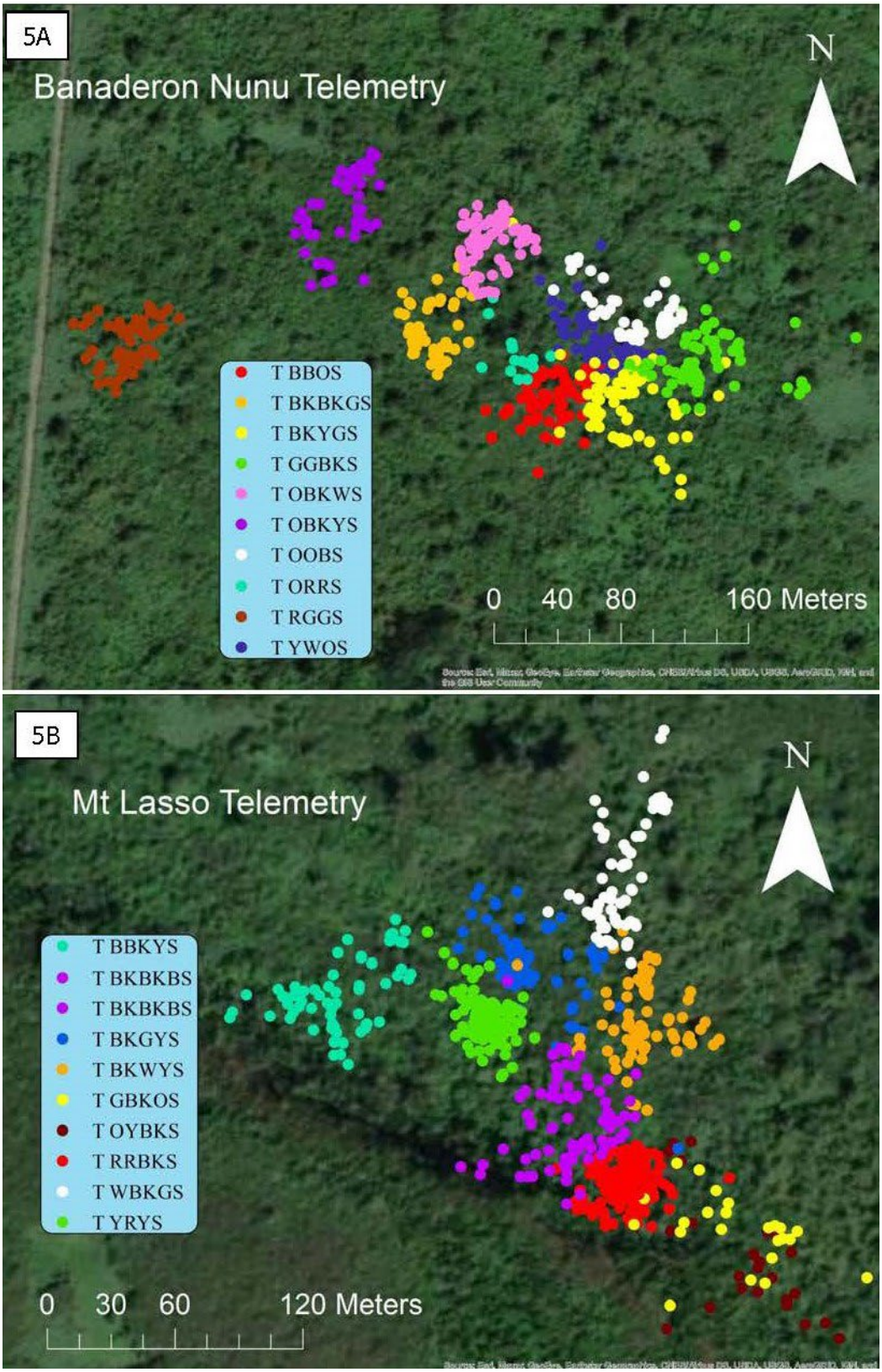

Figure 11. Telemetry points in secondary vegetation (panel 5A) and native limestone forest habitat (panel 5B). Each color represents a tracked male monarch.

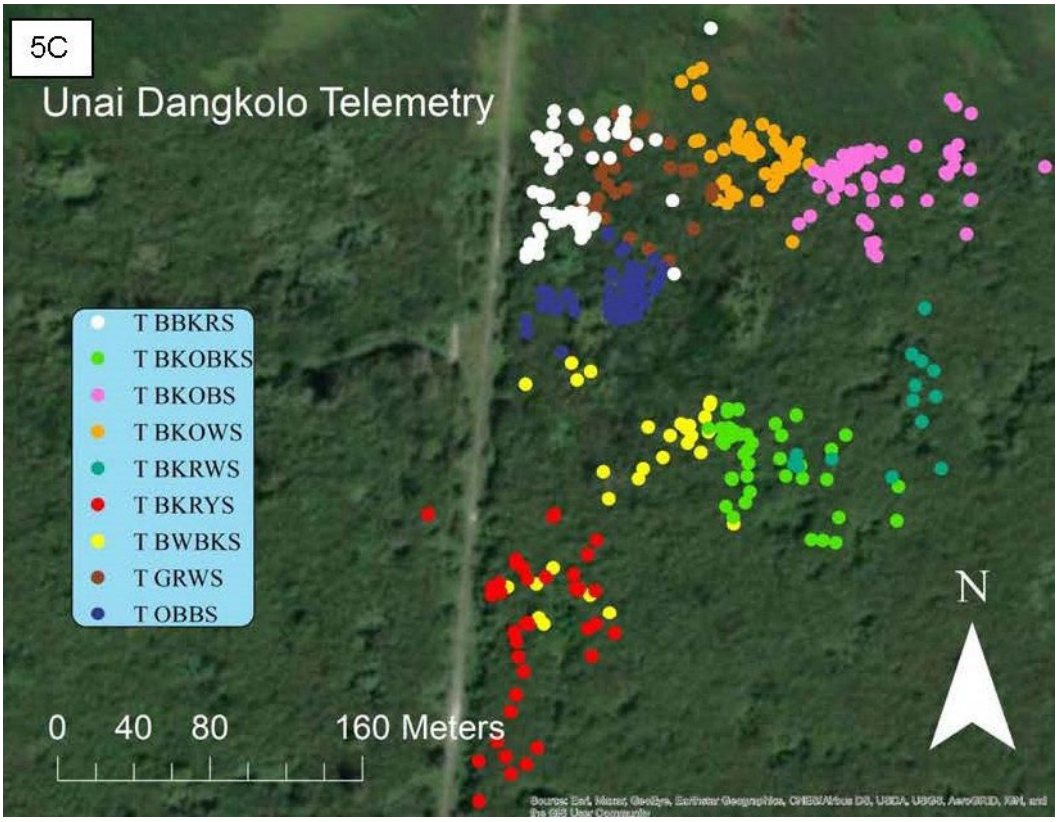

Figure 12. Telemetry points in tangantangan forest habitat (panel 5C). Each color represents a tracked male monarch.

Mariana Common Moorhen Conservation and Management

Location: Tinian MLA **Period of Performance**: AUG2021 – Ongoing

Project Objective

Monitor and investigate Mariana common moorhen (*Gallinula chloropus guami*) populations and habitat use on the Tinian MLA. Communicate and coordinate with conservation partners.

Conservation Benefit

Monitoring informs management decisions for conservation of moorhen populations. Basic ecological research underpins effective management strategies. Effective communication with partners enhances moorhen conservation and recovery efforts on Tinian and range-wide.

FY23 Status

- Lake Hagoi and Bateha wetlands quarterly monitoring ongoing
- Hagoi population trend continues to be stable
- No moorhen detected at Bateha wetlands in FY23
- Hagoi vegetation classification in progress

EPR: 1 S RP MAR CNMI ESA and MBTA Species Management; 61128NR211

2019 JRM INRMP Reference: TPS-3; 11-65

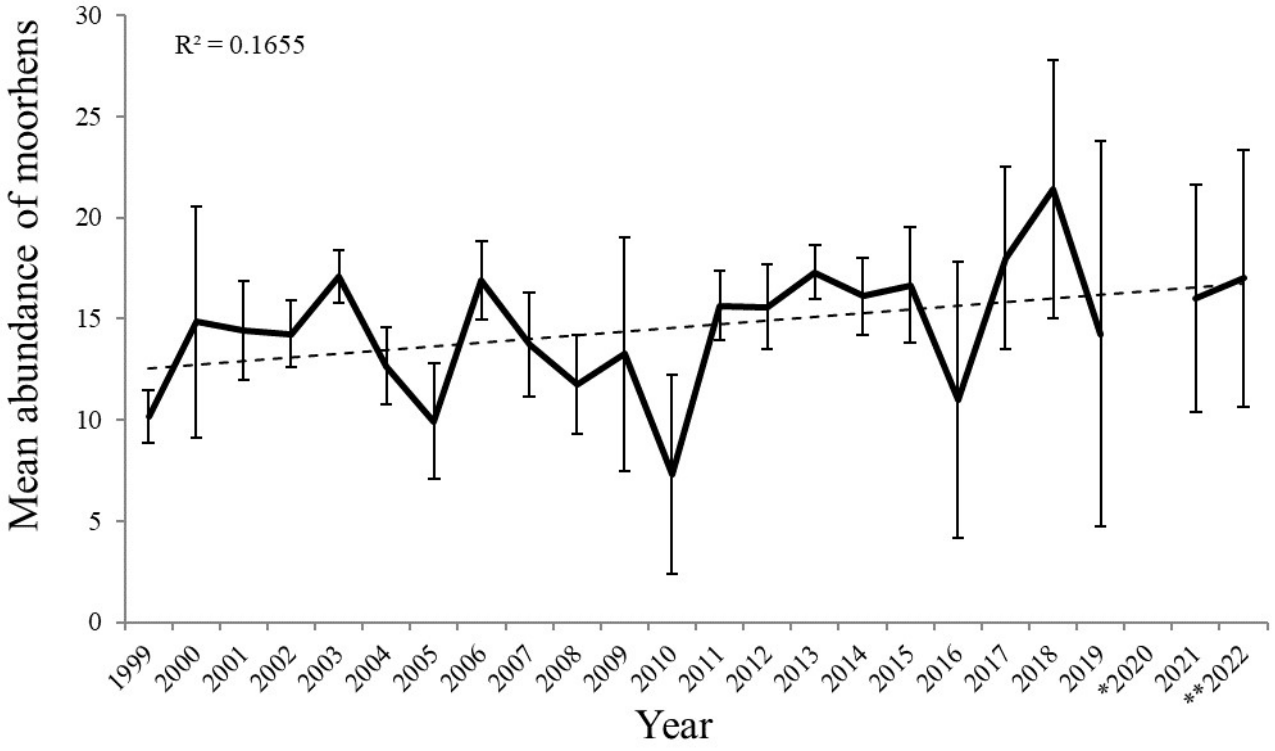

Figure 13. Mean abundance of Mariana Common Moorhen at Lake Hagoi, 1999-2022.

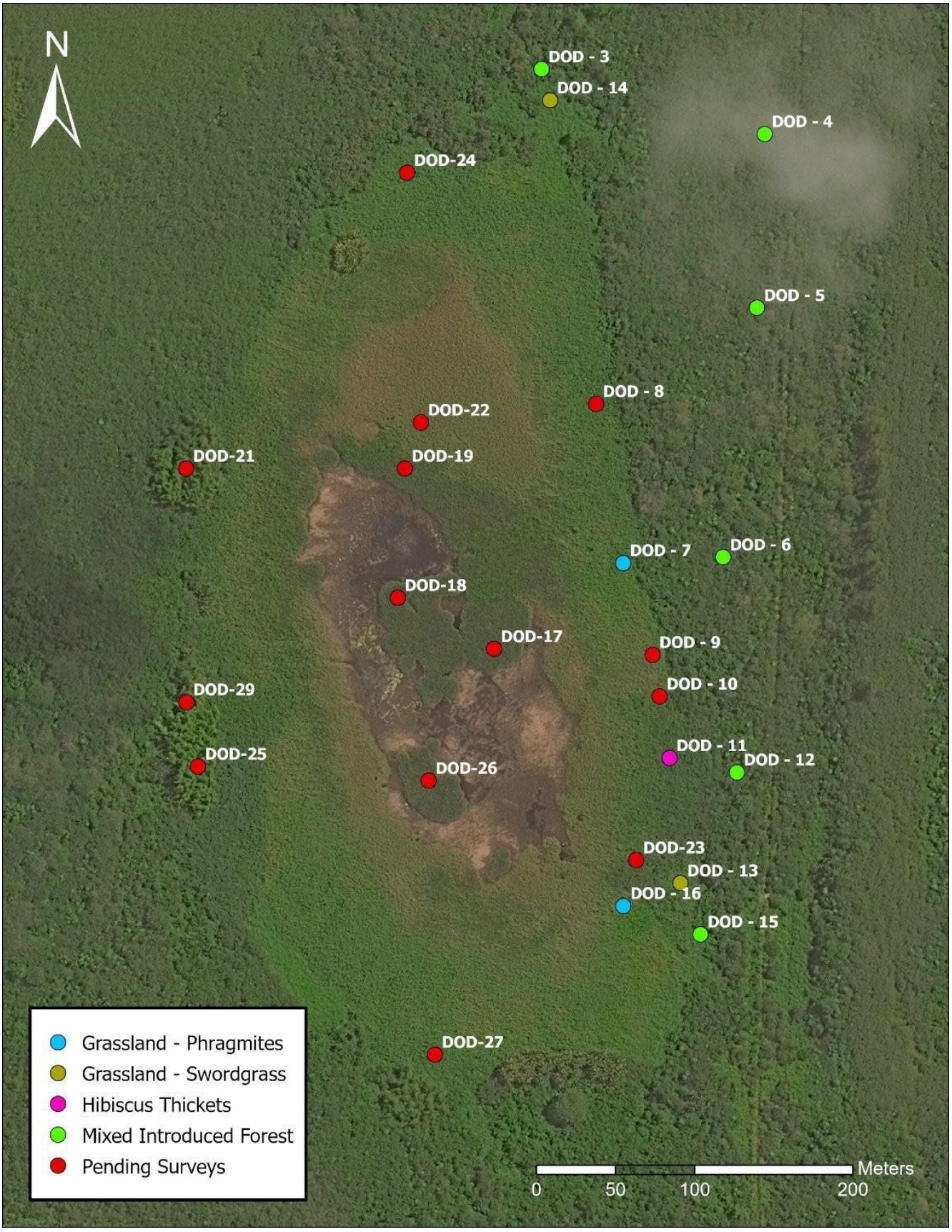

Figure 14. Lake Hagoi vegetation survey progress through Dec 31, 2022.

Sea Turtle Nesting Beach Monitoring and Management

Location: Tinian MLA **Period of Performance**: JUN2021 – Ongoing

Project Objective

Maximize sea turtle nesting opportunities and success on all Tinian MLA beaches

Conservation Benefit

Monitoring provides a measure of success and informs sea turtle conservation and management decisions. Removal of marine debris reduces entanglements and allows successful nest excavation and egg deposition. Secondary benefits accrue to other marine species and ecosystems, and in goodwill with the Tinian public.

FY23 Status

- Twice monthly nesting beach surveys ongoing
- 2,938 lbs of debris removed from 18 MLA beaches
- 2022 results:
- 35 nests, 7 non-nesting emergences
- Tidal inundation impacted 2 nests
- 36 nest inventories were conducted: mean clutch size 80, hatch success 87%, emergence success 85%

EPR: 1 S RP MAR CNMI ESA and MBTA Species Management; 61128NR211

2019 JRM INRMP Reference: TPS-2; 11-64

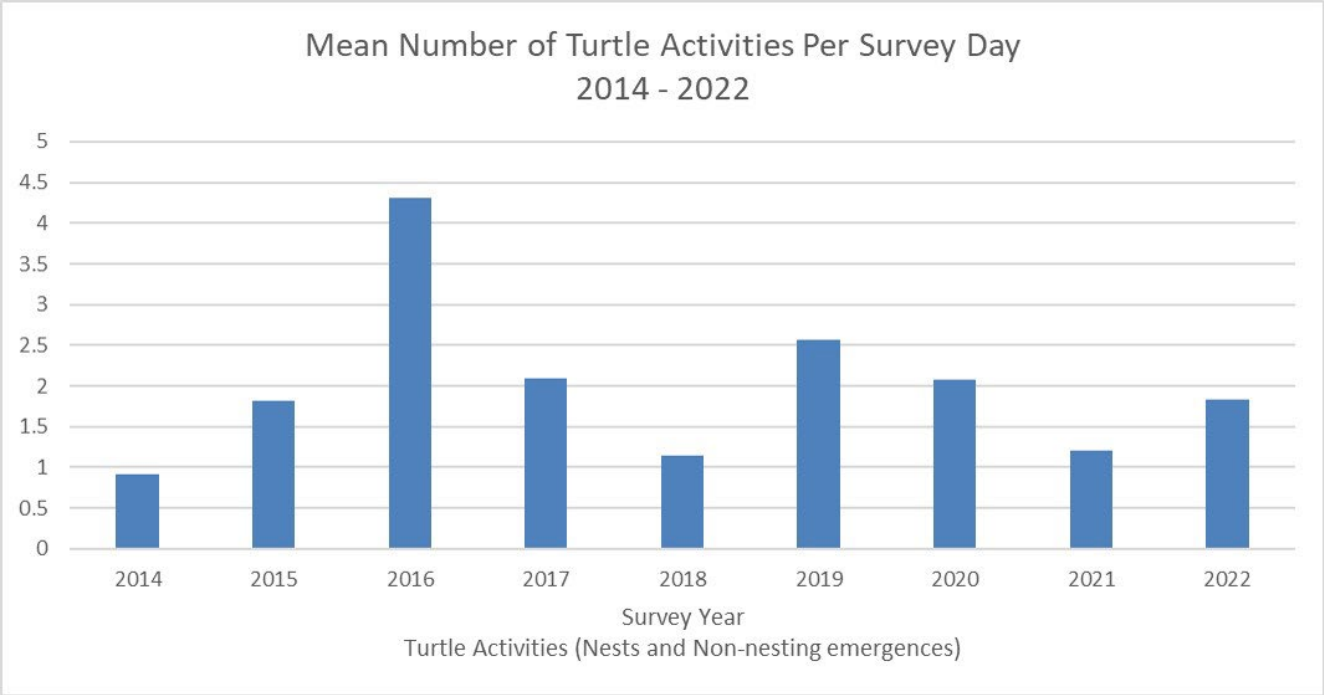

Figure 15. Tinian MLA Green Sea Turtle nesting activity trend, 2014-2022.

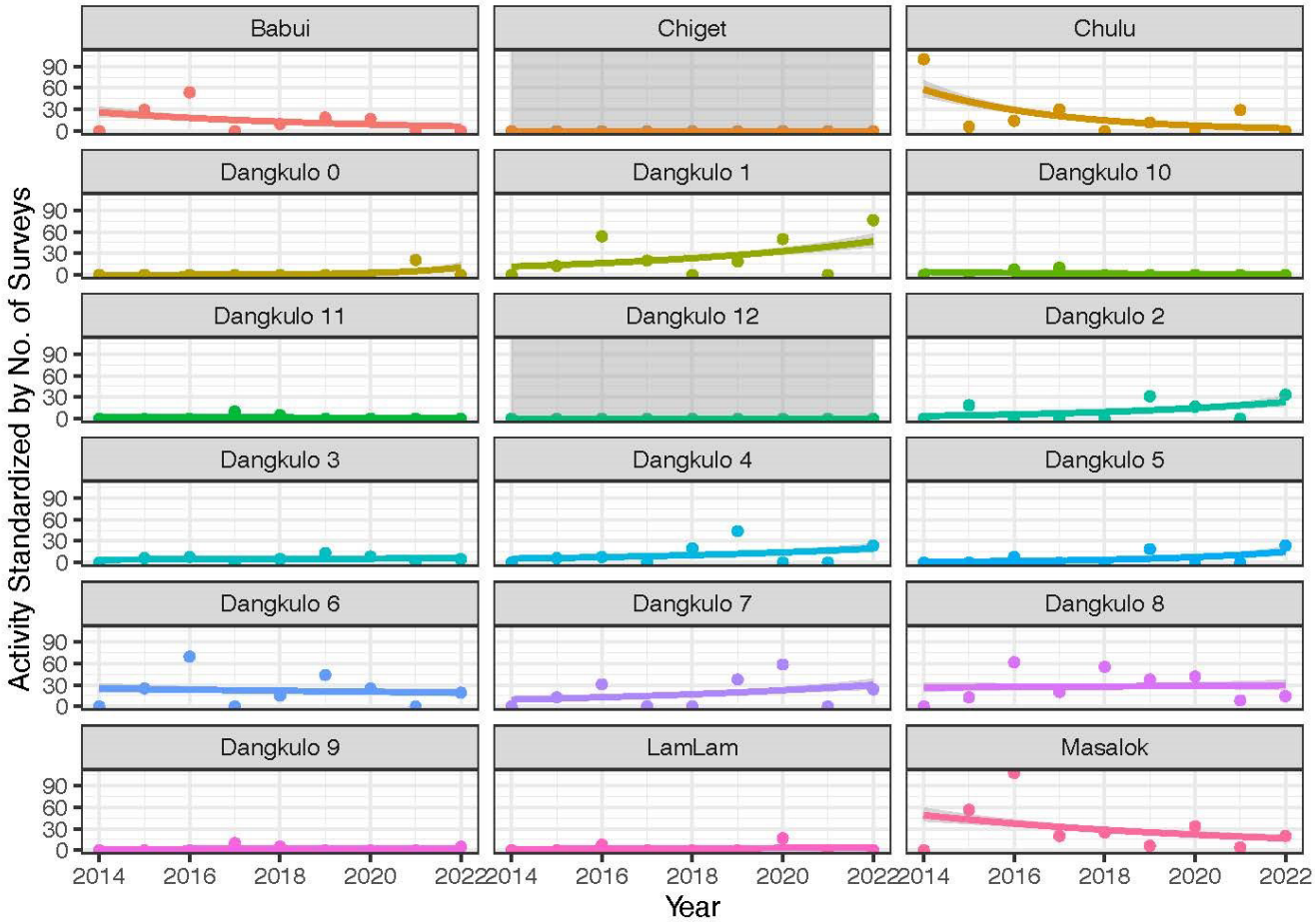

Figure 16. Tinian MLA Green Sea Turtle nesting activity comparison by beach, 2014 - 2022

Conservation of Tinian *Cycas micronesica*

Location: Tinian MLA **Period of Performance**: FEB2023 - Ongoing

Project Objective

To conserve representative plants of Micronesian cycad (*Cycas micronesica*) populations from Guam.

Conservation Benefit

Micronesian cycads on Tinian provide an assurance population which enhances species resiliency to catastrophic events. The Tinian population is suitable for cycad studies and testing of new management strategies.

FY23 Status

- New Cooperator (CEMML) as of February 2023; monthly monitoring and management ongoing.
- As of June 2023, 184 live plants in plots; 60 plants with cycad scale
- 33 ornamentals at 6 sites; 6 plants with cycad scale at 2 sites (Army Hospital and North Field)
- First record of a cycad scale predator on Tinian, February 2023
- UOG Final report “Cycad Monitoring and Management on Joint Region Marianas Area of Responsibility-Tinian Military Lease Area”, January 2023
- NAVFAC in-house report “Status of Ornamental Fadang on the Tinian Military Lease Area”, December 2022

EPR: 1 CP MAR Conservation Management of Tinian Cycads; 61128NR162

2019 JRM INRMP Reference: TPS-1; 11-64

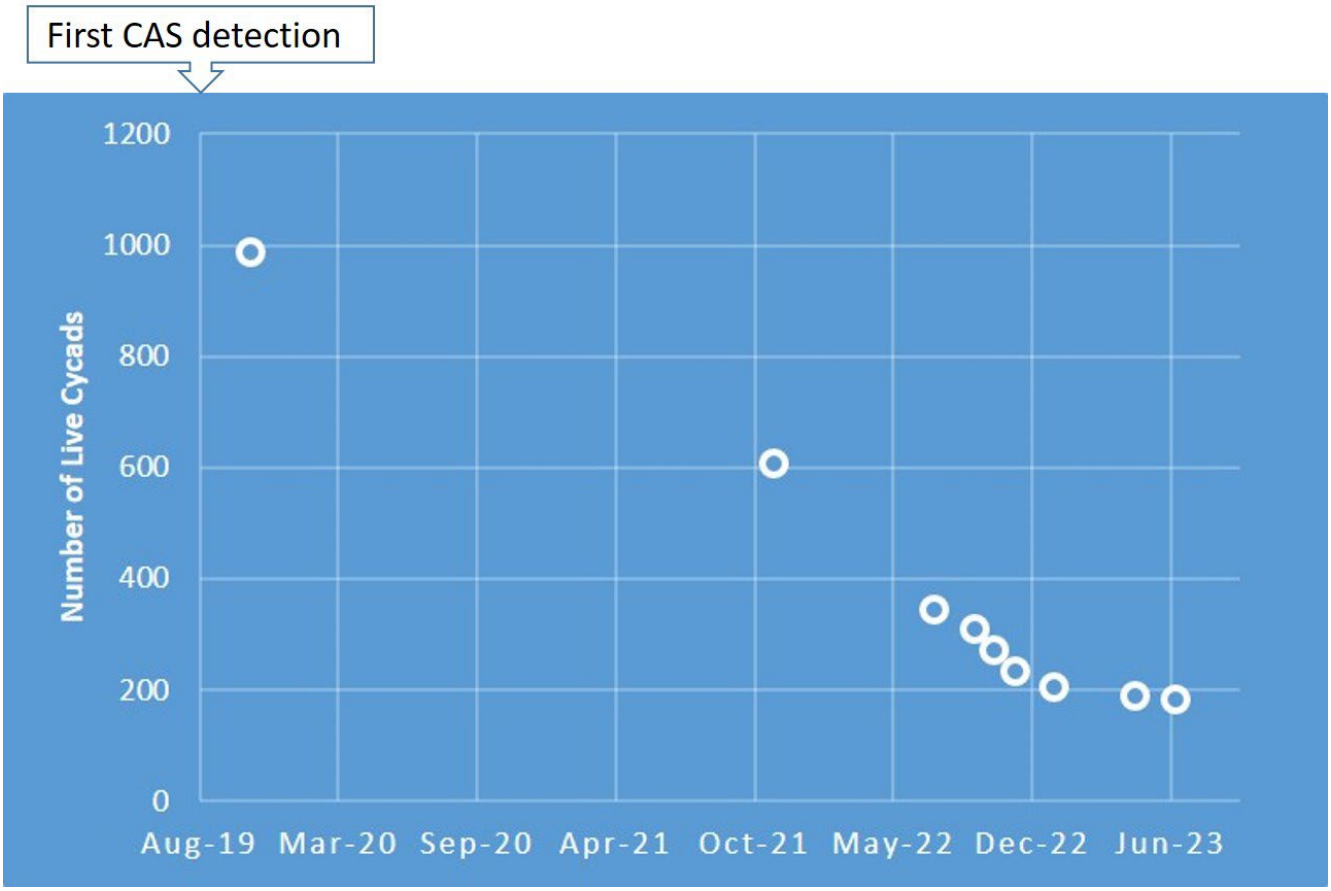

Figure 17. Decline in the number of live Micronesian cycads in the Tinian MLA plots since arrival of cycad Aulacaspis scale.

Forest Enhancement

Location: Tinian MLA **Period of Performance**: AUG2023 - Ongoing

Project Objective

To enhance and restore native forest habitat on Tinian to benefit native flora and fauna including the Tinian monarch and protected species.

Conservation Benefit

Forest restoration and enhancement is an ecosystem-level approach that creates habitat to directly benefit native limestone forest-associated species.

FY23 Status

- Cooperative Agreement awarded to University of Washington in August 2023

EPR: SIKES MAR NBG Tinian Native Forest Enhancement for Listed Species – Climate; 61755NR839

2019 JRM INRMP Reference: THM-1; 11-61

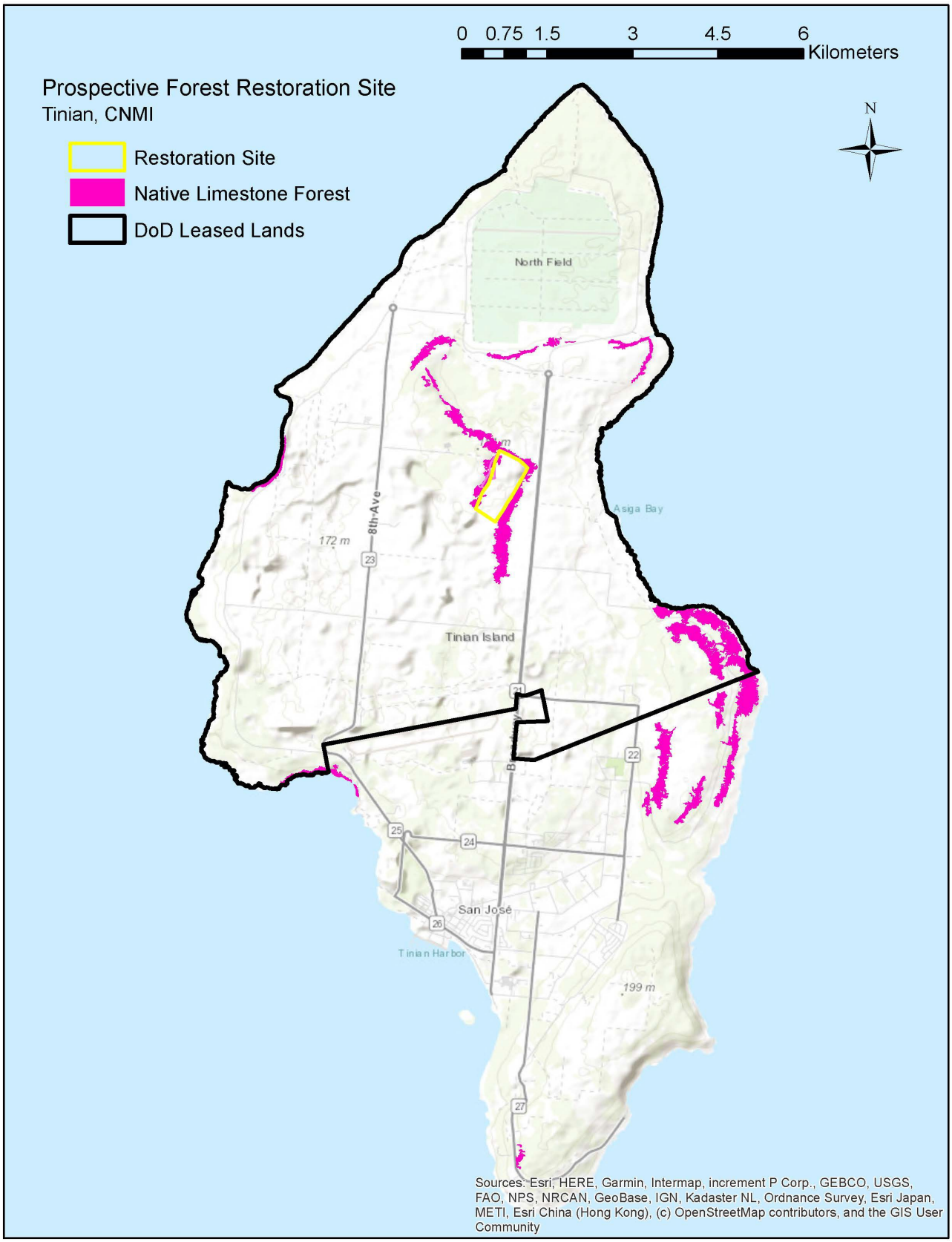

Figure 18. Prospective Forest Restoration Site, Tinian MLA. Final project boundary TBD.

MIGRATORY BIRD MANAGEMENT

Monitoring of MBTA-Listed Bird Species

Location: FDM **Period of Performance**: OCT2022 – SEP2023

Project Objective

To monitor the distribution and abundance of MBTA-listed birds on FDM.

Conservation Benefit

Interactions between training activities and MBTA-listed birds can be minimized.

FY23 Status

- Ground-based counts conducted from three survey stations, May 2023
- Count Totals: Masked Booby, 90; Brown Booby, 123; Red-footed Booby, 147

EPR: 1 RP MAR CNMI ESA and MBTA Species Management; 61128NR211

2019 JRM INRMP Reference: MIG-1; 12-35

Table 2. MBTA-listed bird species and breeding status observed on FDM, May 31, 2023

Species	Evidence of Breeding
Brown noddy	Y
Black noddy	Y
White tern	N
Sooty tern	Y
White-tailed tropicbird	N
Masked booby	Y
Brown booby	Y
Red-footed booby	Y



Figure 19. masked booby eggs (right) and masked booby adult with chick (left).

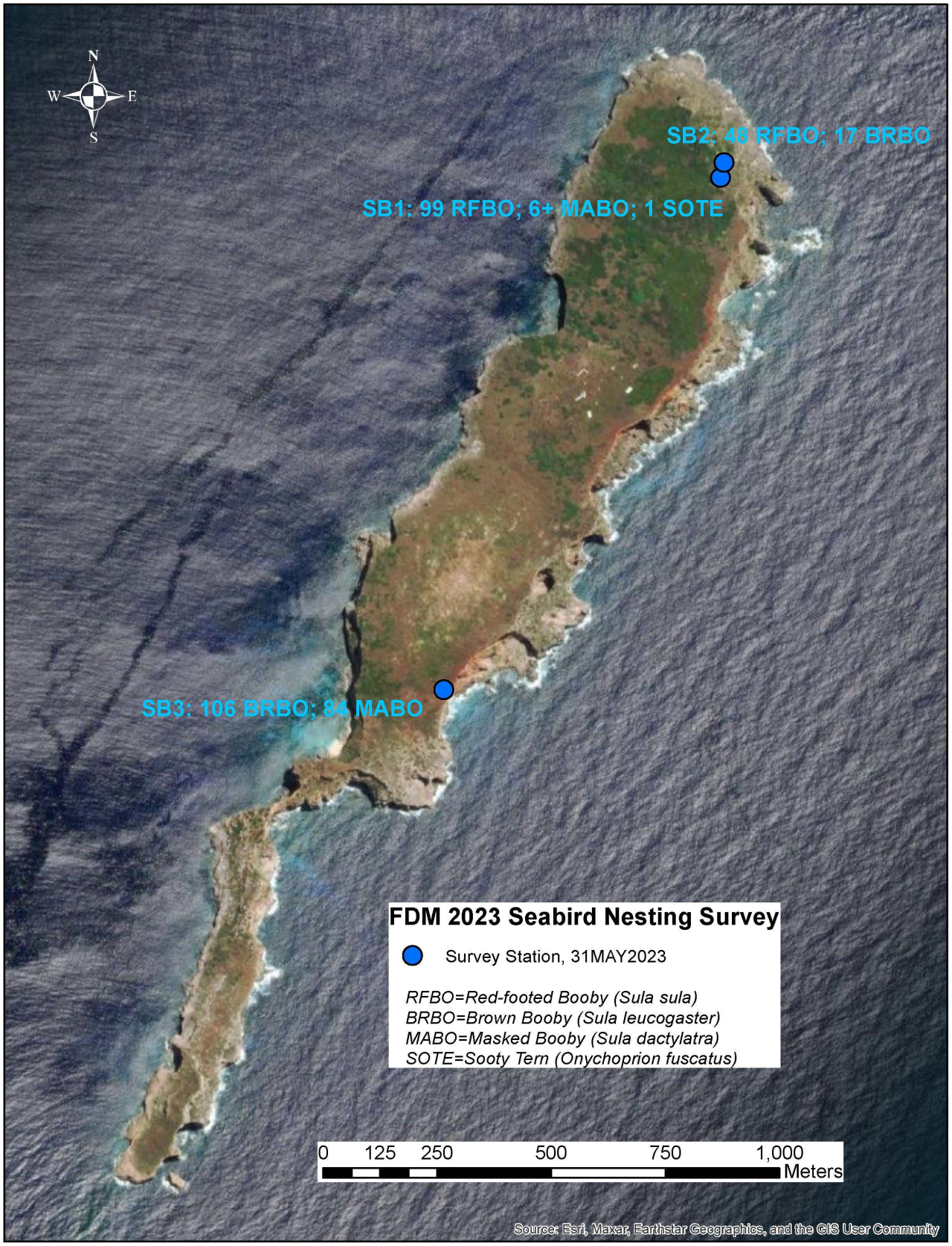

Figure 20. FDM seabird survey stations and adult counts, May 31, 2023. Stations SB1 (looking northeast) and SB2 (looking southwest) survey discrete areas.

TERRESTRIAL NATURAL RESOURCES LAW ENFORCEMENT

Conservation Law Enforcement Program

Location: Guam; Tinian MLA **Period of Performance**: AUG2023 - Ongoing

Project Objective

To establish a conservation law enforcement program for JRM Guam installations and the Tinian MLA.

Conservation Benefit

A conservation law enforcement program will detect and deter unauthorized activity that negatively affects natural resources (terrestrial and marine) on JRM Guam installations and the Tinian MLA.

FY23 Status

- Contract for needs assessment awarded AUG2023

EPR: SIKES MAR JRM Conservation Law Enforcement Program; 61128NR589

2019 JRM INRMP Reference: TLAW-1; 11-69

NATURAL RESOURCES EDUCATION AND OUTREACH

JRM Natural Resources Stewardship Outreach & Public Engagement Program

Location: JRM **Period of Performance**: AUG2022 - Ongoing

Project Objective

To develop outreach products to effectively and efficiently implement a natural resources (NR) stewardship engagement program. This program aims to better educate uniformed and civilian staff, their dependents, JRM contractors, and the general public in order to improve NR stewardship and awareness within JRM AOR.

Conservation Benefit

The development and production of NR education materials and training is a beneficial support to increasing awareness of Threatened and Endangered species, proper stewardship behavior, and threats to local ecosystems.

FY23 Status

- Closed FY2022 CESU with Micronesian Conservation Coalition
    - Final report available
- New CESU Awarded AUG2023 to UOG SeaGrant
    - Continuing production of Environmental Stewardship Website
    - Continuing production of outreach swag items to support Tinian Art Contest and Turtle Educational Outreach Project

EPR: 61128NR962 JRM Natural Resources Stewardship Outreach and Public Engagement Program

2019 JRM INRMP Reference: TEDU-1; 5-91, MEDU-1; 5-104

PACFLT Funded JRM Natural Resources Stewardship Outreach & Public Engagement Program

Location: JRM **Period of Performance:** SEP2020 - Ongoing

Project Objective

Improve NR stewardship and awareness within JRM AOR.

Conservation Benefit

The development and production of NR education materials and training is a beneficial support to increasing awareness of T&E species, proper stewardship behavior, and threats to local ecosystems.

FY23 Status

- Ongoing implementation and expansion of Young Environmental Stewards (YES!) youth educational program
- Ongoing CNMI outreach initiative in conjunction with EPR 61128NR962 JRM Natural Resources Stewardship Outreach and Public Engagement Program
- Native Terrestrial Species and Migratory Bird Nature Journals and Passports delivered OCT2022
- Final version of Invasive Terrestrial Nature Journal and Passport approved JUL2023, currently in production
- Marine Invasive Species Nature Journal and Passport in draft review
- Ongoing development of sea turtle interactive classroom game

EPR: NA- Funding from PACFLT Stewards of the Sea Initiative

2019 JRM INRMP Reference: TEDU-1; 5-91, MEDU-1; 5-104



Figure 21. Native Terrestrial Species of the Marianas Islands Nature Journal (left) and Passport (right) with Guam Rail species tote bag

Horeg, Jennifer A CIV USN NAVFAC MARIANAS GU (USA)

From: Horeg, Jennifer A CIV USN NAVFAC MARIANAS GU (USA)
Sent: Friday, May 19, 2023 8:41 AM
To: Flores, Jacqueline B; Mizerek, Toni L; Arlene Pangelinan; Kevin Brindock - NOAA Federal; Joel Moribe - NOAA Federal; Jonathan Brown - NOAA Federal; Steven McKagan - NOAA Federal; jay.gutierrez@doag.guam.gov; Manny M. Pangelinan; sylvan.o.igisomar@gmail.com; Bogardus, Michelle; Campbell, Earl W
Cc: Lujan, Dana T CIV USN NAVFAC MARIANAS GU (USA); Salas, John F CIV USN NAVFAC MARIANAS GU (USA); Moon, Edward E CIV USN NAVFAC MARIANAS GU (USA); 'Borja, ALBERT (CAMP BLAZ USMC)'; Cruz, Mark D CIV USN COMJTREG MARIANAS GU (USA); Burrell, Noah S CIV USN NAVFAC MARIANAS GU (USA); Conkle, Tamara S CIV NAVFAC HQ, EV; Mayes, Thomas A CIV USN COMNAVFACENGCOM DC (USA); Gardner, Jeffrey A CIV USN COMNAVFACENGCOM DC (USA); Watterson, James C (Carter) CIV USN NAVFAC LANT NOR VA (USA); Podbesek, Jennifer A CIV USN DCNO N4 (USA); Torres, Barbara F CIV USN NAVFAC FE YOKO JA (USA); Plunkett, Joseph C LT USN INDOPACOM PCJ5 (USA); daniel.aquino@gov.mp; Parker, Megan A CIV USN NAVFAC MARIANAS GU (USA)
Subject: FY23 Joint Region Marianas Natural Resources Metrics - September 2023

Hafa Adai Resource Partners,

I would like to kindly request your participation in the FY23 Joint Region Marianas Natural Resource Metrics meetings. We will be holding in-person meetings on the following dates:

14 Sep: CNMI
20-21 Sep: Guam

More information regarding the venues and agenda will be provided as we get closer to the meeting dates.

Please mark your calendars and have a great summer!

Best,

Jennifer Cruce Horeg
Natural Resources Program Supervisor / Section 7 Lead
Naval Facilities Engineering Systems Command Marianas (NAVFACMAR)
jennifer.a.horeg.civ@us.navy.mil
Office: 671-339-1275
Cell: (671) 487-2040

FY23 JRM INRMP GUAM METRICS MEETING
Wednesday, September 20, 2023
Guam Hyatt Regency

NAME	EMAIL	PHONE	AFFILIATION
Dawn Bruns	dawn-bruns@fws.gov	808-927-4602	USFish + Wildlife Service
Patrick Keeler	patrick.keeler@tnc.org	685-1394	TNC - SENTINEL
Noah Burnell	noah.s.burnell.civ@us.navy.mil	671-339-5310	NAVFAC MAR
Shayna Lopez	shayna.j.lopez.civ@us.navy	671-483-0060	NAVFAC MAR
Anthony Tornito	anthony.tornito@doag.guam.gov	671-734-3151	DOAG DAWR
Megan Volsteadt	megan.volsteadt.doag.guam.gov	671-686-6562	DAWR
Tomona Lapitan	tomona.lapitan@doag.guam.gov	671-487-1649	DAWR
Jeff Quitugua	jeffrey.quitugua@doag.guam.gov	671-7350279	DAWR
Jackie Flores	jacqueline.flores@fws.gov	671 787 6094	USFWS
Laura Gombar	lauraalexandra-gombar@fws.gov	671 787 3819	USFWS
Laura Duenas	laura irene-duenas@fws.gov	671-	USFWS
JEROME PEREZ	jerome.perez@usmc.mil	671-788-7425	NAVFAC MAR. CAMP BLAZ
A. Loerzel	adrienne.loerzel@usmc.mil	671-688-6877	Camp Blaz
Nicole Imamura	nikki_imamura@fws.gov	671-488-6035	USFWS
Tony Montgomery	Tony_Montgomery@fws.gov	808-792-9456	USFWS
Trey Dunn	William_Dunn@FWS.GOV	670 287 8076	USFWS
Brent Tibbett	brent.tibbett@gmail.com	671-787-5857	DAWR
Kevin Brindock	Kevin.Brindock@noaa.gov	808-725-5146	NOAA
Leanne Obra	~~obra~~ Leanne.e.obra@usmil	349-5124	NAVFAC MAR
Anjelica Perez	anjelicaclaire.u.perez.civ	339-7281	NAVFAC MAR
Michelle Bogardus	Michelle_Bogardus@fws.gov	808-792-9473	USFWS
James Kwon	James_Kwon@fws.gov	808-210-6126	USFWS
MARIO MARTINEZ	mario.martinez@fe.navy.mil	671-685-5610	NAVFAC MAR
Scott Vogt	scott.vogt.1@us.af.mil	671 366 2557	NAVFAC AAFB
STEPHEN MOSHER	stephen.m.mosher.civ@us.navy.mil	671-349-2349	NAVFAC MAR
Megan Parker	megan.a.parker11.civ@us.navy.mil	3592344	" "
Jay Gutierrez			DOAG DAWR

FY23 JRM INRMP GUAM METRICS MEETING
Wednesday, September 20, 2023
Guam Hyatt Regency

NAME	EMAIL	PHONE	AFFILIATION
Zerlene Cruz		339-2587	NavFac
Diane Vie			DAWR
Jason Biggs			DAWR
Andrew Kang			DAWR
Frank Roberto			DAWR
Leilani Duenas			DAWR

FY23 JRM INRMP GUAM METRICS MEETING
Thursday, September 21, 2023
Guam Hyatt Regency

NAME	EMAIL	PHONE	AFFILIATION
Christine C. Fejeran	christine.fejeran@doag.guam.gov	671-300-7976	DOAG-FSRD
Shaeka Toreyama	shaeka.toreyama@usmc.mil		Camp Blaz
Shayna Lopez	shayna.j.lopez@usnavy.mil		NAVFAC MAR
Nikki Winner	Nikki.Winner@usmc.mil		Camp Blaz
Trischica Perez	GAL	671-339-7281	NAVFAC MAR NBG
Leanne Obra	Leanne.e.Obra@fe.navy.mil	349-3612	NAVFAC MAR
Laura Gombar	lauraalexandra_gombar@fws.gov	671-787-3819	USFWS
MARIO MARTINEZ	mario.martinez@fe.navy.mil	671 685 5610	NAVFAC MAR
Matthew D. Burt	matthew.burt.4@us.af.mil	671 366-4077	NAVFAC MAR
Megan Valstead	megan.valstead@doag.guam.gov	671-606-4562	DAWR
Jacqueline Flores	jacqueline.flores@fws.gov	671-787-6094	USFWS
Michelle Bogardus	Michelle_Bogardus@fws.gov	808-792-9400	FWS
Tony Montgomery	Tony_Montgomery@fws.gov	808-792-9407	US FWS
Nikki Imamura	nikki_imamura@fws.gov	671-488-6035	USFWS
Ruddy Estoy	ruddy.estoy@doag.guam.gov	671-300-7975	DOAG-FSRD
Trey Duna	william_Duna@FWS.GOV	670 2878076	USFWS
Zerlene Cruz	zerlene.cruz.civ@us.navy.mil	339-2578	NavFac
Andrew Kang		988-5934	DAWR
Jason Biggs			DAWR
Laura Duenes	lauraivon_duenes@fws.gov		USFWS
Dawn Bruns	dawn_bruns@fws.gov	808 927 4602	USFWS

FY23 JRM INRMP CNMI METRICS MEETING

14-Sep-23

Hyatt Chamolinian Room

NAME	EMAIL	PHONE	AFFILIATION
Trey Dunn	William_Dunn@fws.gov	670 287 8076	USFWS
Steve Mullin	Stephen.m.mullin.civ@us.navy.mil	670-285-9482	NAVFAC EV2V
Chuck Wheeler	chuck.wheeler@[illegible]pcoa.gov		NMFS
Laura Gombar	laura.alexandria.gombar@fws.gov		USFWS
Pangelinan Marvin			DFW
Dawn Bruns	dawn_bruns@fws.gov	(808) 927-4602	US Fish + Wildlife Service
Brad Eichelberger	beichelberger.cnmi.dfw@gmail.com	664-6004	DFW
Ellie Roark	ellieroark@gmail.com	287 6241	DFW
Jacque Rice	jacqueline.rice@usnam	5712562796	HQMC
Nikki Imamura	nikki_imamura@fws.gov	671-488-6035	USFWS
Tyler Willsey	tyler_willsey@fws.gov	670-488-8151	USFWS

Appendix E
Species Presence and Associations on Joint Region Marianas Lands and within Associated Nearshore Waters: Guam and Commonwealth of the Northern Mariana Islands

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APPENDIX E

Species Presence and Associations on Joint Region Marianas Lands and within Associated Nearshore Waters: Guam and Commonwealth of the Northern Mariana Islands

E.1 – Mammals

Table E.1-1. Mammals Recorded on JRM Sites and within Nearshore Waters

Common Name(s)/ Chamorro Name	*Scientific Name*	*Federal Status*	*Guam Status*	*CNMI Status*	*Island*	*Origin*	*Occurrence*
Terrestrial							
Domestic cattle/Guaka	*Bos taurus*	--	--	--	Guam Tinian	Nn	Y
Asiatic water buffalo/ Karabao*	*Bubalus bubalis*	--	--	--	Guam	Nn	Y
Feral dog/Galagon machalek	*Canis lupus familiaris*	--	--	--	Guam Tinian	Nn	Y
Feral goat/Chiban machalek	*Capra hircus*	--	--	--	Guam Tinian	Nn	Y
Pacific sheath-tailed bat/ Fanihi	*Emballonura semicaudata rotensis*	E	--	--	Guam Tinian	N	Ex
Feral cat/Katon machalek	*Felis catus*	--	--	--	Guam Tinian	Nn	Y
House mouse/Chakan dikiki	*Mus musculus*	--	--	--	Guam Tinian	Nn	Y
Mariana fruit bat/Fanihi	*Pteropus mariannus mariannus*	T	E, SOGCN	T-E, SOGCN	Guam Tinian FDM	N	Y
Little Mariana fruit bat/ Fanihi	*Pteropus tokudae*	--	E	--	Guam	N	Ex
Polynesian rat or Pacific rat/ Chaka	*Rattus exulans*	--	--	--	Guam	Nn	Y
Norway rat/Chaka yomson	*Rattus norvegicus*	--	--	--	Guam Tinian	Nn	Y
Black rat or roof rat/ Chakan yomson	*Rattus rattus*	--	--	--	Guam Tinian	Nn	Y
Asian house rat/Chaka	*Rattus tanezumi*	--	--	--	Guam Tinian	Nn Nn	Y
Phillipine deer/Binadu	*Rusa marianna*	--	--	--	Guam Tinian	Nn	Y
Asian house shrew or musk shrew/Chaka akaleha	*Suncus murinus*	--	--	--	Guam Tinian	Nn	Y
Feral pig/Babuen halumtano	*Sus scrofa*	--	--	--	Guam	Nn	Y
Marine							
Common minke whale/ Salungai or Bayena	*Balaenoptera acutorostrata*	MMPA	--	--	Guam Tinian FDM	N	Y Y PU
Sei whale/Salungai or Bayena	*Balaenoptera borealis*	E, D-MMPA	SOGCN	--	Guam Tinian FDM	N	Y
Bryde's whale/Salungai or Bayena	*Balaenoptera edeni*	MMPA	SOGCN	--	Guam Tinian FDM	N	Y Y PU

Table E.1-1. Mammals Recorded on JRM Sites and within Nearshore Waters

Common Name(s)/ Chamorro Name	*Scientific Name*	*Federal Status*	*Guam Status*	*CNMI Status*	*Island*	*Origin*	*Occurrence*
Blue whale/Salungai or Bayena	*Balaenoptera musculus*	E, D-MMPA	--	--	Tinian FDM	N	P Y
Fin whale/Salungai or Bayena	*Balaenoptera physalus*	E, D-MMPA	--	--	Guam Tinian FDM	N	P Y Y
Pygmy killer whale/ Salungai or Bayena	*Feresa attenuata*	MMPA	--	--	Guam Tinian FDM	N	Y Y P
Short-finned pilot whale/ Salungai or Bayena	*Globicephala macrorhynchus*	MMPA	SOGCN	--	Guam Tinian FDM	N	Y
Risso's dolphin/Tuninos	*Grampus griseus*	MMPA	SOGCN	--	Guam Tinian FDM	N	Y Y P
Pygmy sperm whale/ Salungai or Bayena	*Kogia breviceps*	MMPA	SOGCN	--	Tinian	N	Y
Dwarf sperm whale/ Salungai or Bayena	*Kogia sima*	MMPA	SOGCN	--	Guam Tinian FDM	N	Y
Humpback whale/ Salungai or Bayena	*Megaptera novaeangliae*	E[(1)], D-MMPA	SOGCN	--	Guam Tinian FDM	N	Y
Blainville's beaked whale/ Salungai or Bayena	*Mesoplodon densirostris*	MMPA	--	--	Guam Tinian FDM	N	Y Y P
Killer whale/Salungai or Bayena	*Orcinus orca*	MMPA	SOGCN	--	Guam Tinian FDM	N	Y Y PU
Melon-headed whale/ Salungai or Bayena	*Peponocephala electra*	MMPA	SOGCN	--	Guam Tinian FDM	N	Y
Sperm whale/Salungai or Bayena	*Physeter macrocephalus*	E, D-MMPA	SOGCN	--	Guam Tinian FDM	N	Y
False killer whale/Salungai or Bayena	*Pseudorca crassidens*	MMPA	--	--	Guam Tinian FDM	N	Y
Pantropical spotted dolphin/ Tuninos	*Stenella attenuata*	D-MMPA	--	--	Guam Tinian FDM	N	Y
Striped dolphin/Tuninos	*Stenella coeruleolba*	MMPA	SOGCN	--	Guam Tinian	N	Y
Spinner dolphin/Tuninos	*Stenella longirostris*	MMPA	SOGCN	SOGCN	Guam Tinian FDM	N	Y
Rough-toothed dolphin/ Tuninos	*Steno bredanensis*	MMPA	--	--	Guam Tinian FDM	N	Y Y P

Table E.1-1. Mammals Recorded on JRM Sites and within Nearshore Waters

Common Name(s)/ Chamorro Name	*Scientific Name*	*Federal Status*	*Guam Status*	*CNMI Status*	*Island*	*Origin*	*Occurrence*
Common bottlenose dolphin/Tuninos	*Tursiops truncatus*	MMPA	--	--	Guam Tinian FDM	N	Y
Cuvier's beaked whale/ Tuninos	*Ziphius cavirostris*	MMPA	SOGCN	--	Guam Tinian FDM	N	Y Y P

Notes: Chamorro names from Government of Guam (GovGuam) (2009), Liske-Clark (2015), U.S. Fish and Wildlife Service (2015).

Key: Name

*The Chamorro alphabet does not recognize the letter 'C'. *Carabao is the English common name for the Asiatic Water Buffalo, spelled as 'Karabao' in Chamorro. Chamorro names from GovGuam (2009), Liske-Clark (2015), USFWS (2015).

Status (Federal, GovGuam, and Commonwealth of the Norther Marianas Islands [CNMI])

-- = not listed; E = listed as endangered under the federal Endangered Species Act (ESA) or by GovGuam; T = listed as threatened under the ESA or by GovGuam; T-E = listed as threatened/endangered by CNMI government; D-MMPA = listed as depleted under the Marine Mammal Protection Act; SOGCN = listed as Species of Greatest Conservation Need by GovGuam or CNMI Government.

Origin

N = native; Nn = non-native, introduced; V = vagrant.

Occurrence

-- = Not possible due to absence of habitat/food resources; Y = yes, known to occur; P = potential for occurrence; PU = potential for occurrence, but unlikely; Ex = extirpated.

Occurrences are approximated to Joint Region Marianas (JRM)-administered submerged lands, but some fishery-based and acoustic-based records have imprecise locations.

(1)Humpback whale Western North Pacific Distinct Population Segment (DPS).

Sources: Guam Division of Aquatic and Wildlife Resource (Guam DAWR) 2006; GovGuam 2009; USAF 2009; USFWS 2009d, 2011a; DON 2010a, 2010b, 2014a; NAVFAC Pacific 2010b, 2014a; CNMI Government 2014; Liske-Clark 2015; Klinck et al. 2015, 2016; Oleson et al. 2015; Martin et al. 2016.

E.2 – Birds

Table E.2-1. Birds Observed on JRM Sites

*Common Name(s)/ Chamorro Name**	*Scientific Name**	*Federal Status*	*Guam Status*	*CNMI Status*	*Island*	*Origin*	*Occurrence*
Accipitridae							
Chinese sparrowhawk/ None	*Accipiter soloensis*	MBTA	--	--	Tinian	V	PU
Black kite/None	*Milvus migrans*	MBTA	--	--	Guam Tinian	M	Y
Acrocephalidae							
Nightingale reed-warbler/ Gaga karisu	*Acrocephalus luscinia*	E	--	T-E	Guam	N	Ex
Alcedinidae							
Guam Micronesian kingfisher/Sihek	*Todiramphus c. cinnamominus*	E, MBTA	E, SOGCN	--	Guam	N	Ex, Cap
Mariana kingfisher/Sihek	*Todiramphus albicilla*	MBTA	--	SOGCN	Tinian	N	Y
Anatidae							
Northern pintail/None	*Anas acuta*	MBTA	--	--	Guam Tinian	M	Y
Northern shoveler/None	*Anas clypeata*	MBTA	--	--	Guam Tinian	M	Y
Green-winged teal/None	*Anas carolinensis*	MBTA	--	--	Guam Tinian	M	Y
Eurasian wigeon/None	*Anas penelope*	MBTA	--	--	Guam Tinian	M	Y
Garganey/None	*Anas querquedula*	MBTA	--	--	Guam Tinian	M	Y
Gadwall/None	*Anas strepera*	MBTA	--	--	Guam Tinian	M	Y
Common pochard/None	*Aythya ferina*	MBTA	--	--	Guam	V	PU
Tufted duck/None	*Aythya fuligula*	MBTA	--	--	Guam Tinian	M	Y
Tundra swan/None	*Cygnus columbianus*	MBTA	--	--	Tinian	V	PU
Apodidae							
Mariana swiftlet/ Chachaguak or Yayaguak or Payesyes	*Aerodramus bartschi*	E, MBTA	E, SOGCN	T-E, SOGCN	Guam Tinian	N	Y Ex
Fork-tailed swift/None	*Apus pacificus*	MBTA	--	--	Guam FDM	M	Y
Ardeidae							
Great egret/Chuchuko	*Ardea alba*	MBTA			Guam	M	Y
Grey heron/Chuchuko	*Ardea cinerea*	MBTA	--	--	Guam	V	PU
Chinese pond heron/ Chuchuko	*Ardeola bacchus*	MBTA	--	--	Guam	V	PU
Eastern cattle egret/ Chuchuko	*Bubulcus coromandus*	MBTA	--	--	Guam Tinian FDM	M	Y
Cattle egret/Chuchuko	*Bubulcus ibis*	--	--	--	Guam Tinian	Nn	Y
Green heron/Chuchuko	*Butorides virescens*	MBTA	--	--	Guam	M	Y
Intermediate egret/ Chuchuko	*Egretta intermedia*	MBTA	--	--	Guam Tinian	M	Y
Little egret/Chuchuko	*Egretta garzetta*	MBTA	--	--	Guam	M	Y

Table E.2-1. Birds Observed on JRM Sites

*Common Name(s)/ Chamorro Name**	*Scientific Name**	*Federal Status*	*Guam Status*	*CNMI Status*	*Island*	*Origin*	*Occurrence*
Pacific reef heron, reef egret/Chuchuko atilong	*Egretta sacra*	MBTA	SOGCN	--	Guam Tinian FDM	N	Y
Yellow bittern/Kakkak	*Ixobrychus sinensis*	MBTA	--	--	Guam Tinian	N	Y
Black-crowned night-heron/None	*Nycticorax nycticorax*	MBTA	--	--	Guam Tinian	M	Y
Charadriidae							
Lesser sand plover, Mongolian plover/Dulili	*Charadrius mongolus*	MBTA	SOGCN	--	Guam Tinian	M	Y
Pacific golden plover/Dulili	*Pluvialis fulva*	MBTA	SOGCN	--	Guam Tinian FDM	M	Y
Grey plover/Dulili	*Pluvialis squatarola*	MBTA	SOGCN	--	Guam	M	Y
Corvidae							
Mariana Crow/Aga	*Corvus kubaryi*	E, MBTA	E	T-E	Guam	N	Ex
Columbidae							
Rock dove/None	*Columba livia*	--	--	--	Guam Tinian	Nn	Y
White-throated ground dove/Paluman apaka (male) and Paluman fache (female)	*Alopecoenas xanthonurus*	MBTA	E, SOGCN	SOGCN	Guam Tinian FDM	N	PU Y Y
Mariana fruit dove/ Paluman totot	*Ptilinopus roseicapilla*	MBTA	E, SOGCN	SOGCN	Guam Tinian FDM	N	Ex Y Y
Island collared dove/Palumat	*Streptopelia bitorquata*	--	--	--	Guam Tinian FDM	Nn	Y
Dicruridae							
Black drongo/Salin Taiwan	*Dicrurus macrocercus*	--	--	--	Guam	Nn	Y
Emberizidae							
Eurasian tree sparrow/ Gagapale	*Passer montanus*	--	--	--	Guam Tinian FDM	Nn	Y
Estrildidae							
Orange-cheeked waxbill/None	*Estrilda melpoda*	--	--	--	Tinian	Nn	P
Fregatidae							
Great frigatebird/Payaya	*Fregata minor*	MBTA	--	SOGCN	Guam Tinian FDM	N	Ex
Hirundinidae							
Barn swallow/None	*Hirundo rustica*	MBTA	--	--	Guam Tinian	M	Y
Laridae							
Black noddy/Fahang dikiki	*Anous minutus*	MBTA	--	--	Guam Tinian FDM	N	Y
Brown noddy/ Fahang dankolo	*Anous stolidus*	MBTA	--	--	Guam Tinian FDM	N	Y
Whiskered tern/Chunge	*Chlidonias hybrida*	MBTA	--	--	Tinian	M	Y

Table E.2-1. Birds Observed on JRM Sites

*Common Name(s)/ Chamorro Name**	*Scientific Name**	*Federal Status*	*Guam Status*	*CNMI Status*	*Island*	*Origin*	*Occurrence*
White-winged tern/Chunge	*Chlidonias leucopterus*	MBTA	--	--	Guam Tinian	M	Y
Black-headed gull/None	*Chroicocephalus ridibundus*	MBTA	--	--	Guam	M	Y
White tern/Chunge	*Gygis alba*	MBTA	--	--	Guam Tinian FDM	N	Y
Sooty tern/Giree girak	*Onychoprion fuscatus*	MBTA	--	--	Guam Tinian FDM	M	Y
Spectacled tern/Chunge	*Onychoprion lunatus*	MBTA	--	--	Tinian	M	Y
Common tern/Chunge	*Sterna hirundo*	MBTA	--	--	Guam Tinian	M	Y
Black-naped tern/Chunge	*Sterna sumatrana*	MBTA	--	--	Guam Tinian	M	Y
Greater crested tern/Chunge	*Thalasseus bergii*	MBTA	--	--	Guam	V	PU
Megapodiidae							
Micronesian megapode/ Sasangat	*Megapodius laperouse*	E	--	T-E, SOGCN	Guam Tinian FDM	N	Ex P P
Meliphagidae							
Micronesian myzomela, Micronesian honeyeater/ Egigi	*Myzomela rubratra saffordi*	--	E, SOGCN	SOGCN	Guam Tinian	N	Ex Y
Monarchidae							
Tinian monarch/ Chichurikan	*Monarcha takatsukasae*	--	--	SOGCN	Tinian	N	Y
Motacillidae							
Gray wagtail/None	*Motacilla cinerea*	MBTA	--	--	Guam	V	PU
Phaethontidae							
White-tailed tropicbird/ Fagpi apaka	*Phaethon lepturus*	MBTA	SOGCN	--	Guam Tinian FDM	N	Ex Y Y
Red-tailed tropicbird/Fagpi	*Phaethon rubricauda*	MBTA	--	--	Guam Tinian FDM	N	Y
Phasianidae							
King quail or blue-breasted quail/Bengbeng	*Excalfactoria chinensis*	--	--	--	Guam	Nn	Y
Black francolin/None	*Francolinus francolinus*	--	--	--	Guam	Nn	Y
Red junglefowl/None	*Gallus gallus*	--	--	--	Guam Tinian	Nn	Y
Procellariidae							
Wedge-tailed shearwater/ Lifaru	*Ardenna pacifica*	MBTA	--	SOGCN	Guam FDM	M	Y
Rallidae							
Eurasian coot/None	*Fulica atra*	MBTA	--	--	Tinian	V	PU
Mariana common moorhen/ Pulattat	*Gallinula chloropus guami*	E, MBTA	E, SOGCN	T-E, SOGCN	Guam Tinian	N	Y
Guam rail/Koko	*Gallirallus owstoni*	E	E, SOGCN	--	Guam	N	Ex†, Cap, NEP

Table E.2-1. Birds Observed on JRM Sites

*Common Name(s)/ Chamorro Name**	*Scientific Name**	*Federal Status*	*Guam Status*	*CNMI Status*	*Island*	*Origin*	*Occurrence*
Recurvirostridae							
Black-winged stilt/None	*Himantopus himantopus*	MBTA	--	--	Guam Tinian	M	Y
Rhipiduridae							
Rufous fantail/Chichirika	*Rhipidura rufifrons uraniae*	--	E	SOGCN	Guam Tinian	N	Ex Y
Scolopacidae							
Common sandpiper/Dulili	*Actitis hypoleucos*	MBTA	SOGCN	--	Guam Tinian	M	Y
Ruddy turnstone/Dulili	*Arenaria interpres*	MBTA	SOGCN	--	Guam Tinian FDM	M	Y
Sharp-tailed sandpiper/ Dulili	*Calidris acuminata*	MBTA	SOGCN	--	Guam Tinian	M	Y
Sanderling/Dulili	*Calidris alba*	MBTA	SOGCN	--	Tinian	M	Y
Curlew sandpiper/Dulili	*Calidris ferruginea*	MBTA	SOGCN	--	Guam	V	PU
Pectoral sandpiper/Dulili	*Calidris melanotos*	MBTA	SOGCN	--	Guam	M	Y
Long-toed stint/None	*Calidris subminuta*	MBTA	SOGCN	--	Guam	M	Y
Common snipe/None	*Gallinago gallinago*	MBTA	SOGCN	--	Tinian	M	Y
Swinhoe's snipe/None	*Gallinago megala*	MBTA	SOGCN	--	Tinian	M	Y
Bar-tailed godwit/None	*Limosa lapponica*	MBTA	SOGCN	--	Guam	M	Y
Black-tailed godwit/None	*Limosa limosa*	MBTA	SOGCN	--	Guam	V	PU
Whimbrel/Kalalang	*Numenius phaeopus*	MBTA	SOGCN	--	Guam Tinian FDM	M	Y
Bristle-thighed curlew/ None	*Numenius tahitiensis*	MBTA	SOGCN	--	Guam FDM	M	Y
Ruff/None	*Calidris pugnax*	MBTA	SOGCN	--	Guam	V	PU
Grey-tailed tattler/None	*Tringa brevipes*	MBTA	SOGCN	--	Guam Tinian	M	Y
Spotted redshank/None	*Tringa erythropus*	MBTA	SOGCN	--	Guam	V	PU
Wood sandpiper/Dulili	*Tringa glareola*	MBTA	SOGCN	--	Guam Tinian	M	Y
Wandering tattler/Dulili	*Tringa incana*	MBTA	SOGCN	--	Guam Tinian FDM	M	Y
Common greenshank/None	*Tringa nebularia*	MBTA	SOGCN	--	Guam	M	Y
Marsh sandpiper/None	*Tringa stagnatilis*	MBTA	SOGCN	--	Guam Tinian	M	Y
Common redshank/None	*Tringa totanus*	MBTA	SOGCN	--	Guam	V	PU
Sturnidae							
Micronesian starling/Sali	*Aplonis opaca*	--	E, SOGCN	--	Guam Tinian	N	Y
Sulidae							
Masked booby/ Luao talisai	*Sula dactylatra*	MBTA	--	SOGCN	Guam FDM	N	Y
Brown booby/Luao	*Sula leucogaster*	MBTA	SOGCN	--	Guam Tinian FDM	N	Y

Table E.2-1. Birds Observed on JRM Sites

*Common Name(s)/ Chamorro Name**	*Scientific Name**	*Federal Status*	*Guam Status*	*CNMI Status*	*Island*	*Origin*	*Occurrence*
Red-footed booby/ Luao talisai	*Sula sula*	MBTA	--	--	Guam Tinian FDM	N	Y
Zosteropidae							
Rota white-eye/Nosa luta	*Zosterops rotensis*	E		T-E	CNMI		Y

Notes: *Common and scientific names based on Gill and Donsker (2017). Chamorro names from GovGuam (2009), Liske-Clark (2015), and USFWS (2015).

Key: Status (Federal, GovGuam, and CNMI)
-- = not listed; E = endangered under the federal Endangered Species Act (ESA) or by GovGuam; T = listed as threatened under the ESA or by GovGuam; T-E = listed as threatened/endangered by CNMI government; MBTA = listed under the Migratory Bird Treaty Act; SOGCN = Species of Greatest Conservation Need.
Origin
N = native; Nn = non-native, introduced; M = migratory; V = vagrant.
Occurrence
-- = Not possible due to absence of habitat/food resources; Y = yes, known to occur; P = potential for occurrence; PU = potential for occurrence, but unlikely; Ex = extirpated; †Extirpated from the main island of Guam; only known occurrence is Cocos Island. Cap = occurs in captivity; NEP = non-essential experimental populations (Rota and Cocos Island).

Sources: Hawaiian Agronomics International, Inc. 1985; Reichel and Glass 1991; Stinson et al. 1997a, b; Vogt and Williams 2004; Guam DAWR 2006; GovGuam 2009; Camp et al. 2009, 2012; USAF 2009; DON 2010a, 2010b; 2013a, 2013b; USFWS 2009d, 2011a, 2013; NAVFAC Pacific 2010b, 2014; CNMI Government 2014; Liske-Clark 2015; National Audubon Society 2017.

E.3 – Reptiles and Amphibians

Table E.3-1. Reptiles and Amphibians Observed on JRM Sites and within Nearshore Waters

*Common Name(s)/ Chamorro Name**	*Scientific Name*	*Federal Status*	*Guam Status*	*CNMI Status*	*Island*	*Origin*	*Occurrence*
Bufonidae							
Marine toad/Kairo	*Rhinella marina = Bufo marina*	--	--	--	Guam Tinian	Nn	Y
Cheloniidae							
Loggerhead turtle/Haggan	*Caretta caretta*	E	--	--	Guam Tinian	N	Y PU
Green turtle/Haggan	*Chelonia mydas*	E	T, SOGCN	T-E, SOGCN	Guam Tinian FDM	N	Y
Hawksbill turtle/Haggan karai	*Eretmochelys imbricata*	E	E, SOGCN	T-E, SOGCN	Guam Tinian FDM	N	Y
Olive Ridley turtle/ Haggan	*Lepidochelys olivacea*	E	--	--	Guam Tinian	N	PU
Chelydridae							
Common snapping turtle/Haggan	*Chelydra serpentina*	--	--	--	Guam	Nn	Y
Colubridae							
Brown treesnake/ Kolepbla	*Boiga irregularis*	--	--	--	Guam	Nn	Y
Dermochelyidae							
Leatherback turtle/ Haggan	*Dermochelys coriacea*	E	E	--	Guam Tinian	N	PU
Dicroglossidae							
Crab-eating frog/Kairo	*Fejervarya cancrivora*	--	--	--	Guam	Nn	Y
Grass frog/Kairo	*Fejervarya limnocharis*				Guam	Nn	Y
Eleutherodactylidae							
Greenhouse frog/Kairo	*Eleutherodactylus planirostris*	--	--	--	Guam	Nn	Y
Emydidae							
Three-toed box turtle/ Haggan	*Terrapene carolina triunduis*	--	--	--	Guam	Nn	Y
Red-eared slider turtle/ Haggan	*Trachemys scripta elegans*	--	--	--	Guam	Nn	Y
Gekkonidae							
Oceanic gecko/Achiak	*Gehyra oceanica*	--	E	--	Guam Tinian	N	Ex Y
Mutilating gecko/Achiak	*Gehyra mutilata*	--	--	--	Guam Tinian	N	Y
House gecko/Achiak	*Hemidactylus frenatus*	--	--	--	Guam Tinian	Nn	Y
Mourning gecko/Achiak	*Lepidodactylus lugubris*	--	--	--	Guam Tinian	N	Y
Pacific slender-toed gecko/Achiak	*Nactus pelagicus*	--	E	--	Guam Tinian	N	Y
Micronesian gecko/ Gualiek	*Perochirus ateles*	--	E, SOGCN	T-E, SOGCN	Guam Tinian	N	Y

Table E.3-1. Reptiles and Amphibians Observed on JRM Sites and within Nearshore Waters

*Common Name(s)/ Chamorro Name**	*Scientific Name*	*Federal Status*	*Guam Status*	*CNMI Status*	*Island*	*Origin*	*Occurrence*
Geomydidae							
Chinese three-keeled pond turtle/Haggan	*Mauremys reevesii*	--	--	--	Guam	Nn	Y
Chinese stripe-necked turtle/Haggan	*Mauremys sinensis*	--	--	--	Guam	Nn	Y
Hylidae							
Barking frog/Kaio	*Hyla gratiosa*	--	--	--	Guam	Nn	Y
Eastern dwarf tree frog/Kairo	*Litoria fallax*	--	--	--	Guam	Nn	Y
Pacific chorus frog, Pacific tree frog/Kairo	*Pseudacris regilla*	--	--	--	Guam	Nn	Y
Leptodactylidae							
Coqui frog/Kairo	*Eleutherodactylus coqui*	--	--	--	Guam	Nn	Y
Microhylidae							
Slender-digit chorus frog/Kairo	*Kaloula picta*	--	--	--	Guam	Nn	Y
Malaysian narrowmouth toad/Kairo	*Kaloula pulchra*	--	--	--	Guam	Nn	Y
Marbled pygmy frog/ Kairo	*Microhyla pulchra*	--	--	--	Guam	Nn	Y
Polychrotidae							
Green anole/Gualiek	*Anolis carolinensis*	--	--	--	Guam Tinian	Nn	Y
Ranidae							
Gunther's Amoy frog/Kairo	*Sylvirana guentheri*	--	--	--	Guam	Nn	Y
Rhacophoridae							
Common tree frog, white-lipped tree frog/Kairo	*Polypedates leucomystax*	--	--	--	Guam	Nn	Y
Hong Kong whipping frog/Kairo	*Polypedates braueri*	--	--	--	Guam	Nn	Y
Scincidae							
Curious skink/ Gualiek halumtano	*Carlia ailanpalai*	--	--	--	Guam Tinian	Nn	Y
Snake-eyed skink/ Gualiek halumtano	*Cryptoblepharus poecilopleurus*	--	E, SOGCN	--	Guam Tinian FDM	N	Y
Tide-pool skink/ Gualiek halumtasi	*Emoia atrocostata*	--	E	SOGCN	Guam Tinian	N	Y
Pacific blue-tailed skink/Gualiek halumtano	*Emoia caeruleocauda*	--	--	--	Guam Tinian FDM	N	Y
Azure-tailed skink/ Gualiek halumtano	*Emoia cyanura*	--	E, SOGCN	--	Guam	N	Ex
Slevin's skink/ Gualiek halumtano	*Emoia slevini*	E	E, SOGCN	SOGCN	Guam Tinian	N	Ex† Ex
Emerald skink/ Gualiek halumtano	*Lamprolepis smaragdina*	--	--	--	Tinian	Nn	Y
Moth skink/Gualiek halumtano	*Lipinia noctua*	--	E, SOGCN	--	Guam	N	Y

Table E.3-1. Reptiles and Amphibians Observed on JRM Sites and within Nearshore Waters

*Common Name(s)/ Chamorro Name**	*Scientific Name*	*Federal Status*	*Guam Status*	*CNMI Status*	*Island*	*Origin*	*Occurrence*
Trionychidae							
Chinese soft-shell turtle/Haggan	*Pelodiscus sinensis*	--	--	--	Guam	Nn	Y
Typhlopidae							
Brahminy blind snake/ Ulo attilong	*Ramphotyphlops braminus*	--	--	--	Guam Tinian	Nn	Y
Varanidae							
Monitor lizard/Hilitai	*Varanus indicus*	--	--	--	Guam Tinian	Nat	Y

Notes: *Chamorro names from GovGuam (2009), USFWS (2015), and Kerr (2012).

Key: Status (Federal, GovGuam, and CNMI)
-- = not listed; E = endangered under the federal Endangered Species Act (ESA) or by GovGuam; T = listed as threatened under the ESA or by GovGuam; T-E = listed as threatened/endangered by CNMI government; SOGCN = Species of Greatest Conservation Need.
Origin
N = native; Nn = non-native, introduced; Nat. = Naturalized.
Occurrence
-- = Not possible due to absence of habitat/food resources; Y = yes, known to occur; P = potential for occurrence; PU = potential for occurrence, but unlikely; Ex = extirpated; †Extirpated from the main island of Guam; only known occurrence is Cocos Island.

Sources: Vogt and Williams 2004; Guam DAWR 2006; GovGuam 2009; USFWS 2009d, 2011a, 2014a; NAVFAC Pacific 2010b; CNMI Government 2014; Liske-Clark 2015.

E.4 – Terrestrial Invertebrates

Table E.4-1. Terrestrial Invertebrates Observed on JRM Sites

*Common Name(s)/ Chamorro Name**	*Scientific Name*	*Federal Status*	*Guam Status*	*CNMI Status*	*Island*	*Origin*	*Occurrence*
Crabs							
Coconut crab/Ayuyu	*Birgus latro*	--	--	SOGCN	Guam Tinian	N	Y
Land hermit crab/ Umang	*Coenobita brevimanus*	--	--	--	Guam Tinian	N	Y
Land crab, red-claw crab/Panglao	*Cardisoma carnifex*	--	--	SOGCN	Tinian	N	Y
Land crab/Panglao	*Discoplax hirtipes*	--	--	--	Tinian	N	Y
Mangrove crab/ Panglao	*Scylla serrata*	--	--	--	Guam	N	Y
Flatworms							
New Guinea flatworm/ Tagulan tano	*Platydemus manokwari*	--	--	--	Guam Tinian	Nn	Y
Butterflies (Chamorro = Ababang)							
Brown skipper	*Badamia exclamationis*	--	--	--	Guam	N	Y
Common migrant, lemon emigrant	*Catopsilia pomona*	--	--	--	Guam Tinian	N	Y
Plains cupid or cycad blue	*Luthrodes pandava*	--	--	--	Guam Tinian	Nn	Y
Monarch	*Danaus plexippus*	--	--	--	Guam	N	Y
Banana skipper	*Erionota thrax*	--	--	--	Guam Tinian	Nn	Y
Blue-banded king crow	*Euploea eunice*	--	--	--	Guam Tinian	N	Y
Three-spot grass yellow	*Eurema blanda*	--	--	--	Guam Tinian	N	Y
Guardian or Malaysian eggfly	*Hypolimnas anomala*	--	--	--	Guam Tinian	N	Y
Blue moon or great eggfly	*Hypolimnas bolina*	--	--	--	Guam Tinian	N	Y
Mariana eight-spot butterfly	*Hypolimnas octocula marianensis*	E	--	--	Guam	N	Y
Bean butterfly	*Lampides boeticus*	--	--	--	Guam	N	Y
Common evening brown	*Melanitis leda*	--	--	--	Guam	N	Y
Common mormon or black citrus swallowtail	*Paplio polytes*	--	--	--	Guam Tinian	Nn	Y
Grassdart	*Taractrocera ziclea*	--	--	--	Guam	Nn	Y
Mariana wandering butterfly	*Vagrans egistina*	E	SOGCN	SOGCN	Guam	N	Ex
Lesser grass blue	*Zizina otis*	--	--	--	Guam	N	Y
Tiny grass blue	*Zizula hylax*	--	--	--	Guam	N	Y
Wasps							
Tropical paper wasp/Gonggong	*Polistes stigma*	--	--	--	Guam Tinian	N	Y
Erythrina gall wasps/Gonggong	*Quadrastichus erythrinae*	--	--	--	Guam	Nn	Y
Greater banded hornet/ Gonggong	*Vespa tropica*	--	--	--	Guam	Nn	Y
Other Insects							
Weevil/None	*Acythopeus burkhartorum*	--	--	--	Guam	Nn	Y

Table E.4-1. Terrestrial Invertebrates Observed on JRM Sites

*Common Name(s)/ Chamorro Name**	*Scientific Name*	*Federal Status*	*Guam Status*	*CNMI Status*	*Island*	*Origin*	*Occurrence*
Cycad aulacaspis scale/None	*Aulacaspis yasumatsui*	--	--	--	Guam	Nn	Y
Longhorn beetle/None	*Dihammus marianarum*	--	--	--	Guam	N	Y
Leaf miner/None	*Erechthias* sp.	--	--	--	Guam	Nn	Y
Stem-boring moth/ Babali	*Melittia oedipus*	--	--	--	Guam	Nn	Y
Coconut rhinoceros beetle/None	*Oryctes rhinoceros*	--	--	--	Guam	Nn	Y
Scarab beetle/None	*Protaetia orientalis*	--	--	--	Guam	Nn	Y
Scarab beetle/None	*Protaetia pryeri*	--	--	--	Guam	Nn	Y
Guam karst katydid/None	*Salomona guamensis*	--	--	--	Guam	N	Y
Little fire ant/None	*Wasmannia auropunctata*	--	--	--	Guam	Nn	Y
Land Snails							
Giant African snail/Akaleha	*Achatina fulica*	--	--	--	Guam Tinian	Nn	Y
American lined tree snail/Akaleha	*Drymaeus multilineatus*	--	--	--	Guam	Nn	Y
Rosy wolf snail/ Akaleha	*Euglandina rosea*	--	--	--	Guam Tinian	Nn	Y
None/Akaleha	*Gonaxis* sp.	--	--	--	Guam	Nn	Y
Cinnamon bun snail/ Akaleha	*Satsuma succincta*	--	--	--	Guam	Nn	Y
Tree Snails							
Humped tree snail/Akaleha	*Partula gibba*	E	E, SOGCN	SOGCN	Guam Tinian	N	Y
Lanford's tree snail/ Akaleha	*Partula langfordi*	E			CNMI		P
Guam tree snail/ Akaleha	*Partula radiolata*	E	E, SOGCN	--	Guam	N	Y
Mount Alifan tree snail/Akaleha	*Partula salifana*	--	E	--	Guam	N	Ex
Fragile tree snail/ Akaleha	*Samoana fragilis*	E	E, SOGCN	SOGCN	Guam	N	Y
Cinnamon bun snail/ Akaleha	*Satsuma mercatoria*	--	--	--	Guam	Nn	Y

Notes: [1] Many more species are known from JRM lands, but this table highlights only the species or groups specifically mentioned in regulatory contexts. If JRM projects are developed that differentially affect other specific species, these will be added to the table for planning and tracking.
[2] Chamorro names from GovGuam (2009) and USFWS (2015).

Key: Status (Federal, GovGuam, and CNMI)
-- = not listed; E = endangered under the federal Endangered Species Act (ESA) or by GovGuam; T = listed as threatened under the ESA or by GovGuam; T-E = listed as threatened/endangered by CNMI government; SOGCN = Species of Greatest Conservation Need.
Origin
N = native; Nn = non-native, introduced.
Occurrence
-- = Not possible due to absence of habitat/food resources; Y = yes, known to occur; P = potential for occurrence; PU = potential for occurrence, but unlikely; Ex = extirpated.

Sources: Schreiner and Nafus 1997; UoG 2007; USAF 2009; NAVFAC Pacific 2010b, 2014d; USFWS 2009d, 2014a, 2015; Guam DAWR 2006; GovGuam 2009; CNMI Government 2014; Liske-Clark 2015.

E.5 – Terrestrial Plants

Table E.5-1. Plants Observed on JRM Sites[1]

Common Name(s)/ Chamorro Name[2]	*Scientific Name*	*Federal Status*	*Guam Status*	*CNMI Status*	*Island*	*Origin*	*Occurrence*
Mallow/Matbas	*Abutilon indicum*	--	--	--	Guam Tinian FDM	Nn	Y
Formosan koa/ Sosugi or Boiffuring	*Acacia confusa*	--	--	--	Guam Tinian	Nn	Y
None/None	*Achyranthes canescens*	--	--	--	Guam FDM	N	Y
Golden leather fern, swampfern or marsh fern/Langayao	*Acrostichum aureum*	--	--	--	Guam	N	Y
None/Mapunyao	*Aglaia mariannensis*	--	--	--	Guam Tinian	N	Y
None/Sumak or Suma	*Aidia cochinchinensis*	--	--	--	Guam Tinian	N	Y
Siris tree/Tronkon kalakas	*Albizia lebbeck*	--	--	--	Guam Tinian	Nn	Y
Giant taro/Piga	*Alocasia macrorrhizos*	--	--	--	Guam	Nn	Y
Slender amaranth/None	*Amaranthus viridis*	--	--	--	Guam Tinian FDM	Nn	Y
Custard apple/None	*Annona reticulata*	--	--	--	Guam Tinian	Nn	Y
Chain-of-love vine, coral creeper vine/Flores kadena	*Antigonon leptopus*	--	--	--	Guam Tinian	Nn	Y
Betelnut palm/None	*Areca catechu*	--	--	--	Guam Tinian	Nn	Y
Seedless Breadfruit/Lemai	*Artocarpus altilis*	--	--	--	Guam Tinian	Nn	Y
Seeded breadfruit/Dukduk	*Artocarpus mariannensis*	--	--	--	Guam Tinian	N	Y
Giant reed/None	*Arundo donax*	--	--	--	Guam	Nn	Y
Bird's nest fern/Galak Dangkulo, Galak	*Asplenium nidus*	--	--	--	Guam	Nn	Y
Pickle tree/None	*Averrhoa bilimbi*	--	--	--	Guam Tinian	Nn	Y
Common bamboo/Piao or Piao Palaoan	*Bambusa vulgaris*	--	--	--	Guam Tinian	Nn	Y
Fish kill tree/Puting	*Barringtonia asiatica*	--	--	--	Guam	Nn	Y
None/Langaasag or Putat	*Barringtonia racemosa*	--	--	--	Guam	N	Y
Spanish needles/None	*Bidens pilosa*	--	--	--	Guam Tinian	Nn	Y
None/Gausali	*Bikkia tetrandra*	--	--	--	Guam Tinian FDM	N	Y
None/Dafao	*Boerhavia albiflora*	--	--	--	FDM	N	Y
None/Dafao	*Boerhavia repens*	--	--	--	FDM	N	Y
Buffalo grass/None	*Brachiaria mutica = Urochloa mutica*	--	--	--	Guam	Nn	Y

Table E.5-1. Plants Observed on JRM Sites[1]

Common Name(s)/ Chamorro Name[2]	*Scientific Name*	*Federal Status*	*Guam Status*	*CNMI Status*	*Island*	*Origin*	*Occurrence*
None/Siboyas halumtano	*Bulbophyllum guamense*	T	--	--	Guam	N	Y
None/Qualitay, kualitai	*Callicarpa candicans*	--	--	--	Guam Tinian FDM	N	Y
Alexandrian laurel or Palomaria or Mastwood/Daog or Daok	*Calophyllum inophyllum*	--	--	--	Guam Tinian FDM	N	Y
Ilangilang	*Cananga odorata*	--	--	--	Guam	Nn	Y
Spiny caper/Atkaparas	*Capparis cordifolia*	--	--	--	Guam Tinian FDM	N	Y
Marianne Caper/Atkaparas	*Capparis mariana*	--	--	--	Guam Tinian	N	Y
Caper/Atkaparas	*Capparis spinosa*	--	--	--	Guam Tinian FDM	Nn	Y
Papaya/None	*Carica papaya*	--	--	--	Guam Tinian FDM	Nn	Y
Ironwood/Gagu or Gago	*Casuarina equisetifolia*	--	--	--	Guam Tinian	N	Y
None/None	*Ceratopteris thalictroides*	--	--	--	Guam	N	Y
None/Chiute	*Cerbera dilatata*	--	--	--	Guam Tinian	N	Y
Inkberry/Tintan-china	*Cestrum diurnum*	--	--	--	Guam Tinian	N	Y
Burr grass/None	*Cenchrus echinatus*	--	--	--	Guam	Nn	Y
Siam weed or jack-in-the-bush/None	*Chromolaena odorata*	--	--	--	Guam Tinian	Nn	Y
Glory bower/None	*Clerodendrum inerme*	--	--	--	Guam	Nn	Y
Ivy Gourd/None	*Coccinia grandis*	--	--	--	Guam	Nn	Y
Coconut palm/Trunkon niyok	*Cocos nucifera*	--	--	--	Guam Tinian FDM	Nn	Y
None/None	*Coelogyne guamensis*	--	--	--	Guam	N	Y
Crinum lily/Piga-palayi	*Crinum asiaticum*	--	--	--	FDM	N	Y
Tree fern/Satsa	*Cyathea lunulata*	--	E, SOGCN	--	Guam	N	Y
None/Fadang	*Cycas micronesica*	T	SOGCN	--	Guam Tinian	N	Y
Bermuda grass/None	*Cynodon dactylon*	--	--	--	Guam Tinian FDM	Nn	Y
None/Gulos	*Cynometra ramiflora*	--	--	--	Guam Tinian	N	Y
Smallflower Umbrella Sedge/None	*Cyperus difformis*	--	--	--	Guam	Nn	Y
None/None	*Cyperus javanicus*	--	--	--	FDM	N	Y
None/None	*Cyperus ligularis*	--	--	--	Guam	Nn	Y

Table E.5-1. Plants Observed on JRM Sites[1]

Common Name(s)/ Chamorro Name[2]	*Scientific Name*	*Federal Status*	*Guam Status*	*CNMI Status*	*Island*	*Origin*	*Occurrence*
Flame tree/Atbut or Arbol-del-Fuego	*Delonix regia*	--	--	--	Guam Tinian	Nn	Y
None/None	*Dendrobium guamense*	T	--	--	Guam Tinian	N	Y
None/None	*Dendrocnide latifolia*	--	--	--	Guam Tinian	N	Y
None/None	*Digitaria gaudichaudii*	--	--	--	Guam FDM	N	Y
None/None	*Digitaria radicosa*	--	--	--	FDM	Nn	Y
None/Otot or Otug	*Discocalyx megacarpum*	--	--	--	Guam	N	Y
None/None	*Egeria densa*	--	--	--	Guam	N	Y
None/Joga	*Elaeocarpus joga*	--	--	--	Guam Tinian	N	Y
None/None	*Elatostema calcareum*	--	--	--	Guam Tinian	N	Y
Coral tree/Gaogao	*Erythrina variegata* var. *orientalis*	--	--	--	Tinian	N	Y
None/Aagan or aabang	*Eugenia bryanii*	E	--	--	Guam	N	Y
None/Agatelang or Aghotoleng	*Eugenia palumbis*	--	--	--	Guam Tinian	N	Y
Beach cherry/Aagan or aabang	*Eugenia reinwardtiana*	--	--	--	Guam Tinian FDM	N	Y
Garden spurge/ Golandrina	*Euphorbia hirta*	--	--	--	Guam Tinian FDM	Nn	Y
Blinding tree/None	*Excoecaria agallocha*	--	--	--	Guam FDM	N	Y
None/None	*Fagraea berteriana*	--	--	--	Guam	N	Y
Banyan/Nunu	*Ficus prolixa*	--	--	--	Guam Tinian	N	Y
Dyer's fig/Hodda	*Ficus tinctoria*	--	--	--	Guam Tinian	N	Y
Banyan/Trunkon taotaomona	*Ficus* spp.	--	--	--	Guam Tinian FDM	N	Y
Tropical fimbry/None	*Fimbristylis cymosa*	--	--	--	Guam Tinian FDM	N	Y
False Rattan/ Beyuko halomtano	*Flagellaria indica*	--	--	--	Guam	N	Y
None/None	*Glochidion marianum*	--	--	--	Guam Tinian	N	Y
Cotton/Algodon	*Gossypium hirsutum*	--	--	--	FDM	Nn	Y
None/None	*Meiogyne cylindrocarpa*	--	--	--	Guam Tinian	N	Y
Zebrawood/Panao	*Guettarda speciosa*	--	--	--	Guam Tinian	N	Y
None/Pau dedu	*Hedyotis laciniata*	E	--	--	Guam	N	Y
None/Pau dedu	*Hedyotis megalantha*	E	--	--	Guam	N	Y

Table E.5-1. Plants Observed on JRM Sites[1]

Common Name(s)/ Chamorro Name[2]	*Scientific Name*	*Federal Status*	*Guam Status*	*CNMI Status*	*Island*	*Origin*	*Occurrence*
None/Ufa halumtano	*Heritiera longipetiolata*	E	E, SOGCN	--	Guam Tinian	N	Y
Lantern tree/None	*Hernandia nymphaeifolia*	--	--	--	Guam	Nn	Y
None/Nonag	*Hernandia sonora*	--	--	--	Guam Tinian	N	Y
Tangle-head/None	*Heteropogon contortus*	--	--	--	Guam FDM	Nn	Y
Sagisi palm/None	*Heterospathe elata*	--	--	--	Guam	Nn	Y
None/None	*Hydrilla verticillata*	--	--	--	Guam	Nn	Y
Swamp morning glory/None	*Ipomoea aquatica*	--	--	--	Guam Tinian	Nn	Y
Beach morning glory/Alalag-tasi	*Ipomoea pes-caprae*	--	--	--	Guam Tinian FDM	N	Y
Morning glory/None	*Ipomoea triloba*	--	--	--	Guam Tinian	Nn	Y
None/Ifit	*Intsia bijuga*	--	--	--	Guam Tinian	N	Y
None/None	*Ixora triantha*	--	--	--	Guam Tinian	N	Y
Lantana/None	*Lantana camara*	--	--	--	Guam Tinian	Nn	Y
None/Lesaga	*Lepturus repens*	--	--	--	Guam FDM	N	Y
Hedge acacia/Tangantangan	*Leucaena leucocephala*	--	--	--	Guam Tinian FDM	Nn	Y
None/None	*Luisia teretifolia*	--	--	--	Guam	N	Y
Cat's tail or Disciplina/None	*Lycopodium phlegmaria var. longifolium*	--	--	T-E	Guam	N	Y
None/Pengua	*Macaranga thompsonii*	--	--	--	Guam Tinian	N	Y
None/Chopak	*Mammea odorata*	--	--	--	Guam Tinian	N	Y
None/None	*Maesa walkeri*	T	--	--	Guam	N	Y
Mango/Mangga	*Mangifera indica*	--	--	--	Guam Tinian	Nn	Y
None/Luluhut	*Maytenus thompsonii*	--	--	--	Guam Tinian	N	Y
Guinea Grass/None	*Megathyrsus maximus = Panicum maximum*	--	--	--	Guam Tinian	Nn	Y
Alum/None	*Melanolepis multiglandulosa*	--	--	--	Guam Tinian	N	Y
Melastoma/Gafao	*Melastoma malabathricum*	--	--	--	Guam Tinian	N	Y
None/Sayafe	*Melochia villosissima*	--	--	--	Guam FDM	N	Y
Bitter vine, mile-a-minute vine/None	*Mikania micrantha*	--	--	--	Guam	Nn	Y

Table E.5-1. Plants Observed on JRM Sites[1]

Common Name(s)/ Chamorro Name[2]	*Scientific Name*	*Federal Status*	*Guam Status*	*CNMI Status*	*Island*	*Origin*	*Occurrence*
Climbing hempweed/None	*Mikania scandens*	--	--	--	Guam Tinian	Nn	Y
None/Gulo	*Millettia pinnata*	--	--	--	Guam Tinian FDM	N	Y
Giant sensitive plant or Nila grass/Singbiguin sasa	*Mimosa diplotricha*	--	--	--	Guam Tinian	Nn	Y
Sensitive plant/Betguen sosa	*Mimosa pudica*	--	--	--	Guam Tinian	Nn	Y
Wild sea daisy/None	*Melanthera biflora*	--	--	--	Guam FDM	Nn	Y
None/Faniok	*Merrilliodendron megacarpum*	--	SOGCN	--	Guam Tinian	N	Y
Swordgrass/Neti	*Miscanthus floridulus*	--	--	--	Guam	N	Y
Indian mulberry/Lada	*Morinda citrifolia*	--	--	--	Guam Tinian FDM	N	Y
None/Seyaihagon or Maisa ulu	*Nervilia jacksoniae*	T	--	--	Guam	N	Y
None/Seyaihagon or Maisa ulu	*Nervilia platychila*	--	--	--	Guam	N	Y
Nypa palm/Nipa	*Nypa fruticans*	--	--	--	Guam	Nn	Y
Lipstick Tree/Langiti	*Ochrosia mariannensis*	--	--	--	Guam Tinian	N	Y
None/Fagot	*Ochrosia (=Neisosperma) oppositifolia*	--	--	--	Guam Tinian	N	Y
None/None	*Oldenlandia strigulosa*	--	--	--	Guam Tinian FDM	Nn	Y
St. Thomas lidpod/None	*Operculina turpethum* var. *ventricosa*	--	--	--	Guam Tinian FDM	Nn	Y
Screw pine/Pahong	*Pandanus dubius*	--	--	--	Guam Tinian	N	Y
Textile Screwpine/Akgak	*Pandanus tectorius*	--	--	--	Guam Tinian	N	Y
Kodo Millet/None	*Paspalum distichum*	--	--	--	Tinian	N	Y
Corky passionflower/None	*Passiflora suberosa*	--	--	--	Guam	Nn	Y
None/Nigas	*Pemphis acidula*	--	--	--	Guam Tinian	Nn	Y
Mission grass	*Pennisetum polystachion*	--	--	--	Guam Tinian	Nn	Y
Elephant grass	*Pennisetum purpureum*	--	--	--	Guam Tinian	Nn	Y
Tall reed/karriso	*Phragmites karka*	--	--	--	Guam	N	Y
Fly-Roost/Maigo-lalo	*Phyllanthus amarus*	--	--	--	Guam Tinian FDM	Nn	Y

Table E.5-1. Plants Observed on JRM Sites[1]

Common Name(s)/ Chamorro Name[2]	*Scientific Name*	*Federal Status*	*Guam Status*	*CNMI Status*	*Island*	*Origin*	*Occurrence*
Safford's Leafflower/None	*Phyllanthus saffordii*	E	--	--	Guam	N	Y
Wild cape gooseberry/ Tomate chaca	*Physalis angulata*	--	--	--	Guam Tinian FDM	Nn	Y
Bay rum tree/None	*Pimenta racemosa*	--	--	--	Guam	Nn	Y
None/Umumu	*Pisonia grandis*	--	--	--	Guam Tinian FDM	N	Y
Madras thorn/None	*Pithecellobium dulce*	--	--	--	Tinian	Nn	Y
None/None	*Pluchea indica*	--	--	--	Guam Tinian	N	Y
None/Mamaka	*Polygonum minus*	--	--	--	Guam	N	Y
None/None	*Polypodium punctatum*	--	--	--	Guam Tinian	N	Y
None/Pepega	*Polyscias grandifolia*	--	--	--	Guam Tinian	N	Y
None/None	*Portulaca australis*	--	--	--	FDM	Nn	Y
Sea purslane/None	*Portulaca lutea*	--	--	--	Guam Tinian FDM	Nn	Y
Purslane/Botdolagas	*Portulaca oleracea*	--	--	--	Guam Tinian FDM	Nn	Y
Curly-leaf pondweed/None	*Potamogeton crispus*	--	--	--	Guam	Nn	Y
False elder/Ahgao	*Premna obtusifolia*	--	--	--	Guam Tinian	N	Y
None/Ahgao	*Premna serratifolia*	--	--	--	Guam FDM	N	Y
None/None	*Procris pedunculata*	--	--	--	Guam	N	Y
None/ Aplokating-palaoan	*Psychotria malaspinae*	E	--	--	Guam	N	P
None/Aploghating or Aplokhating	*Psychotria mariana*	--	--	--	Guam Tinian	N	Y
Blackweed/Yerbas babui	*Ruellia blechum*	--	--	--	Guam Tinian FDM	Nn	Y
Blackweed/Yerbas babui	*Ruellia prostrata*	--	--	--	?	Nn	Y
Wild sugarcane/Cana dulce	*Saccharum spontaneum*	--	--	--	Guam	N	Y
Half flower, beach naupaka/Nanaso	*Scaevola taccada*	--	--	--	Guam Tinian	N	Y
Bulrush/None	*Schoenoplectus litoralis*	--	--	--	Guam Tinian	N	Y
Nutrush/None	*Scleria polycarpa*	--	--	--	Guam	N	Y
None/None	*Senna alata*	--	--	--	Guam Tinian	Nn	Y

Table E.5-1. Plants Observed on JRM Sites[1]

Common Name(s)/ Chamorro Name[2]	*Scientific Name*	*Federal Status*	*Guam Status*	*CNMI Status*	*Island*	*Origin*	*Occurrence*
Fire tree/Hayun lago	*Serianthes nelsonii*	E	E, SOGCN	T-E	Guam	N	Y
Seaside purslane/Chara	*Sesuvium portulacastrum*	--	--	--	Guam Tinian FDM	N	Y
None/Biringenas halumtano	*Solanum guamense*	E	--	--	Guam Tinian	N	PU
Yellow necklacepod/Bangil	*Sophora tomentosa*	--	--	--	Guam	N	Y
African tulip tree/Apar	*Spathodea campanulata*	--	--	--	Guam Tinian	Nn	Y
Creeping Oxeye or Singapore Daisy/None	*Sphagneticola trilobata*	--	--	--	Guam	Nn	Y
Indian snakeweed/None	*Stachytarpheta indica*	--	--	--	Guam Tinian	Nn	Y
False verbena/None	*Stachytarpheta jamaicensis*	--	--	--	Guam Tinian FDM	Nn	Y
None/None	*Stachytarpheta urticifolia*	--	--	--	Guam Tinian	Nn	Y
None/Abubo	*Stictocardia tiliifolia*	--	--	--	Guam Tinian	N	Y
Beach hibiscus/Pago	*Taliparti (=Hibiscus) tiliaceum*	--	--	--	Guam Tinian FDM	N	Y
Cuban Pink Trumpet Tree or White Cedar/None	*Tabebuia pallida*	--	--	--	Guam Tinian	Nn	Y
None/None	*Tabernaemontana rotensis*	T	SOGCN	--	Guam	N	Y
Teak/None	*Tectona* spp.	--	--	--	Guam	Nn	Y
Tropical almond tree/None	*Terminalia catappa*	--	--	--	Guam Tinian	N	Y
None/None	*Tetrastigma pubinerve*	--	--	--	Guam	Nn	Y
Willdenow's maiden fern/None	*Thelypteris interrupta*	--	--	--	Guam	N	Y
None/None	*Thelypteris warburgii*	--	--	--	Guam	N	Y
Portia tree/None	*Thespesia populnea*	--	--	--	Guam Tinian	N	Y
None/None	*Tinospora homosepala*	E	--	--	Guam	N	Y
Tree heliotrope/Hunik	*Tournefortia argentea*	--	--	--	Guam Tinian	N	Y
Limeberry/None	*Triphasia trifolia*	--	--	--	Guam Tinian	Nn	Y
None/None	*Tristiropsis acutangula*	--	--	--	Guam Tinian	N	Y
None/None	*Tuberolabium guamense*	T	--	--	Guam	N	Y
Para grass/None	*Urochloa muticum*	--	--	--	Guam Tinian	Nn	Y

Table E.5-1. Plants Observed on JRM Sites[(1)]

Common Name(s)/ Chamorro Name[(2)]	*Scientific Name*	*Federal Status*	*Guam Status*	*CNMI Status*	*Island*	*Origin*	*Occurrence*
Creeping panic grass/None	*Urochloa reptans*	--	--	--	Guam Tinian FDM	N	Y
Bladderwort/None	*Utricularia* spp.	--	--	--	Guam	N, Nn	Y
Molave tree/None	*Vitex parviflora*	--	--	--	Guam Tinian	Nn	Y
Beach sunflower/Masigsig	*Wedelia biflora*	--	--	--	Guam Tinian FDM	N	Y

Notes: [(1)] Many more species are known from JRM lands, but this table highlights only the species or groups specifically mentioned in regulatory contexts. If JRM projects are developed that differentially affect other specific species, these will be added to the table for planning and tracking.

[(2)] Chamorro names from GovGuam (2009), USFWS (2015), and Topping et al. (1975).

Key: Status (Federal, GovGuam, and CNMI)

-- = not listed; E = endangered under the federal Endangered Species Act (ESA) or by GovGuam; T = listed as threatened under the ESA or by GovGuam; T-E = listed as threatened/endangered by CNMI government; SOGCN = Species of Greatest Conservation Need.

Origin

N = native; Nn = non-native, introduced.

Occurrence

-- = Not possible due to absence of habitat/food resources; Y = yes, known to occur; P = potential for occurrence; PU = potential for occurrence, but unlikely; Ex = extirpated.

Sources: NAVFAC Pacific 2010b; 2014a; Guam DAWR 2006; GovGuam 2009; CNMI Government 2014; Liske-Clark 2015; Gutierrez 2018; HEAR 2018; IUCN 2018.

E.6 – Marine Fish

Table E.6-1. Select Marine Fish Species Observed in Nearshore Waters of JRM Sites

Common Name/ Chamorro Name[1]	*Scientific Name*	*Federal Status*	*Guam Status*	*CNMI Status*	*Island*	*Origin*	*Occurrence*
Wahoo/Uahu	*Acanthocybium solandri*	--	--	--	Guam Tinian FDM	N	Y
Bumphead parrotfish/ Atuhong	*Bolbometopon muricatum*	--	SOGCN		Guam Tinian FDM	N	Y P P
Grey reef shark/Haluun unai	*Carcharhinus amblyrhynchos*	--	--	SOGCN	Guam Tinian FDM	N	Y
Oceanic whitetip shark/Haluu	*Carcharhinus longimanus*	T[2]	--		Guam Tinian FDM	N	PU
Blacktip reef shark/Haluu	*Carcharhinus melanopterus*	--	--	--	Guam Tinian FDM	N	Y
Giant trevally/None	*Caranx ignobilis*	--	--	--	Guam Tinian FDM	N	Y
Black jacks/tailas	*Caranx lugubris*	--	--	--	Guam Tinian FDM	N	Y
Butterflyfish/ Ababang pintado	*Chaetodon bennetti*	--	--	--	Guam Tinian FDM	N	Y
Butterflyfish/ Ababang pintado	*Heniochus lunulatus*	--	--	--	Guam Tinian FDM	N	Y
Butterflyfish/ Ababang pintado	*Chaetodon melannotus*	--	--	--	Guam Tinian FDM	N	Y
Butterflyfish/ Ababang pintado	*Chaetodon ornatissimus*	--	--	--	Guam Tinian FDM	N	Y
Butterflyfish/ Ababang pintado	*Chaetodon quadrimaculatus*	--	--	--	Guam Tinian FDM	N	Y
Butterflyfish/ Ababang pintado	*Chaetodon reticulatus*	--	--	--	Guam Tinian FDM	N	Y
Humphead/Napoleon wrasse/Tanguisson	*Cheilinus undulatus*	--	SOGCN	SOGCN	Guam Tinian FDM	N	Y
Slopehead parrotfish/ Laggua or Palakse	*Chlorurus frontalis*	--	--	--	FDM	N	Y
Steephead parrotfish/ Laggua or Palakse	*Chlorurus strongylocephalus*	--	SOGCN	SOGCN	Guam Tinian FDM	N	Y P P
Eight-band grouper/ Gadao	*Hypothordus octofasciatus*	--	--	--	Guam Tinian FDM	N	Y P P
Dogtooth tuna/Kachu	*Gymnosarda unicolor*	--	--	--	Guam Tinian FDM	N	Y

Table E.6-1. Select Marine Fish Species Observed in Nearshore Waters of JRM Sites

Common Name/ Chamorro Name[1]	*Scientific Name*	*Federal Status*	*Guam Status*	*CNMI Status*	*Island*	*Origin*	*Occurrence*
Butterflyfish/ Ababang pintado	*Heniochus chrysostomus*	--	--	--	Guam Tinian FDM	N	Y
Honeycomb stingray/ Fanihen tasi	*Himantura uarnak*	--	--	--	Guam Tinian FDM	N	P P Y
Skipjack tuna/Bunitu	*Katsuwonus pelamis*	--	--	--	Guam Tinian FDM	N	Y
Seagrass parrotfish/ Lacha or Luggua	*Leptoscarus vaigiensis*	--	SOGCN	SOGCN	Guam Tinian FDM	N	P P --
Redgill emperor/ Lililuk of managu	*Lethrinus rubrioperculatus*	--	--	--	Guam Tinian FDM	N	Y
Twinspot snappers/Tagafi	*Lutjanus bohar*	--	--	--	Guam Tinian FDM	N	Y
Humpback snapper/ Fafaet	*Lutjanus gibbus*	--	--	--	Guam Tinian FDM	N	Y
Bluelined snapper/Kuninas	*Lutjanus kasmira*	--	--	--	Guam Tinian FDM	N	Y
Indo-Pacific blue marlin/Batu	*Makaira nigricans*	--	--	--	Guam Tinian FDM	N	Y P P
Giant manta ray/Afula or Hafula or Fanihen Tasi	*Manta birostris*	T	--		Guam Tinian FDM	N	Y P P
Tawny nurse shark/ Haluu	*Nebrius ferrugineus*	--	--	--	Guam Tinian FDM	N	Y
Flame hawkfish/Guihan	*Neocirrhites armatus*				Guam Tinian FDM	N	Y
Violet demoiselle/Fohmo	*Neopomacentrus violascens*	--	--	--	Guam Tinian FDM	Nn	Y P P
Redlipped parrotfish/Laggua	*Scarus rubroviolaceus*	--	--	--	Guam Tinian FDM	N	Y P P
Scalloped hammerhead shark/Haluun kiluus or Ulon matiyu na huluu	*Sphyrna lewini*	T	--		Guam Tinian FDM	N	Y Y P
Great barracuda/Alu	*Sphyraena barracuda*	--	--	--	Guam Tinian FDM	N	Y Y P
Yellowfin tuna/ Tuninosor makuro	*Thunnus albacares*	--	--	--	Guam Tinian FDM	N	Y P P
Albacore tuna/Tuninos	*Thunnus alalunga*	--	--	--	Guam Tinian FDM	N	Y P P

Table E.6-1. Select Marine Fish Species Observed in Nearshore Waters of JRM Sites

Common Name/ Chamorro Name[1]	*Scientific Name*	*Federal Status*	*Guam Status*	*CNMI Status*	*Island*	*Origin*	*Occurrence*
Bigeye tuna/Tuninos	*Thunnus obesus*	--	--	--	Guam Tinian FDM	N	Y P P
Northern bluefin tuna/Tuninos	*Thunnus thynnus*	--	--	--	Guam Tinian FDM	N	Y P P
Whitetip reef shark/Haluon unai	*Triaenodon obesus*	--	--	--	Guam Tinian FDM	N	Y
Broadbill swordfish/Saoara	*Xiphias gladius*	--	--	--	Guam Tinian FDM	N	Y P P

Note: Many more species are known from JRM waters, but this table highlights only the species or groups specifically mentioned in regulatory contexts. If JRM projects are developed that differentially affect other specific species, these will be added to the table for planning and tracking.

Key: Status (Federal, GovGuam, and CNMI)
-- = not listed; E = endangered under the federal Endangered Species Act (ESA) or by GovGuam; T = listed as threatened under the ESA or by GovGuam; T-E = listed as threatened/endangered by CNMI government; SOGCN = Species of Greatest Conservation Need.
[1] Chamorro names from GovGuam (2009), Kerr (1990), Kerr (2012), and Topping et al. (1975).
[2] Indo-West Pacific DPS
Origin
N = native; Nn = non-native, introduced.
Occurrence
-- = Not possible due to absence of habitat/food resources; Y = yes, known to occur; P = potential for occurrence; PU = potential for occurrence, but unlikely; Ex = extirpated.

Sources: DON 2010a, 2010b; NAVFAC Pacific 2013; NMFS 2016; Guam DAWR 2006; GovGuam 2009; CNMI Government 2014; Liske-Clark 2015; Myers and Donaldson 2003; Smith et al. 2013; Smith and Marx 2016; Paulay et al. 2002; Schils et al. 2017; Brainard et al. 2012; Schroeder et al. 2006; 2018a, 2018b.

E.7 – Corals and Marine Invertebrates

Table E.7-1. Select Corals Observed within Nearshore Waters of JRM Sites

Common Name(s)/ Chamorro Name[1]	*Scientific Name*	*Federal Status*	*Guam Status*	*CNMI Status*	*Island*	*Origin*	*Occurence*
Hard Corals (Scleractinia, Stylasteridae, Helioporacea, and Milleporina)							
Coral/Acho tasi	*Acropora globiceps*	T	SOGCN	SOGCN	Guam Tinian FDM	N	Y
Coral/Acho tasi	*Acropora retusa*	T	SOGCN	SOGCN	Guam Tinian FDM	N	Y Y P
Coral/Acho tasi	*Astrea curta*	--	--	--	Guam Tinian FDM	N	Y
Coral/Acho tasi	*Astreopora myriophthalma*	--	--	--	Guam Tinian FDM	N	Y
Coral/Acho tasi	*Coscinaraea*	--	--	--	Guam Tinian FDM	N	Y
Coral/Acho tasi	*Cyphastrea microphthalma*	--	--	--	Guam Tinian FDM	N	Y
Coral/Acho tasi	*Disticopora* sp.	--	--	--	Guam Tinian FDM	N	Y
Coral/Acho tasi	*Echinophyllia*	--	--	--	Guam Tinian FDM	N	Y
Coral/Acho tasi	*Favia* spp.	--	--	--	Guam Tinian FDM	N	Y
Coral/Acho tasi	*Goniastrea retiformis*	--	--	--	Guam Tinian FDM	N	Y
Fire Coral/Acho dagon haya	*Millepora foveolata*	--	--	--	Guam Tinian FDM	N	Y
Coral/Acho tasi	*Leptastrea purpurea*	--	--	--	Guam Tinian FDM	N	Y
Coral/Acho tasi	*Pavona diffluens*	*	SOGCN		Guam Tinian FDM	N	Y Y P
Coral/Acho tasi	*Pavona divaricata*	--	--	--	Guam Tinian FDM	N	Y
Coral/Acho tasi	*Pavona varians*	--	--	--	Guam Tinian FDM	N	Y
Coral/Acho tasi	*Psammocora* spp.	--	--	--	Guam Tinian FDM	N	Y
Coral/Acho tasi	*Pocillopora elegans*	--	--	--	Guam Tinian FDM	N	Y

Table E.7-1. Select Corals Observed within Nearshore Waters of JRM Sites

Common Name(s)/ Chamorro Name[1]	*Scientific Name*	*Federal Status*	*Guam Status*	*CNMI Status*	*Island*	*Origin*	*Occurence*
Coral/Acho tasi	*Pocillopora eydouxi*	--	--	--	Guam Tinian FDM	N	Y
Coral/Acho tasi	*Pocillopora meandrina*	--	--	--	Guam Tinian FDM	N	Y
Coral/Acho tasi	*Pocillopora verrucosa*	--	--	--	Guam Tinian FDM	N	Y
Coral/Acho tasi	*Porites lobata*	--	--	--	Guam Tinian FDM	N	Y
Coral/Acho tasi	*Porites lutea*	--	--	--	Guam Tinian FDM	N	Y
Coral/Acho tasi	*Porites australiensis*	--	--	--	Guam Tinian FDM	N	Y
Coral/Acho tasi	*Porites murrayensis*	--	--	--	Guam Tinian FDM	N	Y Y P
Coral/Acho tasi	*Seriatopora aculeata*	T	SOGCN	SOGCN	Guam Tinian FDM	N	Y P P
Coral/Acho tasi	*Stylaster* sp.	--	--	--	Guam Tinian FDM	N	Y
Staghorn corals (a sub-group of Acroporidae listed in CNMI)							
Coral/Acho tasi	*Acropora aspera*	--	SOGCN	SOGCN	Guam Tinian FDM	N	Y Y PU
Coral/Acho tasi	*Acropora austera*	--	SOGCN	SOGCN	Guam Tinian FDM	N	Y Y PU
Coral/Acho tasi	*Acropora intermedia*	--	SOGCN	SOGCN	Guam Tinian FDM	N	Y Y PU
Coral/Acho tasi	*Acropora muricata*	--	SOGCN	SOGCN	Guam Tinian FDM	N	Y Y PU
Coral/Acho tasi	*Acropora pulchra*	--	SOGCN	SOGCN	Guam Tinian FDM	N	Y Y PU
Coral/Acho tasi	*Acropora teres*	--	SOGCN	SOGCN	Guam Tinian FDM	N	Y Y PU
Soft Corals (Alcyonacea)							
Soft coral/None	*Lobophyton* sp.	--	--	--	Guam Tinian FDM	N	Y
Soft coral/None	*Lobophyton batarum*	--	--	--	Guam Tinian FDM	N	Y

Table E.7-1. Select Corals Observed within Nearshore Waters of JRM Sites

Common Name(s)/ Chamorro Name[(1)]	*Scientific Name*	*Federal Status*	*Guam Status*	*CNMI Status*	*Island*	*Origin*	*Occurence*
Soft coral/None	*Sarcophyton* sp.	--	--	--	Guam Tinian FDM	N	Y
Soft coral/None	*Sarcophyton trocheliophorum*	--	--	--	Guam Tinian FDM	N	Y
Soft coral/None	*Sinularia* sp.	--	--	--	Guam Tinian FDM	N	Y
Soft coral/None	*Sinularia leptoclados*	--	--	--	Guam Tinian FDM	N	Y
Soft coral/None	*Sinularia racemosa*	--	--	--	Guam Tinian FDM	N	Y
Sea Fans, Horny Coral (Gorgonacea)							
None/None	Gorgonacea	--	--	--	Guam Tinian FDM	N	Y
Black Coral (Antipatheria)							
None/None	Antipatheria	--	--	--	Guam Tinian FDM	N	Y

Note: Many more species are known from JRM waters, but this table highlights only the species or groups specifically mentioned in regulatory contexts. If JRM projects are developed that differentially affect other specific species, these will be added to the table for planning and tracking.

Key: Status (Federal, GovGuam, and CNMI)

-- = not listed; T = listed as threatened under the ESA or by GovGuam; SOGCN = Species of Greatest Conservation Need.

(1) Chamorro names from GovGuam (2009), Kerr (1990), Kerr (2012), and Topping et al. (1975).

(2) *Pavona diffluens* is present on Tinian (DON 2017) and Guam. The NMFS Final Listing Determination specifically states that the listing applies to the species called *P. diffluens* in the Indian Ocean and Red Sea (NMFS 2014). The Final Listing Determination stated that corals fitting the description of *P. diffluens* in the Pacific are a different species. The specimens observed on Tinian were rare, and were conspicuously identifiable as the *Pavona* described from Guam in Randall & Meyers (1983). There is insufficient morphological evidence to make a distinction between the "local*" P. diffluens* and the ESA Threatened *P. diffluens*, consequently it is not considered to be subject to the ESA.

Origin

N = native; Nn = non-native, introduced.

Occurrence

-- = Not possible due to absence of habitat/food resources; Y = yes, known to occur; P = potential for occurrence; PU = potential for occurrence, but unlikely; Ex = extirpated.

Sources: Guam DAWR 2006; Liske-Clark 2015; Smith et al. 2013; Smith and Marx 2016; Minton et al. 2009; DON 2014c; DON 2017d; Brainard et al. 2012; Paulay et al. 1997; Paulay et al. 2001; Paulay et al. 2002; Smith et al. 2008; NAVFAC Pacific 2011a; Smith and Shannon 2013

Table E.7-2. Marine Invertebrate Species in JRM Nearshore Waters

Common Name(s)/ Chamorro Name	*Scientific Name*	*Federal Status*	*GovGuam Status*	*CNMI Status*	*Island*	*Origin*	*Occurrence*
Sponges (Porifera)							
None/None	*Terpios hoshinota*	--	--	--	Guam Tinian FDM	N	Y Y P
Bivalves							
Pectinate venus/ Hima	*Gafrarium pectinatum*	--	--	SOGCN	Guam Tinian FDM	N	PU PU --
Fluted giant clam/ Hima	*Tridacna squamosa*	--	SOGCN	SOGCN	Guam Tinian FDM	N	Y
Small giant clam/ Hima	*Tridacna maxima*	--	SOGCN	SOGCN	Guam Tinian FDM	N	Y
None/Hima	*Tridacna* spp.	--	--	--	Guam Tinian FDM	N	Y
Gastropods							
Horned helmet/ Dogas or koncha	*Cassis cornuta*	--	--	SOGCN	Guam Tinian FDM	N	Y P P
None/Dogas or koncha	*Cerithium zonatum*	--	--	--	Guam Tinian FDM	N	Y
Triton's trumpet/Kulo	*Charonia tritonis*	--	SOGCN	SOGCN	Guam Tinian FDM	N	Y
Branched murex/ Dogas or koncha	*Chicoreus ramosus*	--	--	SOGCN	Guam Tinian FDM	N	P
Corallivorous gastropod/Dogas or koncha	*Drupella cornus*	--	--	--	Guam Tinian FDM	N	Y
Vermivorous cone snail/Dogas or koncha	*Conus sponsalis*	--	--	--	Guam Tinian FDM	N	Y
Common spider conch/Dogas or koncha	*Lambis lambis*	--	--	SOGCN	Guam Tinian FDM	N	Y
Spider conch/ Dogas or koncha	*Lambis* sp.	--	--	--	Guam Tinian FDM	N	Y
Giant spider conch/ Dogas or koncha	*Lambis truncata*	--	--	--	Guam Tinian FDM	N	Y
Topshell, topsnail/ Alileng	*Tectus niloticus*	--	--	--	Guam Tinian FDM	Nn	Y
Nudibranch or Sea slug/Balate	*Thuridilla gracilis*	--	--	--	Guam Tinian FDM	N	Y
Silver-mouth turban/Dogas or koncha	*Turbo argyrostoma*	--	--	SOGCN	Guam Tinian FDM	N	Y

Table E.7-2. Marine Invertebrate Species in JRM Nearshore Waters

Common Name(s)/ Chamorro Name	*Scientific Name*	*Federal Status*	*GovGuam Status*	*CNMI Status*	*Island*	*Origin*	*Occurrence*
Tapestry turban/ Dogas or koncha	*Turbo petholatus*	--	--	SOGCN	Guam Tinian FDM	N	Y
Rough turban/ Dogas or koncha	*Turbo setosus*	--	--	SOGCN	Guam Tinian FDM	N	Y
Cephalopods							
Ornate octopus/ Gamson	*Callistoctopus ornatus*	--	--	--	Guam Tinian FDM	N	Y Y P
Day octopus/ Gamson	*Octopus cyanea*	--	--	SOGCN	Guam Tinian FDM	N	Y
Bigfin reef squid/ Nosnos	*Sepioteuthis lessoniana*	--	--	--	Guam Tinian FDM	N	Y Y P
Crustaceans							
Pronghorn spiny lobster/Mahongang	*Panulirus penicillatus*	--	SOGCN	SOGCN	Guam Tinian FDM	N	Y
Painted spiny lobster/Mahongang	*Panulirus versicolor*	--	SOGCN	SOGCN	Guam Tinian FDM	N	Y
Longlegged spiny lobster/Mahongang	*Panulirus longipes*	--	SOGCN	SOGCN	Guam Tinian FDM	N	Y
Slipper lobster/ Papangpang	*Parribacus antarcticus*	--	--	--	Guam Tinian FDM	N	Y
Rock-boring snapping shrimp/ Uhang	*Alpheus schmitti*	--	--	--	Guam Tinian FDM	N	Y
Echinoderms							
Sea cucumber/ Balate	*Actinopyga varians*	--	--	--	Guam Tinian FDM	N	Y
Crown-of-thorns starfish/None	*Acanthaster planci*	--	--	--	Guam Tinian FDM	N	Y
Sea cucumber/ Balate	*Bohadschia argus*	--	--	--	Guam Tinian FDM	N	Y
Sea cucumber/ Balate	*Bohadschia marmorata*	--	--	--	Guam Tinian FDM	N	Y
Cushion star/None	*Culcita novaeguineae*	--	--	--	Guam Tinian FDM	N	Y
Sea urchin/None	*Diadema savignyi*	--	--	--	Guam Tinian FDM	N	Y
Needle-spine urchin/None	*Echinostrephus aciculatus*	--	--	--	Guam Tinian FDM	N	Y

Table E.7-2. Marine Invertebrate Species in JRM Nearshore Waters

Common Name(s)/ Chamorro Name	*Scientific Name*	*Federal Status*	*GovGuam Status*	*CNMI Status*	*Island*	*Origin*	*Occurrence*
Burrowing urchin/ None	*Echinometra mathaei*	--	--	--	Guam Tinian FDM	N	Y
Sea urchin/None	*Echinostrephus aciculatus*	--	--	--	Guam Tinian FDM	N	Y
Sea urchin/None	*Echinothrix calamaris*	--	--	--	Guam Tinian FDM	N	Y
Sea urchin/None	*Echinothrix diadema*	--	--	--	Guam Tinian FDM	N	Y
Sea cucumber/ Balate	*Holothuria atra*	--	--	--	Guam Tinian FDM	N	Y
Sea cucumber/ Balate	*Holothuria* sp.	--	--	--	Guam Tinian FDM	N	Y
Blue seastar/None	*Linckia multifora*	--	--	--	Guam Tinian FDM	N	Y
Crinoid/None	*Oxycomanthus bennetti*	--	--	--	Guam Tinian FDM	N	Y
Sea cucumber/ Balate	*Pearsonothuria graeffei*	--	--	--	Guam Tinian FDM	N	Y
Sea cucumber/ Balate	*Stichopus chloronotus*	--	--	--	Guam Tinian FDM	N	Y
Sea cucumber/ Balate	*Thelonata ananas*	--	--	--	Guam Tinian FDM	N	Y
Sea cucumber/ Balate	*Thelonata anax*	--	--	--	Guam Tinian FDM	N	Y
Collector urchin/ None	*Tripneustes gratilla*	--	--	SOGCN	Guam Tinian FDM	N	Y PU PU

Note: Many more species are known from JRM waters, but this table highlights only the species or groups specifically mentioned in regulatory contexts. If JRM projects are developed that differentially affect other specific species, these will be added to the table for planning and tracking.

Key: Status (Federal, GovGuam, and CNMI)
-- = not listed; T = listed as threatened under the ESA or by GovGuam; SOGCN = Species of Greatest Conservation Need.
Origin
N = native; Nn = non-native, introduced.
Occurrence
-- = Not possible due to absence of habitat/food resources; Y = yes, known to occur; P = potential for occurrence; PU = potential for occurrence, but unlikely; Ex = extirpated.

Sources: Guam DAWR 2006; Liske-Clark 2015; Smith et al. 2013; Smith and Marx 2016; Minton et al. 2009; DON 2014c; DON 2017d; Brainard et al. 2012; Paulay et al. 1997; Paulay et al. 2001; Paulay et al. 2002; Smith et al. 2008; NAVFAC Pacific 2011a; Smith and Shannon 2013.

E.8 – Freshwater Macrofauna

Table E.8-1. Freshwater Macrofauna of the NMS[1]

Common Name(s)/ Chamorro Name[2]	*Scientific Name*	*Federal Status*	*Guam Status*	*Origin*	*Occurrence*
Fishes					
Common glass fish/ None	*Ambassis buruensis*	--	--	N	Y
Japanese eel/Hasule	*Anguilla japonica*	--	--	N	Y
Marbled eel/Hasule	*Anguilla marmorata*	--	--	N	Y
Dark-margined flagtail/Atinget	*Kuhlia marginata*	--	--	N	Y
Jungle flagtail, rock flagtail/Atinget	*Kuhlia rupestris*	--	SOGCN	N	Y
Goby/Macheng	*Sicyopterus macrostetholepis*	--	SOGCN	N	Y
Goby/Macheng	*Stiphodon elegans*	--	SOGCN	N	Y
Goby/Macheng	*Stiphodon percnopterygonius*	--	SOGCN	N	Y
Goby/Macheng	*Awaous guamensis*	--	--	N	Y
Sleeper/None	*Eleotris* sp.	--	--	N	Y
Dusky sleeper/None	*Eleotris fusca*	--	--	N	Y
Silver moony/None	*Monodactylus argenteus*	--	--	N	Y
Engel's mullet/ Pios or laiguan	*Moolgarda engeli*	--	--	N	Y
Bluespot mullet/ Pios or laiguan	*Moolgarda seheli*	--	--	N	Y
Bandfin mullet goby/ Macheng	*Mugilogobius cavifrons*	--	--	N	Y
Barred mudskipper/ None	*Periophthalmus argentilineatus*	--	--	N	Y
Bigmouth goby/Macheng	*Redigobius bikolanus*	--	--	N	Y
Gobies/Macheng	*Stenogobius* spp.	--	--	N	Y
Feathered river-garfish/ None	*Zenarchopterus dispar*	--	--	N	Y
Peacock cichlid/None	*Cichla ocellaris*	--	--	Nn	Y
Redbelly tilapia/Talapiha	*Coptodon zillii*	--	--	Nn	Y
Mozambique tilapia/Talapiha	*Oreochromis mossambicus*	--	--	Nn	Y
Philippine catfish/Ito	*Clarias batrachus*	--	--	Nn	Y
Channel catfish/Ito	*Ictalurus punctatus*	--	--	Nn	Y
Western mosquitofish/ None	*Gambusia affinis*	--	--	Nn	Y
Guppy/None	*Poecilia reticulata*	--	--	Nn	Y
Green swordtail/None	*Xiphophorus helleri*	--	--	Nn	Y
Smallmouth bass/None	*Micropterus dolomieu*	--	--	Nn	Y
Largemouth bass/None	*Micropterus salmoides*	--	--	Nn	Y
Crustaceans					
Atyid shrimp/Uhang	*Atyoida pilipes*	--	SOGCN	N	Y
Atyid shrimp/Uhang	*Caridina mertoni*	--	SOGCN	N	Y
Ninja shrimp/Uhang	*Caridina serratirostris*	--	--	N	Y
None/None	*Halocaradina trigonopthalma*	--	--	N	Y
Tahitian prawn/Uhang	*Macrobrachium lar*	--	SOGCN	N	Y

Table E.8-1. Freshwater Macrofauna of the NMS[(1)]

Common Name(s)/ Chamorro Name[(2)]	*Scientific Name*	*Federal Status*	*Guam Status*	*Origin*	*Occurrence*
Forest ghost crab/ Naot or apotalang or atopalang	*Ocypode cordimanus*	--	--	N	Y
Freshwater crab/Naot or apotalang or atopalang	*Ptychognathus* sp.1.	--	--	N	Y
Freshwater crab/Naot or apotalang or atopalang	*Varuna* cf. *litterata*	--	SOGCN	N	Y
Molluscs					
Dark apple snail/Akaleha	*Ampullaria conica*	--	--	Nn	Y
Crown nerite/None	*Clithon corona*	--	SOGCN	N	Y
Dubious nerite/None	*Clithon oualaniensis*	--	SOGCN	N	Y
Green pond snails/ Akaleha	*Lymnaea viridis*	--	--	N	Y
Red-rimmed melania/None	*Melanoides tuberculata*	--	SOGCN	N	Y
Bat snail/None	*Neritina auriculata*	--	SOGCN	N	Y
Petit's nerite/None	*Neritina petitii*	--	SOGCN	N	Y
Freshwater nerite/None	*Neritina pulligera*	--	SOGCN	N	Y
None/None	*Neritina squamipicta*	--	--	N	Y
Freshwater nerite/None	*Neritodryas subsulcata*	--	SOGCN	N	Y
Variegated nerite/None	*Neritina variegata*	--	SOGCN	N	Y
Golden apple snail/ Akaleha	*Pomacea canaliculata*	--	--	Nn	Y
Lineated nerite/None	*Septaria lineata*	--	SOGCN	N	Y
Porcelain nerite/None	*Septaria porcellana*	--	SOGCN	N	Y
River snail/Akaleha	*Sinotaia magniciana*	--	--	Nn	Y
Freshwater thiarid snail/Akaleha	*Stenomelania plicaria*	--	SOGCN	N	Y
Quilted melania/None	*Tarebia granifera*	--	SOGCN	N	Y
None/None	*Thiara granifera*	--	--	Nn	Y
Pagoda tiara/Akaleha	*Thiara scabra*	--	SOGCN	Nn	Y

Note: [(1)] Data on Freshwater macrofauna exists only for Guam.
[(2)] Chamorro names from GovGuam (2009), Kerr (1990), Kerr (2012), and Topping et al. (1975).

Key: Status (Federal, GovGuam, and CNMI)
-- = not listed; SOGCN = Species of Greatest Conservation Need.
Origin
N = native; Nn = non-native, introduced.
Occurrence
-- = Not possible due to absence of habitat/food resources; Y = yes, known to occur; P = potential for occurrence; PU = potential for occurrence, but unlikely; Ex = extirpated.

Sources: Maciolek 1984; Myers 1999; Fitzsimons et al. (2002); Leberer and Cai 2003; Guam DAWR 2006; Mailautoka and Hoese 2012; Kerr 2013; Froese and Pauly 2017; USGS Non-Indigenous Aquatic Species Database 2017.

E.9 – Marine Flora

Table E.9-1. Select Marine Flora of the NMS

Common Name(s)/ Chamorro Name(1)	*Scientific Name*	*Federal Status*	*Guam Status*	*Island*	*Origin*	*Occurrence*
Diatoms						
Golden noodle algae/None	Chrysophyceae	--	--	Guam Tinian FDM	N	Y
Algae						
None/Chaiguan	*Acanthophora spicifera*	--	--	Guam Tinian FDM	Nn	Y Y P
None/Chaiguan	*Amphiroa* sp.	--	--	Guam Tinian FDM	N	Y
Green angel hair/ Chaiguan	*Chaetomorpha* spp.	--	--	Guam Tinian FDM	N	Y
None/Chaiguan	*Galaxaura* sp.	--	--	Guam Tinian FDM	N	Y
None/Chaiguan	*Gracilaria salicornia*	--	--	Guam Tinian FDM	Nn	Y Y P
None/Chaiguan	*Halimeda* spp.	--	--	Guam Tinian FDM	N	Y
None/Chaiguan	*Halimeda opuntia*	--	--	Guam Tinian FDM	N	Y
None/Chaiguan	*Neomeris*	--	--	Guam Tinian FDM	N	Y
None/Chaiguan	*Padina* spp.	--	--	Guam Tinian FDM	N	Y
None/Chaiguan	*Portieria hornemannii*	--	--	Guam Tinian FDM	N	Y
None/Chaiguan	*Turbinaria ornata*	--	--	Guam Tinian FDM	N	Y Y P
Sea lettuce/ Chaiguan	*Ulva lactuca*	--	--	Guam Tinian FDM	N	Y Y P
Mangroves						
Grey mangrove, white mangrove/ None	*Avicennia marina*	--	--	Guam Tinian FDM	N	Y P PU
Black mangrove/ Mangle macho	*Bruguiera gymnorrhiza*	--	--	Guam Tinian FDM	N	Y P PU
Looking-glass mangrove/None	*Heritiera littoralis*	--	--	Guam Tinian FDM	N	Y P PU

Table E.9-1. Select Marine Flora of the NMS

Common Name(s)/ Chamorro Name(1)	*Scientific Name*	*Federal Status*	*Guam Status*	*Island*	*Origin*	*Occurrence*
Black mangrove/ Nganga	*Lumnitzera littorea*	--	--	Guam Tinian FDM	N	Y P PU
Red/tall-stilt mangrove/Mangle	*Rhizophora apiculata*	--	--	Guam Tinian FDM	N	Y P PU
Loop-root mangrove or Asiatic mangrove/ Mangle hembra	*Rhizophora mucronata*	--	--	Guam Tinian FDM	N	Y P PU
Cannonball/cedar mangrove/Lalanyok	*Xylocarpus moluccensis*	--	--	Guam Tinian FDM	N	Y P PU
Seagrass						
Tape seagrass/None	*Enhalus acoroides*	--	--	Guam Tinian FDM	N	Y Y PU
Narrowleaf seagrass/ None	*Halodule uninervis*	--	--	Guam Tinian FDM	N	Y Y PU
Hartog seagrass/ None	*Halophila minor*	--	--	Guam Tinian FDM	N	Y Y PU

Note: * Data on Freshwater macrofauna exists only for Guam.

(1) Chamorro names from GovGuam (2009), Kerr (1990), Kerr (2012), and Topping et al. (1975).

Key: Status (Federal, GovGuam, and CNMI)

-- = not listed; SOGCN = Species of Greatest Conservation Need.

Origin

N = native; Nn = non-native, introduced.

Occurrence

-- = Not possible due to absence of habitat/food resources; Y = yes, known to occur; P = potential for occurrence; PU = potential for occurrence, but unlikely; Ex = extirpated.

Sources: Burdick et al. 2008; Fonseca and Olsen 2016; Furukawa et al. 1997; Lobban and Tsuda 2003; Minton et al. 2009; Nagelkerken et al. 2008; NAVFAC Marianas 2011; Schils 2015; Sukhraj et al. 2010; Paulay et al. 1997; Paulay et al. 2001; NAVFAC Pacific 201

Appendix F
Biological Opinions and Associated Conservation Measures for Joint Region Marianas Lands and Associated Implementation and Tracking

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F1 Biological Opinions

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F1A USFWS, BO on the Establishment and Operation of an Intelligence, Surveillance, Reconnaissance, and Strike (ISR Strike) Capability Project on Andersen AFB, Guam (October 2006)

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United States Department of the Interior

FISH AND WILDLIFE SERVICE

Pacific Islands Fish and Wildlife Office
300 Ala Moana Boulevard, Room 3-122, Box 50088
Honolulu, Hawaii 96850

In Reply Refer To:
1-2-2006-F-266

OCT 0 3 2006

Lieutenant Colonel Peter A. Ridilla
Department of the Air Force
36th Civil Engineer Squadron (PACAF)
Unit 14007
APO AP 96543-4007

Subject: Biological Opinion on the Establishment and Operation of an Intelligence, Surveillance, Reconnaissance, and Strike Capability Project on Andersen Air Force Base, Guam

Dear Lieutenant Colonel Ridilla:

This document transmits the U.S. Fish and Wildlife Service's (Service) biological opinion based on our review of the U.S. Air Force's (Air Force) proposed Establishment and Operation of an Intelligence, Surveillance, Reconnaissance, and Strike Capability (ISR/Strike) project on Andersen Air Force Base (AFB), Guam. This opinion addresses the effects of the proposed action on the endangered Mariana crow (*Corvus kubaryi*) and the threatened Mariana fruit bat (*Pteropus mariannus mariannus*) in accordance with section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 USC 1531, et seq.). Although the endangered Guam Micronesian kingfisher (*Halcyon cinnamomina cinnamomina*), and Guam rail (*Gallirallus owstoni*) are extirpated from Guam, they are addressed in this opinion based on the requirements identified in the Cooperative Agreement between the Air Force and Service for the establishment and management of the Guam National Wildlife Refuge (Air Force and Service 1994). As stated in our June 21, 2006, letter, this formal consultation was initiated on May 22, 2006.

This biological opinion is based on the following information: 1) the Air Force's March 2006 Biological Assessment (BA) (Air Force 2006a) and April, May, and June supplements; 2) the Air Force's April 2006 Draft Environmental Impact Statement (EIS) (Air Force 2006b); 3) peer-reviewed articles and gray literature; 4) information in our files; and 5) meeting notes and correspondence associated with this consultation. A complete administrative record of this consultation is on file in the Service's Pacific Islands Fish and Wildlife Office in Honolulu, Hawaii.

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Consultation History

December 13, 2004: The Air Force briefed the Service on the proposed ISR/Strike project and other Air Force projects on Andersen AFB at the Service's Pacific Islands Fish and Wildlife Office.

March 22, 2005: The Air Force sent the Service a letter requesting technical assistance on the proposed ISR/Strike and Northwest Field Beddown projects. This letter was not received by the Service until August 30, 2005 (see below).

May 18, 2005: The Air Force published a Notice of Intent to prepare a draft EIS for the proposed ISR/Strike project in the *Federal Register*.

June 24, 2005: The Service sent the Air Force a letter with comments on the May 18, 2005, Notice of Intent.

August 30, 2005: The Service received an August 25, 2005, letter from the Air Force requesting guidance on whether to proceed with formal or informal consultation on the proposed ISR/Strike project. This letter also included a copy of the Air Force's March 22, 2005, letter and a copy of the *Field Studies Survey Report, Vegetation Community Mapping, AAFB, Guam* which contained information on the vegetation in the proposed project area (Air Force 2005).

September 28, 2005: The Service met with the Air Force at the Service's Pacific Islands Fish and Wildlife Office to discuss the status of the proposed ISR/Strike project and whether formal or informal consultation was appropriate.

September 30, 2005: The Service sent the Air Force a letter requesting additional information regarding the status of listed species and vegetation community composition and structure within the project areas.

October 30, 2005: The Air Force's natural resource personnel at Andersen AFB sent an electronic mail message to the Service requesting our review of the proposed vegetation survey methodology. On November 4, 2005, we replied to the Air Force's electronic mail message with suggestions for survey methods within the project area for listed species.

February 13, 2006: The Service received an electronic mail message from the Air Force requesting informal comments on the February 2006 Draft BA for the ISR/Strike project. On February 28, 2006, we sent an electronic mail message to the Air Force containing informal comments on the February 2006 Draft BA for the ISR/Strike project.

March 23, 2006: The Service received a March 22, 2006, letter from the Air Force requesting formal consultation on the proposed ISR/Strike project. This letter included the March 2006 BA of the proposed project.

April 21, 2006: The Service sent a letter to the Air Force confirming receipt of its March 22, 2006, request for formal consultation, and requested additional information on potential project impacts to listed species in order to initiate the consultation.

May 2, 2006: The Service met with the Air Force at the Service's Pacific Islands Fish and Wildlife Office to discuss project impacts and avoidance and minimization measures to reduced impacts to listed species.

May 10, 2006: The Service participated in a conference call with the Air Force and its contractors to discuss potential noise impacts to listed species from increased aviation operations at Andersen AFB.

May 12, 2006: The Air Force published a Notice of Availability in the *Federal Register* for the April 2006 Draft EIS for the proposed ISR/Strike project.

May 22, 2006: The Service received the Air Force's May 19, 2006, letter providing the additional information on noise analyses and potential aircraft accidents we requested in our April 21, 2006, letter.

June 2, 2006: The Service sent the Air Force an electronic mail message requesting additional information and clarification regarding aviation noise and flight tracks in the vicinity of listed species territories.

June 12, 2006: The Air Force sent us an electronic mail message containing supplementary information on aviation noise and flight tracks requested on June 2, 2006.

June 22, 2006: The Service sent the Air Force a letter indicating that the information required for the consultation was complete and that formal consultation had been initiated on May 22, 2006. The letter also stated that consultation would be completed on October 4, 2006.

July 19, 2006: The Air Force sent an electronic mail message to the Service requesting that the biological opinion be completed within 90 days of initiation due to conflicts with the project schedule.

August 1, 2006: The Service met with the Air Force and its contractors at the Service's Pacific Islands Fish and Wildlife Office to discuss the timeline for the formal consultation, impacts to listed species, and conservation measures. The Service agreed to expedite the completion of the biological opinion.

August 4, 2006: The Service sent the Air Force an electronic mail message requesting inclusion of additional avoidance and minimization measures associated with construction activities for the ISR/Strike project.

August 10, 2006: The Service sent the Air Force an electronic mail message inquiring whether the proposed brown treesnake (*Boiga irregularis*) control conservation measure could be

modified to include research and development of appropriate snake control measure for the Mariana fruit bat colony.

August 14, 2006: The Air Force sent the Service electronic mail messages agreeing to consider the proposed modification of the brown treesnake control conservation measure and avoidance and minimization measures for project construction activities discussed in our August 4 and 10 electronic mail messages.

August 17, 2006: The Service and the Air Force exchanged electronic mail messages regarding proposed measures to minimize and avoid potential impacts associated with the Mariana fruit bat colony abandoning Pati Point due to the proposed project.

August 31, 2006: The Service solicited comments from the Air Force via electronic mail on the "Description of the Proposed Action" for this Biological Opinion. The Air Force and Service exchanged electronic mail messages to finalize this project description on September 7, 12 to 15, and 19, 2006.

BIOLOGICAL OPINION

Description of Proposed Action

The Air Force is proposing to establish an Intelligence, Surveillance, Reconnaissance, and Strike Operational Capability at Andersen AFB, Guam (Figure 1). The objective of the ISR/Strike project is to achieve pre-engagement battle space awareness, locate and identify critical adversary movement, achieve assured success through air dominance, and deliver decisive effects via persistent and precise application of air and space power over the next decade (Table 1). The following project description is a summary of construction activities, aircraft operations, anticipated personnel increases, and conservation measures as presented in the BA (Air Force 2006a), Draft EIS (Air Force 2006b), and correspondence and meetings with Air Force personnel.

Facilities and Construction

Facility construction will begin in fiscal year (FY) 2007. Sixty-seven construction projects are included in the proposed action. Most of these projects will occur on previously developed land on the main portion of Andersen AFB and are not expected to impact listed species on Guam. However, the increase in personnel, goods, and cargo associated with these projects may impact listed species outside of Guam (see "Personnel Increases" below). Of the proposed construction projects, only the Aircraft Staging Area, Commercial Entry Gate, and Truck Inspection Facility are expected to impact listed species on Guam (Figure 2). These three projects are described in detail below. For additional information on the other construction projects associated with this proposed action, see the associated Draft EIS (Air Force 2006b).

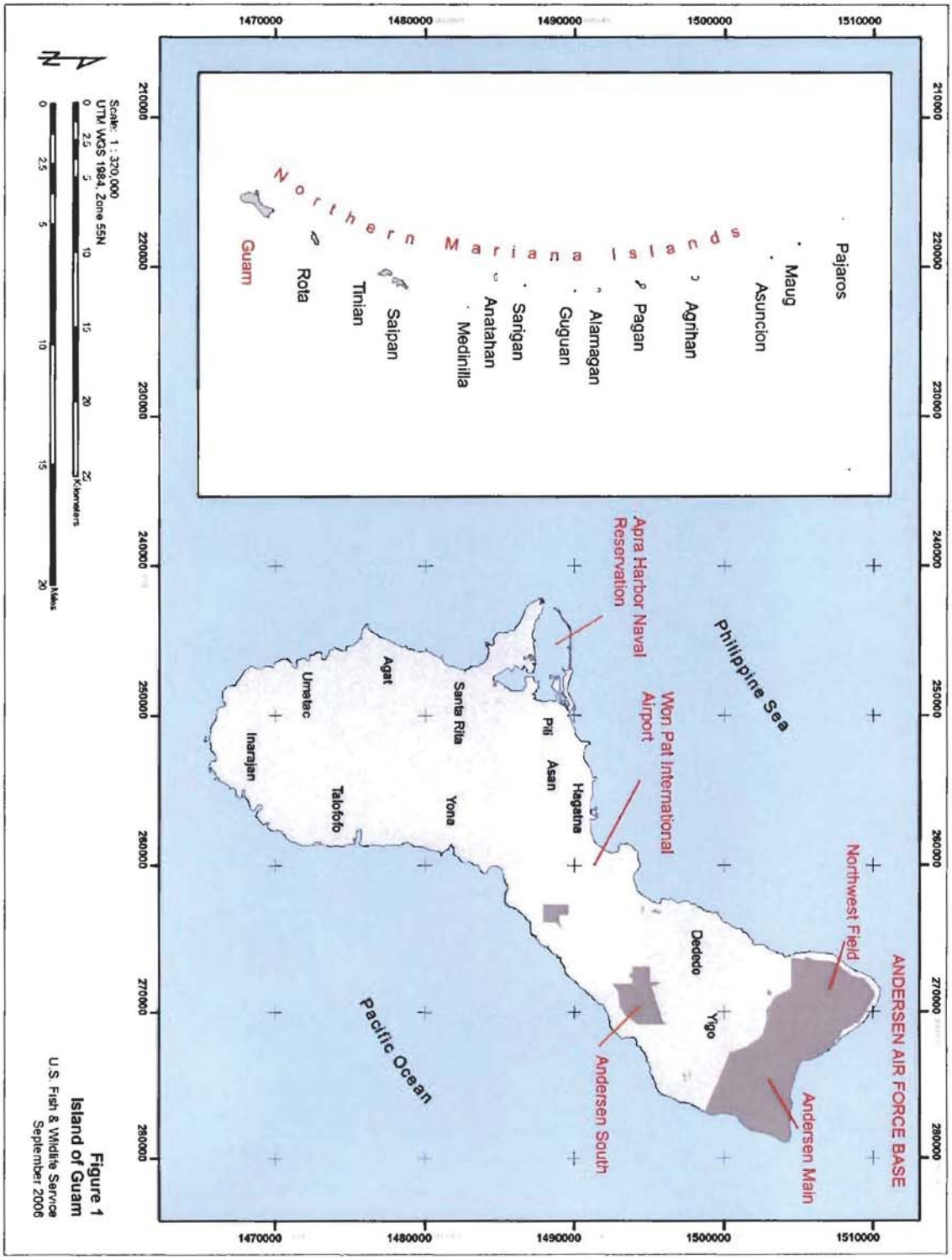

Figure 1
Island of Guam
U.S. Fish & Wildlife Service
September 2006

Table 1. Draft Timeline for the Proposed ISR/Strike Project

	Construction Phases		Operational Phases		
	FY07[a]	FY08	Phase 1 FY09 – FY13	Phase 2 FY14 – FY16	Phase 3 FY17+
Construction Activities					
Commercial Entry Gate	-	-	Construction FY09-FY10	-	-
Truck Inspection Facility	-	-	Construction FY09-FY10	-	-
Global Hawk Hangar (for UAVs[b])	Construction Begins FY07	-	Construction Ends FY09	-	-
Aircraft Staging Area	-	-	Construction Begins FY10	-	Construction Ends FY17+
Aircraft Operations					
Based on Andersen AFB	-	-	4 UAV 12 Tankers	4 UAV 12 Tankers	4 UAV 12 Tankers
Rotating to Andersen AFB	-	-	6 Bombers 24 F-22A	6 Bombers 24 F-22A	6 Bombers 48 F-22A
Total Number of Aircraft	-	-	46	46	70
Number of Personnel					
Permanent	-	-	650	650	650
Rotational	-	-	850	850	1,250
Dependents	-	-	1,100	1,100	1,100
Total	-	-	2,600	2,600	3,000
Conservation Measures					
Additional Staffing	-	Wildlife Management Specialist	-	-	-
Habitat Improvement	-	Ungulate Management Plan	(1) Ungulate Exclosure Fencing begins (2) Vegetation plot establishment	Ungulate Exclosure Fencing ends	-
Studies and Research	Base-wide vegetation surveys	-	-	-	-
Avoidance and Minimization Measures	Continuous and commensurate with specific construction projects and aircraft operations				
Snake Interdiction, Control and Research	Continuous				
Adaptive Management and Monitoring	As needed. Management decisions will be based on vegetation studies (FY07), multi-year noise studies, and other recommended actions.				

[a] *FY October 1 to September 30.*
[b] *Unmanned aerial vehicle (UAV).*

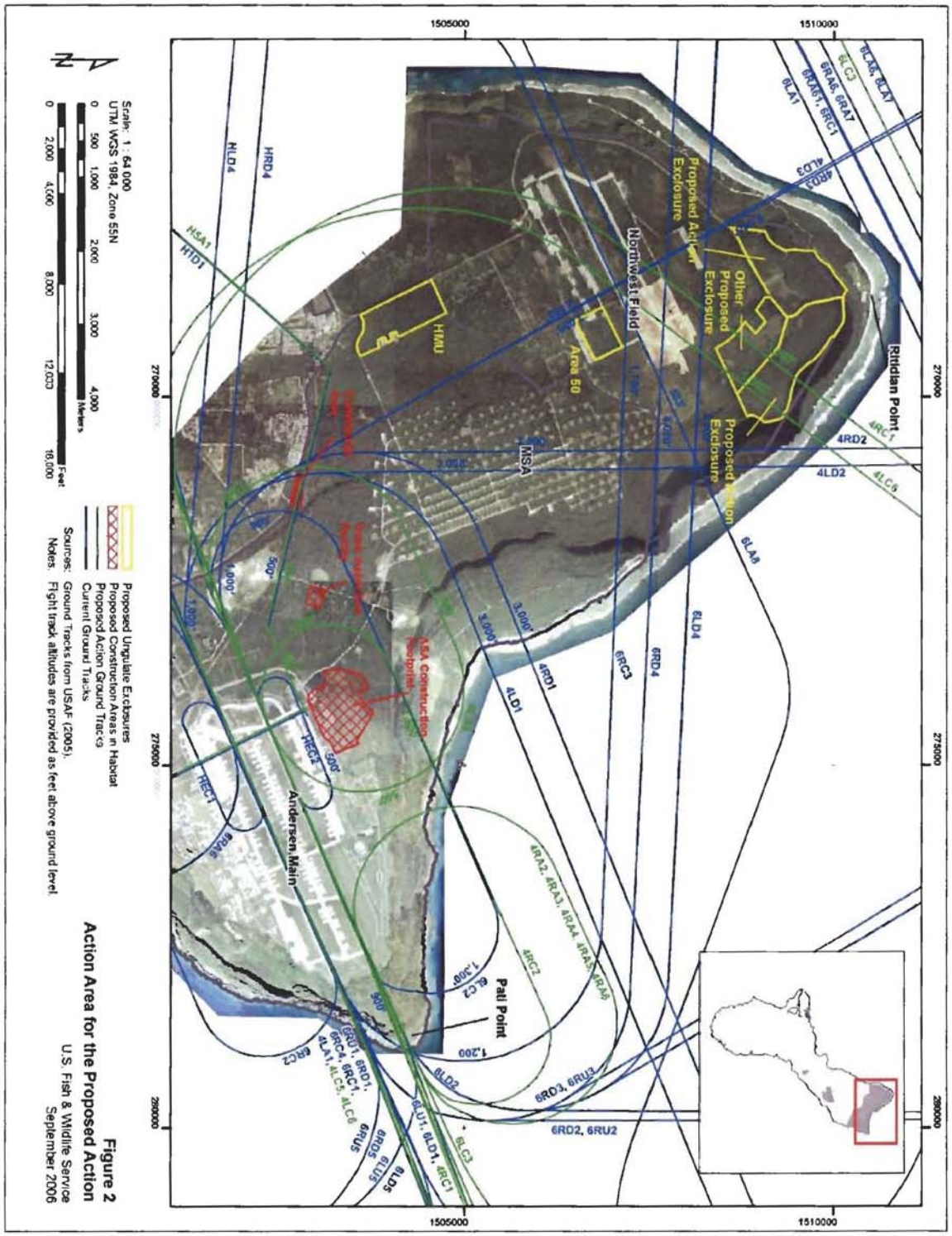

Figure 2
Action Area for the Proposed Action
U.S. Fish & Wildlife Service
September 2006

The Aircraft Staging Area includes approximately 23 different facilities, taxiways, and aircraft parking aprons constructed to support F-22 or F-15E aircraft operations. Construction of the Aircraft Staging Area is expected to begin in FY10 and is expected to be completed after FY17 (see Table 1). Up to 48 fighter aircraft will be stored at the facility, and operational activity at the facility is expected to occur throughout the day and night. Approximately 74 hectares (ha) (184 acres [ac]) of vegetation will be cleared for the Aircraft Staging Area facilities and road construction (Table 2).

Table 2. Estimated Quantity of Vegetation to be Cleared as Part of the ISR/Strike Project

Vegetation Type	Cleared Area	
	Hectares	Acres
Aircraft Staging Area		
Neisosperma - Macaranga Forest	1.4	3.5
Guamia - Premna Forest	9.0	22.2
Guamia Forest	16.9	41.8
Aglaia – Guamia Forest	20.5	50.7
Hibiscus - Leucaena Shrub	6.0	14.8
Herbaceous Scrub	12.6	31.1
Aircraft Staging Area Subtotal	66.4	164.1
Commercial Entry Gate		
Guamia Forest	0.2	0.5
Vitex - Elaeocarpus Forest	1.8	4.4
Hibiscus - Leucaena Shrub	0.5	1.2
Herbaceous Scrub	1.0	2.5
Commercial Entry Gate Subtotal	3.5	8.6
Truck Inspection Facility		
Guamia Forest	0.5	1.2
Hibiscus - Leucaena Shrub	0.7	1.7
Herbaceous Scrub	2.8	6.9
Truck Inspection Facility Subtotal	4.0	9.9
Total All Facilities	**73.9**	**182.6**

The proposed Commercial Entry Gate and Truck Inspection Facility will be constructed in FY09 and FY10 (see Table 1). The Commercial Entry Gate will be constructed along Route 9 to allow for commercial and contractor vehicles to enter the base on the west side of Andersen main (see Figure 2). The Entry Gate will require a paved entry with gate, security fence, and small facility for security personnel. The amount of vegetation that will be cleared for the Entry Gate equates to 4 ha (9 ac). The Truck Inspection Facility will be constructed east of the Commercial Entry Gate for the purpose of inspecting vehicles and material delivered to the base (see Figure 2). The amount of vegetation that will be cleared for the Truck Inspection Facility is approximately to 4 ha (10 ac).

The existing road connecting the proposed Commercial Entry Gate and Truck Inspection Facility will be repaved to a width of 7 meters (m); 24 feet (ft) with 1-m (3-ft) shoulders on each side, for a total width of 9 m (31 ft). Because the existing road corridor can accommodate proposed road modifications, vegetation clearing within the existing road corridor will be minimal and limited

to removal of herbaceous or shrubby vegetation. Street lights will be installed along the road between the Commercial Entry Gate and the Truck Inspection Facility. The street lights will be hooded and illuminated only when the Commercial Entry Gate is in operation.

Aircraft Operations

At full implementation, the proposed ISR/Strike project will base 12 KC-135 tanker aircraft and four unmanned aerial vehicles (UAV) at Andersen AFB. As many as 48 fighter aircraft (F-22A and F-15E) and six bombers (comprising B-1, B-2, and B-52 bombers) will be rotated from other Air Force bases to Andersen AFB. The rotational period for aircraft (and personnel) will be 120 days. The 70 permanently based and rotational aircraft associated with the proposed ISR/Strike project will increase the amount of aircraft at Andersen AFB to 84. Currently, the number of aircraft rotating through Andersen AFB is between 12 and 24, depending on the rotation schedule.

Table 3 lists the projected annual and average daily airfield operations for ISR/Strike aircraft at Andersen AFB, as well as baseline current operations, and reflects the total recurring airfield operations condition after the proposed ISR/Strike project is fully established. Operations for the ISR/Strike aircraft include mission arrivals and departures as well as training sortie arrivals and departures, and closed pattern operations (closed pattern consists of two airfield operations [*i.e.*, one takeoff and one landing accomplished as a touch and go]).

Fighter aircraft flights will occur 240 days per year. Each of the 48 rotational fighter aircrews will fly 72 sorties per year, for a total of 3,456 annual sorties, or an average of 14.4 sorties per flying day. Eighty percent of the fighter operations will be accomplished by F-22 aircraft, and 20 percent will be accomplished by F-15Es. About 30 percent of the training sorties will be accomplished after dark (between 30 minutes after sunset and 30 minutes before sunrise). It is estimated that about 5 percent of the sorties and airfield operations flown during darkness (*i.e.*, 5 percent of 30 percent, or 1.5 percent) will occur between 2200 and 0700, the period known as "environmental nighttime." Depending on the current rotation schedule, between zero and 12 fighter aircraft will rotate through Andersen AFB.

Based Tanker KC-135 aircrews will fly four sorties per day, 240 days per year from Andersen AFB. A typical sortie will include a departure from the base, aerial refueling of receiver aircraft, and an arrival at the base followed by an average of 60 to 90 minutes of instrument approach and closed pattern training before termination. It is estimated that about 13 percent of airfield operations for the tankers will occur during nighttime. Depending on the current rotation schedule, tanker aircraft rotating through Andersen AFB number between four and six.
The UAVs will fly one sortie per day, 220 days per year from Andersen AFB. A typical sortie will include departing from the base, conducting its mission or training, and then returning to the base. A closed pattern will be flown on approximately half of the sorties. It is estimated that about 15 percent of airfield operations for the UAVs will occur during nighttime. Currently, no UAVs are based at Andersen AFB.

Table 3. Current and Proposed Action Annual and Average Daily Airfield Operations on Andersen AFB.

	Arrival and Departure Operations		Closed Pattern Operations		Total Operations	
Aircraft	**Annual**	**Avg. Daily**	**Annual**	**Avg. Daily**	**Annual**	**Avg. Daily**
CURRENT AIRCRAFT OPERATIONS						
Military AIRCRAFT						
EA-6	153	0.42	0	0.00	153	0.42
B-1	453	1.24	0	0.00	453	1.24
B-52	569	1.56	0	0.00	569	1.56
C-5	891	2.44	0	0.00	891	2.44
C-9	927	2.54	0	0.00	927	2.54
KC-10	204	0.56	0	0.00	204	0.56
C-12	88	0.24	0	0.00	88	0.24
C-17	314	0.86	0	0.00	314	0.86
C-20	285	0.78	0	0.00	285	0.78
C-21	606	1.66	0	0.00	606	1.66
C-130	1,956	5.36	0	0.00	1,956	5.36
KC-135	694	1.90	0	0.00	694	1.90
C-141	197	0.54	0	0.00	197	0.54
E-2	796	2.18	0	0.00	796	2.18
F-15	409	1.12	0	0.00	409	1.12
F-16	380	1.04	0	0.00	380	1.04
F-18	1,000	2.74	0	0.00	1,000	2.74
P-3	650	1.78	0	0.00	650	1.78
CH-46	88	0.24	0	0.00	88	0.24
Ch-53	95	0.26	0	0.00	95	0.26
SK-70	183	0.50	0	0.00	183	0.50
UH-60	14,206	38.92	59,648	163.42	73,854	202.34
Subtotal	**25,144**	**68.88**	**59,648**	**163.42**	**84,792**	**232.30**
Transient Civil Aircraft						
B-747	847	2.32	0	0.00	847	2.32
B-757	95	0.26	0	0.00	95	0.26
Subtotal	**942**	**2.58**	**0**	**0.00**	**942**	**2.58**
Total BASELINE	**26,086**	**71.46**	**59,648**	**163.42**	**85,734**	**234.88**
AIRCRAFT ADDED IN THE PROPOSED ACTION						
Fighter						
F-22	5,530	23.04	16,589	69.12	22,119	92.16
$F\text{-}15^{E}$	1,382	5.76	4,147	17.28	5,529	23.04
Fighter Subtotal	6,912	28.80	20,736	86.40	27,648	115.20
Tanker						
KC-135	1,920	8.00	5,760	24.00	7,680	32.00
UAV						
Global Hawk	440	2.00	220	1.00	660	3.00
Bomber						
B-1	432	1.80	864	3.60	1,296	5.40
B-2	96	0.40	192	0.80	288	1.20
B-52	432	1.80	864	3.60	1,296	5.40
Bomber Subtotal	960	4.00	1,920	8.00	38,868	12.00
TOTAL PROPOSED ACTION	**10,232**	**42.80**	**28,636**	**119.40**	**38,868**	**162.20**
TOTAL AIRCRAFT OPERATIONS	**36,318**	**114.26**	**88,284**	**282.82**	**124,602**	**397.08**

Rotational bomber aircrews will fly two sorties per day, 240 days per year from Andersen AFB. Ten percent of the bomber operations will be accomplished by B-2 aircraft, and 45 percent will be accomplished by B-1 and B-52 bombers. A typical sortie will include a departure from the base, weapons training at a range/training airspace complex, low level terrain avoidance procedures training, anti-ship mining operations, and an arrival at Andersen AFB followed by two closed patterns before termination. It is estimated that about 13 percent of airfield operations for the bombers will occur during nighttime. Since 1990, there has been a persistent rotational presence of bombers at Andersen AFB. Currently, six bombers rotate through Andersen AFB.

Personnel, Household Goods, Equipment, and Aircraft Movement

When fully established, the ISR/Strike capability will increase the population at Andersen AFB by about 3,000 people when combining the additional military, Air Force civilian and contractor, personnel and dependents. The additional 3,000 people on Andersen AFB associated with the proposed ISR/Strike project will increase the base population to approximately 8,900 people. Because of the shortage of skilled labor on Guam, off-base personnel will be expected to increase temporarily to as many as 1,800 workers during construction periods.

It is expected that 650 permanently assigned personnel will be at Andersen AFB for two or three years at a time. Based on a three-year assignment duration, about 220 of the permanently assigned personnel and associated dependents will depart Andersen AFB and Guam by commercial air carrier flights that use Guam International Airport (see Figure 1). The majority of household goods belonging to the permanently assigned personnel will be transported in cargo ships out of Apra Harbor. Based on three rotations per year (each 120 days), and 48 fighters, 6 bombers, and 1,250 personnel per rotation, it is estimated that 3,750 personnel will rotate to/from Andersen AFB annually. Rotational personnel will also travel to and from Guam by contract commercial aircraft.

Conservation Measures

During the consultation process, the Service and the Air Force worked cooperatively to develop ways to reduce impacts to listed species, specifically the Mariana fruit bat, Mariana crow, Guam Micronesian kingfisher, and Guam rail. The Air Force included conservation measures as part of the proposed action to reduce impacts resulting from the establishment of the proposed ISR/Strike project. The conservation measures correspond to recovery actions outlined in the draft revised Mariana crow (USFWS 2005a) and Guam Micronesian kingfisher (USFWS 2004a) recovery plans and the Guam rail (USFWS 1990a) and Mariana fruit bat (USFWS 1990b) recovery plans. All conservation measures that involve activities on the Refuge Overlay unit will be coordinated with Guam National Wildlife Refuge staff. The following descriptions of the conservation measures for the proposed ISR/Strike project are summarized from the associated Draft EIS (Air Force 2006b). For the purposes of this biological opinion, the conservation measures are grouped into six categories - additional staffing for the conservation program, habitat improvement measures, studies and research, brown treesnake interdiction and control, avoidance and minimization measures, and monitoring.

Additional Staffing – The Air Force will hire a Wildlife Management Specialist by FY08 to carry out day-to-day field operations of the Andersen AFB conservation program. The wildlife management specialist will be supported by other environmental program staff, as well as a number of volunteer conservation officers. The assigned duties of the wildlife management specialist will include: a) oversight of barrier construction in sites detailed in this document; b) acting as coordinator and Andersen AFB point of contact for ungulate eradication efforts; c) day-to-day management of the Andersen AFB recreation ungulate hunting and depredation programs; d) fenceline reconnaissance for maintenance needs; and e) day-to-day coordination with the Service and other resource agencies.

Habitat Improvement – The Air Force adjusted the construction footprint within the Aircraft Staging Area to reduce clearing within areas of relatively intact forest. Adjusting the footprint precludes the clearing of an 8-ha (20-acre) pocket of relatively high quality forest, containing potential Mariana fruit bat, Mariana crow, and Guam Micronesian kingfisher habitat.

Coordination with the Service and the Guam Division of Aquatic and Wildlife Resources will be sought to develop a multi-year ungulate control plan in FY08. The plan will be designed to guide Andersen AFB ungulate eradication, depredation, and recreational hunting issues managed by the proposed Wildlife Management Specialist. Consultants, with appropriate and recognized experience, will be used to develop the plan. The plan will be implemented by the proposed Andersen AFB Wildlife Management Specialist, conservation officers, and other management stakeholders. The plan will focus on successful implementation of ungulate eradication within the ungulate exclosure areas (see below) and the reduction of ungulate densities in non-fenced areas. Control and monitoring techniques will be clearly defined in the ungulate control plan.

To offset the loss of habitat from clearing and aircraft operations associated with the proposed action, two areas totaling approximately 200 ha (494 ac) will be fenced to prevent incursion of deer and pigs. Construction of the ungulate exclosure fence will begin in FY10 and be completed by FY13 (see Table 1). An eradication program will be managed by the Wildlife Management Specialist within exclosure areas. The intent of exclosure fencing is to facilitate forest regeneration by eliminating ungulate browsing pressure, so emergent canopy species may be replaced by saplings. Final placement of the exclosure units will be coordinated with the Service (Guam National Wildlife Refuge and Ecological Services) and Guam Division of Aquatic and Wildlife Resources. Further, the Andersen AFB General Plan will be modified to include a special conservation designation for the exclosure areas after the units are finalized. Assuming that cliff lines can serve as effective barriers to ungulate entry, cliff lines will not be fenced. Leveraging cliff lines as barriers will reduce forest clearing and disturbance necessary for fence construction. The proposed exclosure fencing will involve construction of 3,400 m (11,155 ft) of fenceline, using suitable posts and fencing material sufficient to prevent ungulate incursion and to withstand Guam's environmental conditions (*e.g.*, sea spray, high winds, humidity).

The Air Force proposes to reduce impacts to *Tabernaemontana rotensis*, a rare tree species. There are at least 15 locations containing approximately 1,000 *T. rotensis* trees within the ISR/Strike area. The majority of the trees are saplings, and the remaining are mature trees. *Tabernaemontana rotensis* saplings respond well to transplanting. Prior to construction (FY10),

a landscaping crew will remove the saplings and transplant them outside the project area(s). At the same time, a landscaping crew will collect *T. rotensis* seeds for outplanting outside the project area. This will offset the impacts to *T. rotensis* individuals from construction operations within the project areas.

Vegetation plots containing native tree species utilized by Mariana fruit bats and Mariana crows will be established within ungulate exclosure units by FY11. This conservation measure will contribute to existing foraging habitat with native trees important to the Mariana fruit bat and Mariana crow. The finalized list of tree species will be dependent on commercial nursery or herbarium stocks, and will be coordinated with the Service, Guam Division of Aquatic and Wildlife Resources forestry personnel, University of Guam herbarium personnel, and the U.S. Department of Agriculture Natural Resources Conservation Service field office. Supplemental protective fencing to prevent browse pressure within foraging plots will line the perimeter of the foraging plots. Additional management actions within these plots will include herbaceous vegetation control, fenceline maintenance, and quarterly monitoring of outplanting success. The goal of this conservation measure is to improve habitat outside the ISR/Strike project areas for Mariana fruit bats and Mariana crows.

Studies and Research – The Air Force has also committed to a base-wide vegetation survey, funded to begin in FY07. This survey will characterize vegetation composition and structure throughout the forested areas of Andersen AFB. Vegetation surveys of habitat areas for the Mariana fruit bat, Mariana crow, and Guam Micronesian kingfisher will be conducted to target management resources for species recovery.

Ungulate management on Andersen AFB will be enhanced by information obtained by ungulate movement studies. This could be done through radio telemetry or newer technologies and specific research related to ungulate management may be suggested in the aforementioned multi-year ungulate control plan to be developed in FY08. Outside experts may need to be contracted by the Air Force to conduct this work but the Air Force's proposed Wildlife Management Specialist will provide technical support for such research activities, including anesthetizing deer and pigs for radio tagging. The proposed Wildlife Management Specialist may also provide technical assistance for dressing of carcasses for stomach content analysis or wildlife disease studies.

In an effort to increase survivorship of Mariana fruit bat pups at the Pati Point colony, the Air Force proposed to provide funding to trap or bait brown treesnakes at the Pati Point roost site. However, due to concern about the efficacy of current control techniques for the proposed effort and the potential impacts of human disturbance, the Air Force will not be undertaking this project using currently available control techniques. Instead, the Air Force will be consulting with the U.S. Department of Agriculture – Animal, Plant, Health Inspection Service – Wildlife Service's National Wildlife Research Center Headquarters in Fort Collins, Colorado to determine the most effective and least disruptive control strategies. Resulting research requirements will be finite projects that will assist in the development or refinement of snake control techniques that will assist in management of Mariana fruit bat roosts through the adaptive management strategy (see "Avoidance and Minimization Measures" below). The scope of work for this effort will be reviewed annually by Andersen Air Force and Service staff with in put from the Guam Division

of Aquatic Wildlife Resources staff and U.S. Department of Agriculture – Animal, Plant, Health Inspection Service – Wildlife Services Operations staff. Rapid implementation of brown treesnake research products by management agencies for Mariana fruit bat conservation efforts on Guam is the focus of this effort. The Department of Defense has been funding applied research for brown treesnake control via U.S. Department of Agriculture – Animal, Plant, Health Inspection Service – Wildlife Service's National Wildlife Research Center since 1992.

Brown Treesnake Interdiction and Control – To prevent brown treesnakes from leaving Guam in any Air Force cargo, vehicles, munitions, household goods, and other items the Air Force will program for and facilitate a 100 percent inspection rate for all of these items departing Guam from Andersen AFB or other sites on Guam where they are staged for departure from Guam (see Appendix C of Air Force 2006b). The Air Force will implement this effort by providing funds to support sustained brown treesnake trapping, capture, and toxicant use efforts by the U.S. Department of Agriculture – Wildlife Services (Wildlife Services) in the vicinity of sites where Andersen AFB cargo, munitions, vehicles, and other items are staged, stored, or packed prior to departing Guam. To insure that adequate funding is available for the 100 percent inspection rate during periods of peak movement of Air Force cargo, vehicles, munitions, household goods, and other items shipped from Guam, the Air Force will develop a mechanism, with Wildlife Services and the Service, that will forecast and program funding with the Air Force's or Andersen AFB's annual budgeting cycle to ensure adequate funding is available for Wildlife Services to maintain a 100 percent inspection level for these items at least 18 months in advance. Also, to insure that the orders to inspect cargo meet the Department of Defense's Defense Transportation Regulations, Chapter 505 protocols of these regulations (Appendix 1) will be incorporated into the Andersen AFB 36 WG Instruction 32-7004, Brown Tree Snake Management. (Appendix C of Air Force 2006b).

The Air Force will also actively seek sustained Department of Defense funding for applied research efforts by the U.S. Department of Agriculture- Wildlife Services-National Wildlife Research Center related to brown treesnake control. The applied research efforts will focus on: 1) developing aerial broadcast techniques for toxicants; 2) development of artificial lures and attractants for brown treesnakes; and 3) development of more cost-effective strategies to control or eliminate brown treesnakes in quarantine and field situations. The research scope and direction of these efforts will be determined by the Air Force, Service, Wildlife Services Operations, and Wildlife Services-National Wildlife Research Center staff through annual and multi-year plans with discrete, finite applied goals. These efforts are expected to increase the effectiveness of the brown treesnake interdiction program, support large-scale snake control programs for listed species, and may reduce the cost of brown treesnake control on Guam.

Finally, to evaluate the effectiveness of the inspection program, the Air Force will have Wildlife Services provide monthly reports on their operations. In addition, the Air Force will review the status of the inspection program quarterly with the Service and Wildlife Services and at the annual brown treesnake meeting in Honolulu, Hawaii. The monthly reports will provide details on which cargo was inspected or un-inspected, potential level of risk of cargo type, and where the cargo was shipped (mainland United States, United States Territories, and Hawaii). The report will also provide a simple explanation of why specific cargo shipments were missed and document all snake detections by canines or other high risk incidents. This report will be

submitted to the Service, Air Force (Pacific Air Forces, Andersen AFB Commander, and Environmental Flight), State of Hawaii(Department of Agriculture and Department of Land and Natural Resources), Commonwealth of the Northern Mariana Islands (Division of Fish and Wildlife), and Air Force Cooperators.

Avoidance and Minimization Measures – To avoid and/or minimize potential project impacts to the Mariana fruit bat and Mariana crow, the Air Force has incorporated the following measures into its project:

- To avoid impacts to nesting Mariana crows, the Air Force will initiate construction activities at the Aircraft Staging Area, Commercial Entry Gate, Truck Inspection Facility, and Ungulate Exclosure areas; and conduct ungulate eradication in the Ungulate Exclosure areas and the Vegetation Assessment outside the Mariana crow breeding season (October to April). In addition, one week prior to clearing vegetation and conducting ungulate eradication, the Air Force will have a biologist (approved by the Service and the Guam Division of Aquatic and Wildlife Resources) survey the proposed project site and adjacent areas to determine if Mariana crows are in the area. If crows are nesting within 300 m (984 ft) of the project site, construction/clearing activities and ungulate eradication within 300 m (984 ft) of the nest will be postponed until the breeding attempt is completed, resulting in either successful fledging or nest failure. The Air Force will also coordinate with the Guam Division of Aquatic and Wildlife Resources during the Vegetation Assessment to postpone vegetation sampling within 300 m (984 ft) of a Mariana crow nesting until the breeding attempt is completed.
- To avoid impacts to foraging Mariana fruit bats, the Air Force will only allow construction activities at the Aircraft Staging Area, Commercial Entry Gate, Truck Inspection Facility, and Ungulate Exclosure areas during the day. In addition, hooded lights will be used outside the Aircraft Staging Area, Commercial Entry Gate and Truck Inspection Facility, and for all streetlights along roads connecting these facilities.
- To avoid impacts to roosting Mariana fruit bats, the Air Force will have a biologist (approved by the Service and Guam Division of Aquatic and Wildlife Resources) survey the Aircraft Staging Area, Commercial Entry Gate, Truck Inspection Facility, and Ungulate Exclosure area and areas within 150 m (492 ft) of these proposed project sites to determine if Mariana fruit bats are in the area. If Mariana fruit bats are observed within 150 m (492 ft) of the project site, construction will be delayed within 150 m (492 ft) of the bat(s) until the bat(s) have left the area.
- To minimize impacts to Mariana fruit bats on Guam if the Pati Point colony roosting location is abandoned for other on-base locations, the Air Force will: 1) increase security patrols utilizing conservation officers and/or base security around newly established roost sites to decrease the likelihood of illegal hunting; 2) close public hunting areas near new roost sites to limit access and decrease the likelihood of illegal hunting; and 3) implement the brown treesnake control, utilizing measures developed for use at roost sites, at newly established roost sites to increase breeding success.
- To minimize impacts to Mariana fruit bats from Rota that may migrate to Guam after a typhoon event on Rota, the Air Force will provide travel assistance for a Service Special Agent to go to Rota after a typhoon event to decrease the likelihood of illegal hunting on Rota.

- To avoid potential impacts to Mariana crows nesting under ground tracks below 305 m (1,000 ft), the Air Force has agreed to increase the altitude of those ground tracks to at least 305 m (1,000 ft) during the Mariana crow breeding season (October to April).

To avoid, minimize, and/or offset potential unknown impacts to any listed species during the life of the project, the Air Force will develop an Adaptive Management Strategy that will incorporate the conservation measures described here and any additional measures that may be needed. The goals of this Adaptive Management Strategy are to minimize and avoid project impacts to listed species and maintain and increase listed species populations on Andersen AFB, including reestablishing Guam Micronesian kingfishers and Guam rails. A formalized written strategy will include the following: a) time frame for completing its implementation phase; b) identification of priority actions; c) methods for minimizing and/or avoiding impacts to listed species; d) definitions of success for proposed impact minimization, avoidance, and offsetting measures; e) methods for monitoring, data tracking, analysis and feedback; f) a cost estimate for plan implementation; and g) a methodology to increase listed species population on Guam.

This formal strategy will be developed by the Air Force and will include an Adaptive Management Team consisting of Air Force, Service (Ecological Services and the Guam National Wildlife Refuge), and Guam Division of Aquatic and Wildlife Resources biologists familiar with the species and their conservation. The Adaptive Management Team will use data collected from the research and monitoring to evaluate impacts caused by the proposed activities and identify additional measures to minimize, avoid, and/or offset those impacts. Potential management measures that may be included in the strategy are: 1) aircraft noise reduction (*e.g.*, modifying ground track location and flight profile of aircraft without creating a flight hazard or noncompliance with the aircraft flight manual and potential efforts to increase populations), 2) threat removal (*e.g.*, controlling brown treesnake populations at Mariana fruit bat roost sites, Mariana crow nests, and Mariana crow breeding territories, and preventing illegal Mariana fruit bat hunting on Andersen AFB), 3) population enhancement (*e.g.*, supporting on-base aspects of Mariana crow aviculture enhancement and reintroduction efforts for listed species), and 4) efforts to establish and maintain Mariana fruit bat, Mariana crow, Guam Micronesian kingfisher, and Guam rail populations on Guam.

The Adaptive Management Team will review the progress of the Adaptive Management Strategy annually, and make recommendations to the Air Force as to needed modifications. The Adaptive Management Team may also advise that sections of the written strategy reviewed and improved by appropriate species and conservation experts. The Service and Adaptive Management Team will approve the basic written strategy as well as subsequent changes to ensure it meets the goals of avoidance, minimization, and species recovery efforts. The approved strategy will be incorporated or attached to the Andersen AFB Integrated Natural Resources Management Plan. The Plan's formal updates carry the Service as a signatory under the Sikes Act Improvement Amendments.

The Adaptive Management Team will be formed by February 1, 2007, and will communicate regularly at first to formalize the strategy and then meet annually to evaluate monitoring and research activities. The formal Adaptive Management Strategy is scheduled for completion by September 2007 and will be revised as needed prior to implementation of Phase 2 (approximately September 2013) and Phase 3 (approximately September 2016) of the proposed project.

Monitoring – The Air Force will conduct a multi-year program to monitor Mariana fruit bats and Mariana crows. The goals of this program will be to monitor the status of Mariana fruit bats and Mariana crows and evaluate project impacts on these two species. This program will involve: 1) monitoring Mariana fruit bat numbers at the Pati Point roost site and any additional roost sites established if the Pati Point site is abandoned, 2) monitoring impacts of aircraft overflights on Mariana fruit bats at the Pati Point roost site, 3) monitoring the status of fruit bat(s) that utilize the Aircraft Staging Area site before and after construction, and 4) monitoring impacts of aircraft overflights on Mariana crow nesting success. All monitoring will be conducted by a properly credentialed biologist(s) and final selection will be coordinated with the Service and Guam Division of Aquatic and Wildlife Resources.

The specific methodology utilized for the monitoring will be developed and incorporated into the formal Adaptive Management Strategy by the Adaptive Management Team with input from appropriate species and conservation experts as needed. Additionally, the Service will have final approval of the methodology and actual implementation to ensure the techniques avoid and/or minimize impacts ("take" per the Endangered Species Act) to listed species. Monitoring Mariana fruit bat responses to aircraft overflights will begin prior to the proposed south runway repair project and the first phase of the proposed increase in aircraft operations (FY09) to obtain baseline data on bat responses and will continue, at a minimum, until the project is fully implemented. The Mariana fruit bat(s) utilizing the Aircraft Staging Area site will be monitored prior to clearing the site in FY 08 (see Table 1) and for at least one year after clearing is completed. Mariana crow nest monitoring will begin prior to the first phase of the proposed increase in aircraft operations (FY09) to obtain baseline data on crow responses and will continue, at a minimum, until the proposed project is fully implemented. As noted above, the Adaptive Management Team will use the data collected from these monitoring efforts to evaluate impacts caused by the proposed activities and identify additional measures to minimize, avoid, and/or offset those impacts.

Status of the Species

Mariana Fruit Bat

Species Description – The Mariana fruit bat or flying fox, known as "fanihi" in Chamorro, is a medium-sized fruit bat in the family *Pteropodidae* that weighs 330 to 577 grams (0.66 to 1.15 pounds). Males are slightly larger than females. The underside (abdomen) is black to brown with gray hair interspersed that creates a grizzled appearance. The shoulders (mantle) and sides of the neck are bright golden brown, but may be paler in some individuals. The head varies from brown to dark brown. The well-formed, rounded ears and large eyes give the face a canine appearance.

Listing Status – The Guam population of the Mariana fruit bat was listed as endangered in 1984 (USFWS 1984). However, in 2005 the subspecies was listed as threatened throughout the Mariana archipelago and downlisted to threatened on Guam (USFWS 2005b). On October 28, 2004, approximately 152 ha (376 ac) were designated as critical habitat for the Mariana fruit bat on Guam (USFWS 2004b). All critical habitat for the species is found on the fee simple portion of the Guam National Wildlife Refuge (see Figure 2).

Historic and Current Distribution – This subspecies of *Pteropus mariannus* is endemic to the Mariana archipelago, where it is found on most of the 15 major islands. To the best of our knowledge, there are no records of fruit bats on Uracas, and fruit bats have been observed only once on Farallon de Medinilla.

No known historical records exist to document the status of the Mariana fruit bat prior to the 20th century. Surveys on most or all islands in the archipelago were conducted in 1983 (Wiles, *et al.* 1989), 2000 (Cruz, *et al.* 2000a-f), and 2001 (Johnson 2001). The relatively isolated northern islands support the majority of the fruit bats in the archipelago, but because of their remote location, these islands have not been surveyed as frequently as the southern islands (*i.e.,* Saipan, Tinian, Aguiguan, and Rota). Individual surveys have been conducted on several of the southernmost islands at relatively frequent intervals (*e.g.,* Kessler 2000; Worthington, *et al.* 2001; Wiles and Johnson 2004). Because of the similarity of the methods used by Wiles and others (1989) and Cruz and others (2000a-f), we considered only these two multi-island surveys for purposes of comparison (Table 4). A conservative interpretation of these data indicates a 37 percent decline in fruit bat numbers between 1983 and 2000 among the six northern islands surveyed in both years. The majority of this decline was recorded on two of the three largest northern islands, Anatahan and Pagan, which together harbored roughly 70 percent of the archipelago's fruit bats in the 1980s (Wiles, *et al.* 1989).

On Guam, the sighting of fruit bats was considered to be "not...uncommon" in the 1920s (Crampton 1921). Woodside (1958) reported that in 1958, the Guam population was estimated to number no more than 3,000, although the method used to make this estimate is not known. This estimate had dropped to between 200 and 750 animals by 1995 (Wiles, *et al.* 1995; Wiles 1996). The most recent surveys on Guam put the bat population at fewer than 50 individuals (Aguon, C., pers. comm. 2006).

Ecology – During the day, Mariana fruit bats roost in colonies of a few to over 800 animals (Wiles 1987a; Pierson and Rainey 1992; Worthington and Taisacan 1995). Bats are typically grouped into harems (one male and two to 15 females) or bachelor groups (predominantly males). Some single males reside at the colony's periphery (Wiles 1987a). On Guam, the average estimated sex ratio in one colony varied from 37.5 to 72.7 males per 100 females (Wiles 1982a).

Table 4. Summary of Mariana Fruit Bat Survey Results: Minimum Estimates[1]

Island	Area Sq. mi (Sq. km)	Estimated Number of Bats 1983[2]	Estimated Number of Bats 2000[3]
Maug	0.8 (2.0)	<25	not surveyed
Asuncion	2.9 (7.4)	400	not surveyed
Agrihan	18.3 (47.4)	1,000	1,000
Pagan	18.4 (47.7)	2,500	1,500
Alamagan	4.3 (11.0)	0	200
Guguan	1.5 (4.0)	400	350
Sarigan	1.9 (5.0)	125	200
Anatahan	12.5 (32.3)	3,000	1,000
Subtotal (Northern Islands) [Subtotal six islands]		7,450 [7,025]	[4,250]
Saipan	47.5 (122.9)	<50	not surveyed
Tinian	39.3 (101.8)	<25	not surveyed
Aguiguan	2.7 (7.0)	<10	150-200
Rota	37.0 (95.7)	800-1,000	not surveyed
Guam	212.0 (549.0)	425-500	not surveyed
Subtotal (Southern Islands)		1,310-1,585	insufficient data
TOTAL (All Islands)		**8,760-9,035**	**insufficient data**

[1] *Two of the northern islands are not included in Table 3: Uracas, the most northerly, where fruit bats are not known to occur; and Farallon de Medinilla, where fruit bats have been observed on only one occasion.*

[2] *Wiles, et al. 1989. Dates: August 17-September 10, 1983; 1-4 days/island. Count methods: Evening dispersal counts at colonies; evening station counts of solitary fruit bats.*

[3] *Cruz, et al. 2000a-f. Dates: June 4-August 16, 2000; 7-9 days/island. Count methods: Evening dispersal counts at colonies, evening and morning station counts of solitary fruit bats.*

Reproduction in Mariana fruit bats has been observed year-round on Guam (Perez 1972; Wiles 1983) and on Rota; individual females have a single offspring each year (Pierson and Rainey 1992). Wiles (1987a) found no apparent peak in births on Guam, but a peak may occur in May and June on Rota (Glass and Taisacan 1988). Although specific data for the Mariana fruit bat are lacking, female bats of the family *Pteropodidae* have one offspring per year, generally are not sexually mature until at least 18 months of age, and have a gestation period of four to six months (Pierson and Rainey 1992). The average lifespan of this species is unknown; the longevity of a similar species in Australia is four to five years, with a maximum of eight years (Vardon and Tidemann 2000).

Roost sites are an important aspect of the Mariana fruit bat's biology because they are used for sleeping, grooming, breeding, and intra-specific interactions (USFWS 1990b). Published reports of roost sites on Guam indicate these sites occur in mature limestone forest and are found within 100 m (328 ft) of 80 to 180 m (262 to 591 ft) tall clifflines (USFWS 1990b). On Guam, Mariana fruit bats prefer to roost in mature *Ficus* spp. and *Mammea odorata* trees, but will also

roost in other tree species such as *Casuarina equisetifolia*, *Macaranga thompsonii*, *Guettarda speciosa*, and *Neisosperma oppositifolia* (Wheeler and Aguon 1978; Wiles 1981, 1982b). On other islands in the Mariana archipelago, Mariana fruit bats have been observed in secondary forest and *Casuarina equisetifolia* groves (Glass and Taisacan 1988, Worthington and Taisacan 1996, Worthington, *et al.* 2001). Factors involved in roost site selection are not clear, but data from Guam indicate that some sites may be selected for their inaccessibility by humans and, thus, limited human disturbance. Fruit bats will abandon roost sites if disturbed and have been reported to move to new locations up to ten kilometers (km) (six miles [mi]) away (USFWS 1990b).

Several hours after sunset, bats depart their roost sites to forage for fruit and other native and non-native plant materials such as leaves and nectar (USFWS 1990a). This species feeds on a variety of plant material but is primarily frugivorous (Wiles and Fujita 1992). Specifically, Mariana fruit bats forage on the fruit of at least 28 plant species, the flowers of 15 species, and the leaves of two plant species (Wiles and Fujita 1992). Some of the plants used for foraging include *Artocarpus* sp., *Carica papaya*, *Cycas circinalis*, *Ficus* spp., *Pandanus tectorius*, *Cocos nucifera*, and *Terminalia catappa*. Many of these plant species are found in a variety of forested habitats on Guam, including limestone, ravine, coastal, and secondary forests (Stone 1970; Raulerson and Rhinehart 1991). Little is known about their nightly movements, but fruit bats have been observed foraging as far as 12 km (7 mi) from known roosting sites on Guam (Wiles, *et al.* 1995).

Threats – The primary threats to the Mariana fruit bat throughout its range are habitat destruction and modification and illegal hunting (USFWS 2005b). In addition, predation by brown treesnakes threatens the Mariana fruit bat on Guam (USFWS 2005b).

Mariana Crow

Species Description – The Mariana crow, known as "aga" in Chamorro, is a forest dwelling crow in the family *Corvidae*. Males and females look outwardly similar but, on average, females (242 grams [8.5 ounces]) weigh less than males (256 grams [9.0 ounces]; Baker 1951). The adult Mariana crow is black with brown eyes, a slender, black bill, and short visible nasal bristles. With the exception of the occasional brown gloss to its tail, the immature Mariana crow resembles an adult.

Listing Status – The Mariana crow was listed as endangered in 1984 (USFWS 1984). On October 28, 2004, approximately 152 ha (376 ac) were designated as critical habitat for the Mariana crow on Guam, and 2,552 ha (6,033 ac) were designated on Rota (USFWS 2004b). All critical habitat for the species on Guam is found on the fee simple portion of the Guam National Wildlife Refuge (see Figure 2).

Historic and Current Distribution – The Mariana crow is endemic to the two southernmost islands of the Mariana archipelago, Rota and Guam. In 1976, Mariana crows were considered relatively common and widely distributed on Rota (Pratt, *et al.* 1979). The first island-wide survey for the species on Rota in 1982 resulted in a population estimate of 1,318 individuals (Engbring, *et al.* 1986). Subsequent surveys in 1995 and 1998 indicate the population had

declined to 592 individuals and 234 breeding adults, respectively (Fancy, *et al.* 1999; Plentovich, *et al.* 2005).

Mariana crows were once considered abundant and widely distributed throughout Guam (Baker 1951). However, by the mid-1960s, Mariana crows had disappeared from the southern region of Guam, and by the mid-1970s, they were absent from central Guam (Jenkins 1983). By 1981, the population was restricted to northern Guam and consisted of less than 400 individuals (Engbring and Ramsey 1984). Ten years later, in 1991, fewer than 50 individuals were found on Guam (Wiles, *et al.* 1995). Between 1997 and 2003, 26 Mariana crows were translocated from Rota and released on Guam (USFWS 2005a). Currently, the Guam population consists of 11 individuals (Quitigua, J., pers. comm. 2006).

Ecology – Mariana crows are omnivorous and forage at all heights in the forest and on the ground. They have been observed to feed on a variety of native and non-native invertebrates, reptiles, young rats, and bird eggs, as well as on the foliage, buds, fruits, and seeds of at least 26 plant species (Jenkins 1983; Tomback 1986; Michael 1987; USFWS 2005a). Mariana crows likely breed year round. However, peak nesting occurs between August and February on Rota (Morton, *et al.* 1999) and October and April on Guam (Morton 1996). Both parents generally participate in building the nest, incubating the eggs, and rearing the chicks through fledging (Morton, *et al.* 1999). Nest construction typically takes a week and the incubation and nestling periods are approximately from 21 to 23 days and 36 to 39 days, respectively (Morton, *et al.* 1999). Clutch sizes range from one to four eggs, and the number of nestlings average 1.42 (n=50; Morton, *et al.* 1999). In general, Mariana crows only produce a single brood a year but nest failure and other factors lead to multiple nest attempts. On Rota, 32 pairs constructed an average of two nests a year and nested up to seven times in one season (Morton, *et al.* 1999). After fledging, Mariana crows will typically remain in family groups until the following breeding season, but fledgling attendance can vary from 99 to 537 days (Morton, *et al.* 1999).

Historically, the distribution of Mariana crows among habitats was similar on Guam and Rota. Crows were known to use secondary, coastal, ravine, and agricultural forests, including coconut plantations (Seale 1901; Stophet 1946; Marshall 1949; Baker 1951; Jenkins 1983), but all evidence indicates they were most abundant in native limestone forests (Michael 1987; Morton, *et al.* 1999). Mariana crow nests on Guam have been found in 11 tree genera, all but one of which are native, but most nests are located high in emergent *Ficus* spp. or *Elaeocarpus joga* trees (Morton 1996; Aguon, C., Guam Division of Aquatic and Wildlife Resources, unpubl. data). On Rota, crows primarily use both mature and secondary limestone forests (Morton, *et al.* 1999). Of 156 nest sites on Rota, 39 percent and 42 percent were in mature and secondary limestone forest, respectively (Morton, *et al.* 1999). Of 161 nest trees found during 1996-99, 63 percent were of four species: fagot, *Eugenia reinwardtiana*, *Intsia bijuga*, and *Premna obtusifolia* (Morton, *et al.* 1999). Individual nest trees averaged 16.9 centimeters (6.7 inches) diameter at breast height and 8.7 m (28.5 ft) high. Canopy cover over nest sites averaged 93 percent and was never less than 79 percent. Nests were located at least 290 m (950 ft) from the nearest road and 62 m (203 ft) from the nearest forest edge, in areas with forest canopy cover that averaged 93 percent. The distances from edges strongly suggest that nesting crows are sensitive to disturbance by humans (Morton, *et al.* 1999).

On Rota, Morton, *et al.* (1999) found that breeding crows on six study areas averaged one pair per 22 ha (50 ac) of forested habitat, and each territory was dominated by native forest. Pair densities ranged from one per 37 ha (91 ac) in relatively fragmented forest, to as high as one pair per 12 ha (30 ac) in mostly intact limestone forest along a coastal terrace. Territories were aggressively defended from July through January, although established pairs occupied these areas throughout the year.

Threats – The primary threats to the Mariana crow throughout its range are habitat destruction and modification, predation by introduced predators like the brown treesnake, and human persecution (USFWS 2005a).

Guam Micronesian Kingfisher

Species Description – The Guam Micronesian kingfisher, known as "sihek" in Chamorro, is a sexually dimorphic forest kingfisher in the family *Alcedinidae* (Baker 1951). The adult male has a cinnamon-brown head, neck, upper back, and under parts. The lower back, lesser and underwing coverts, and scapular feathers are greenish-blue and the tail is blue. The feet and iris of the eye are brown and the bill is black except for some white at the base of the lower mandible. The female resembles the adult male, but the upper breast, chin, and throat are paler and the remaining underparts and underwing lining are white instead of cinnamon. Males weigh between 51 and 64 grams (1.8 to 2.3 ounces), and females weigh between 58 and 76 grams (2 to 2.7 ounces; Baker 1951, Jenkins 1983).

Listing Status – The Guam Micronesian kingfisher was listed as endangered in 1984 (USFWS 1984). On October 28, 2004, approximately 152 ha (376 ac) were designated as critical habitat for the Guam Micronesian kingfisher on Guam (USFWS 2004b). All critical habitat for this subspecies is found on the fee simple portion of the Guam National Wildlife Refuge (see Figure 2).

Historic and Current Distribution – This subspecies of *Halcyon cinnamomina* is endemic to Guam. The other two subspecies occur on the islands of Pohnpei (*H. cinnamomina reichenbachii*) and Palau (*H. cinnamomina pelwensis*). The Guam Micronesian kingfisher was considered "fairly common" and occurred throughout forested areas on Guam in 1945 (Baker 1951). Populations in southern and central Guam disappeared by the 1980s (Jenkins 1983) and only 3,023 individuals were recorded in 1981 in northern Guam (Engbring and Ramsey 1984). This population subsequently declined rapidly, and by 1985 only 30 individuals were recorded on Guam (Marshall 1989). This subspecies was believed extinct in the wild by 1988 (Wiles, *et al.* 2003).

Between 1984 and 1986, 29 Guam Micronesian kingfishers were captured and sent to zoological institutions in the mainland Unites States (Hutchins, *et al.* 1996). As of August 2006, the captive population included 77 individuals in 12 captive breeding institutions (International Species Information System 2006).

Ecology – Guam Micronesian kingfishers feed both on invertebrates and small vertebrates, including insects, segmented worms, hermit crabs, skinks, geckoes, and possibly other small vertebrates (Marshall 1949; Baker 1951; Jenkins 1983). This species typically forages by

perching motionless on exposed perches and swooping down to capture prey on the ground (Jenkins 1983). Guam kingfishers will also capture prey from foliage and have been observed gleaning insects from tree bark (Maben 1982).

This subspecies nests in cavities, and breeding activity appears to be concentrated from December to July (Marshall 1949; Baker 1951, Jenkins 1983). Nests have been reported in a variety of trees, including *Ficus* spp., *Cocos nucifera*, *Artocarpus* spp., *Pisonia grandis*, and *Tristiropsis obtusangula* (Baker 1951; Jenkins 1983; Marshall 1989). Pairs may excavate their own nests in soft trees, arboreal termitaria (the nests of termites [*Nasutitermes* spp.]), arboreal fern root masses, or they may utilize available natural cavities such as broken tree limbs (Jenkins 1983; Marshall 1989). Jenkins (1983) observed that some excavated cavities were never used as nesting sites, which suggests that the process of excavating nest sites may be important in pair-bond formation and maintenance.

Both male and female Guam Micronesian kingfishers incubate eggs and brood and feed nestlings (Jenkins 1983). Clutch sizes from wild populations (n=3) were either one or two eggs (Baker 1951; Jenkins 1983; Marshall 1989) and clutch sizes of one to three eggs have been reported in the captive population (Bahner, *et al.* 1998). Incubation, nestling, and fledgling periods for populations of Guam Micronesian kingfishers in the wild are unknown. However, incubation and nestling periods of captive birds averaged 22 and 33 days, respectively (Bahner, *et al.* 1998).

Jenkins (1983) reported that the Guam Micronesian kingfishers nested and fed primarily in mature, secondary growth, and, to a lesser degree, in scrub limestone forest. It was also found in coastal strand vegetation containing coconut palm as well as riparian habitat. However, Jenkins (1983) reported it was probably most common along the edges of mature limestone forest. Few data exist about specific kingfisher nest sites in the wild, but in one study in northern Guam, 16 nest sites were correlated with closed canopy cover and dense understory vegetation. In this study, nest cavities were excavated in the soft, decaying wood of large, standing dead trees averaging 43 centimeters (17 inches) in diameter (Marshall 1989). Research on the Pohnpei Micronesian kingfisher indicates that an area of approximately 8 to10 ha (20 to 25 ac) of mixed forest and open area may be needed to support a pair of kingfishers (Kesler 2006). Kesler (2006) also noted that at least part of this territory included mature forest. However, it should be noted that Micronesian kingfisher territories may differ from Pohnpei Micronesian kingfisher territories due to differences in forest structure on Guam and Pohnpei (Mueller-Dombois and Fosberg 1998).

Threats – The primary threats to the Guam Micronesian kingfisher are habitat destruction and modification, predation by brown treesnakes, and limited population growth in the captive population (USFWS 2004a).

Guam Rail

Species Description – The Guam rail, known as "koko" in Chamorro, is a flightless rail in the family *Rallidae*. Males and females look outwardly similar but, on average, females (212 grams [8 ounces]) weigh less than males (241 grams [9 ounces]; Jenkins 1979). The head, neck, and eye stripe of the Guam rail are brown, and the eyebrow, lower neck and upper breast are grey.

Their lower breast, abdomen, under tail coverts, and tail are blackish with white barrings. Their legs, feet, and iris are brown and their bill is grey.

Listing Status – The Guam rail was listed as endangered in 1984 (USFWS 1984). No critical habitat for this species has been designated.

Historic and Current Distribution – The Guam rail is endemic to Guam. This species was once distributed throughout Guam, but by 1981 the population was reduced to approximately 2,300 birds and only existed in northern Guam (Engbring and Ramsey 1984; USFWS 1990a). In 1983, it was estimated that fewer than 100 individuals remained, and it was considered extinct in the wild by 1987 (Witteman, *et al.* 1990). In 2003, 129 individuals were in captivity in zoological institutions and Guam Division of Aquatic and Wildlife Resources captive propagation facilities (Lynch, C., pers. comm. 2003). Efforts to establish an experimental population on the island of Rota have been underway since 1989 (Beauprez and Brock 1999a). The current population on Rota is estimated to be between 40 and 70 individuals (Wenninger, P., pers. comm. 2005) but it is not self sustaining and requires annual reintroductions.

Ecology – Guam rails are territorial ground nesters that breed year-round (Jenkins 1979; USFWS 1990a); however, peak breeding may occur during the rainy season (July through November) (Perez 1968). Clutches typically consist of three to four eggs, and broods range from one to four chicks (Jenkins 1979). Guam rails are omnivorous but appear to prefer animal matter over vegetable foods (Jenkins 1979). They have been known to eat gastropods, skinks and geckos, insects, carrion, seeds, and palm leaves (Jenkins 1979). This species is primarily believed to prefer secondary vegetation, though it was found in all habitats except wetlands, though savanna and mature forest may have been marginal habitats (Jenkins 1979; USFWS 1990a ; Wenninger, P., pers. comm. 2006).

Threats – The primary threats to the Guam rail are predation by brown treesnakes and feral cats (*Felis cattus*) (USFWS 1984; 1990a). Predation by brown treesnakes is believed to be the primary factor in the decline of the species on Guam, and high snake populations on Guam still threaten recovery efforts there. However, feral cat predation has been found to be a major obstacle to efforts to establish an experimental population on Rota and to re-establish a population on Guam (Beauprez and Brock 1999a,b).

Environmental Baseline

The action area for the proposed project includes the proposed sites for facility construction and renovation and all the areas on Andersen AFB covered under the flight lines of aircraft included in the proposed project (see Figure 2). Also, because Mariana fruit bats are believed to fly back and forth between Guam and Rota (Wiles and Glass 1990; Esselstyn, *et al.* 2006), individuals in the Mariana fruit bat population on Rota are also included in the action area since these bats may be impacted by the proposed action if they migrate to Guam.

Status of Species in Action Area

Mariana fruit bat - Currently, the Mariana fruit bat colony at Pati Point consists of approximately 30 to 40 individuals (Aguon, C., pers. comm. 2006). The colony has declined severely since the early 1980s when approximately 500 bats were observed at the colony (Wiles 1987a). An unknown number of single bats, potentially juveniles and/or bachelors, roost in forests on Andersen AFB. The bat population on Rota is approximately 550 individuals (Esselstyn, *et al.* 2006). Esselstyn and others (2006) estimated that approximately 100 Mariana fruit bats may have migrated between Rota and Guam after a typhoon in December 2002. Wiles and Glass (1990) estimated that between 225 and 300 have moved between Rota and Guam due to human disturbance or other factors.

As stated in the "Status of the Species" section above, Mariana fruit bats utilize limestone and coastal forest and coconut plantations for foraging and roosting. A detailed assessment of the available Mariana fruit bat habitat on Guam has not been completed. However, using the Donnegan and others (2004) vegetation survey of Guam, limestone forest and plantation forest contain components that Mariana fruit bats utilize for foraging and roosting and may be potential habitat for this species. In 2002, the Service identified approximately 5,803 ha (14,338 ac) in northern Guam as essential habitat for the Mariana fruit bat (USFWS 2002). Utilizing the recent vegetation assessment (Donnegan, *et al.* 2004), it is estimated that approximately 4,867 ha (12,026 ac) of potential Mariana fruit bat habitat is located within these essential habitat areas. Approximately 3,848 ha (9,508 ac) of this habitat is located on Andersen AFB.

Mariana crow – Only 11 Mariana crows are known to occur on Guam, and all are located on Andersen AFB (Quitugua, J., pers. comm. 2006). Nine individuals (four territorial pairs) are located within the Munitions Storage Area, and two individuals (one territorial pair) are located in the northern part of the base near the Guam National Wildlife Refuge (see Figure 3). All of these Mariana crows are located below the flight paths for aircraft associated with this proposed action. However, none of the Mariana crows are located near the proposed Aircraft Staging Area, Commercial Gate, or Truck Inspection Facility areas.

As stated in the "Status of the Species" section above, Mariana crows utilize limestone, secondary, coastal, ravine, and agricultural forests for foraging and nesting. Again, Donnegan and others (2004) vegetation survey of Guam indicates limestone forest and plantation forest contain components that Mariana crows utilize for foraging and nesting and may be potential habitat for this species. In 2002, the Service identified approximately 5,075 ha (12,540 ac) in northern Guam as essential habitat for the Mariana crow (USFWS 2002). Utilizing the recent vegetation assessment (Donnegan, *et al.* 2004), it is estimated that approximately 4,360 ha (10,774 ac) of potential Mariana crow habitat is located within these essential habitat areas. Approximately 3,848 ha (9,508 ac) of this habitat are located on Andersen AFB.

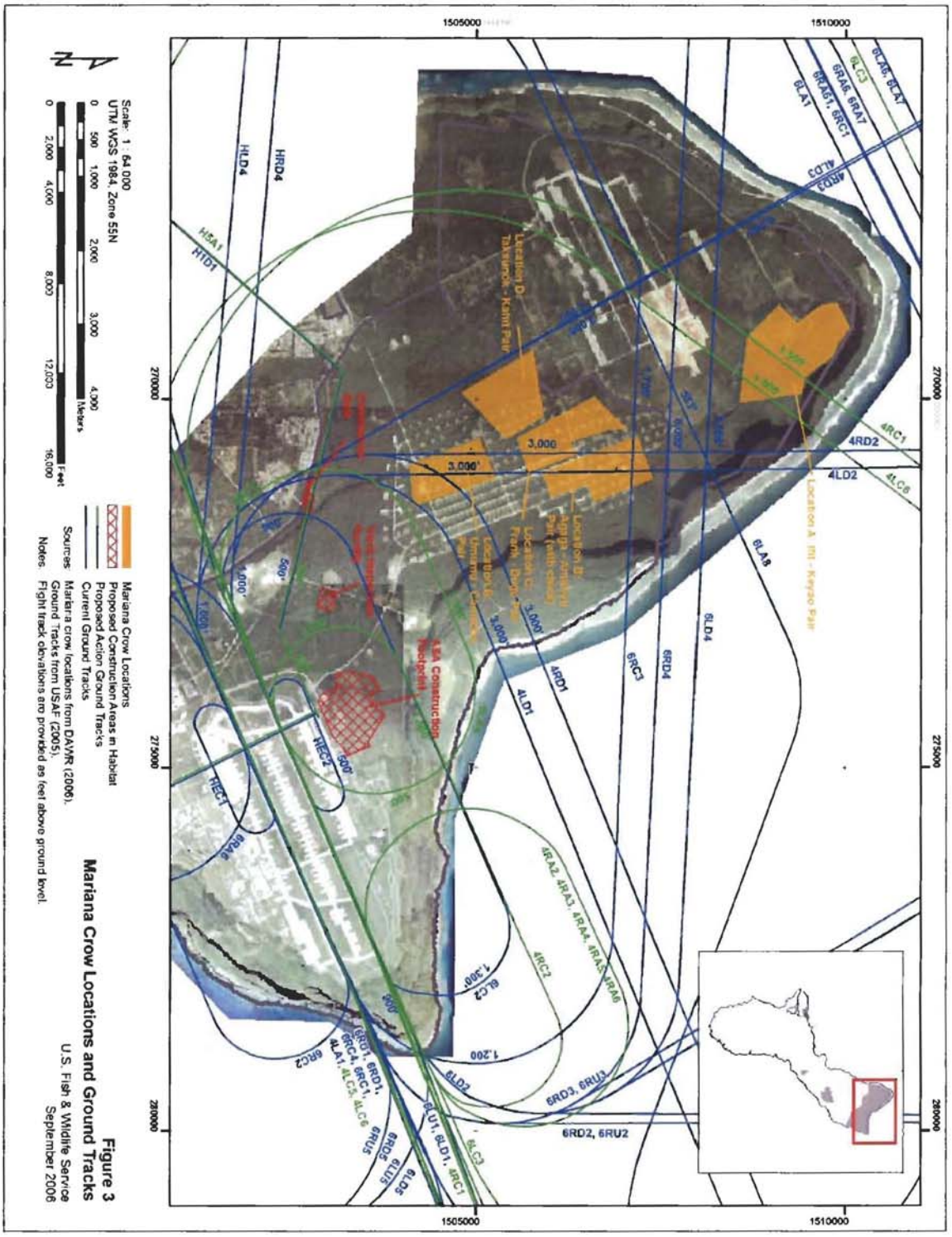

Figure 3
Mariana Crow Locations and Ground Tracks
U.S. Fish & Wildlife Service
September 2006

Guam Micronesian kingfisher – The Guam Micronesian kingfisher is currently extinct in the wild and is not found in the action area. However, habitat required to support the recovery of the species is located within the action area. As stated in the "Status of the Species" section above, Guam Micronesian kingfishers are believed to utilize mature limestone forest, secondary forests, and coastal forests dominated by coconut trees for foraging and nesting. A detailed assessment of the available Guam Micronesian kingfisher habitat on Guam has not been completed. However, Donnegan and others (2004) vegetation survey of Guam indicates limestone forest and plantation forest contain components that Guam Micronesian kingfishers utilize for nesting and may be potential breeding habitat for this species. In 2002, the Service identified approximately 5,803 ha (14,338 ac) in northern Guam as essential habitat for the Guam Micronesian kingfisher (USFWS 2002). Utilizing the recent vegetation assessment (Donnegan, *et al.* 2004), it is estimated that approximately 4,867 ha (12,026 ac) of potential Guam Micronesian kingfisher breeding habitat is located within these essential habitat areas. Approximately 3,848 ha (9,508 ac) of this habitat are located on Andersen AFB.

Guam rail – The Guam rail is currently extinct in the wild and is not found in the action area. However, habitat required to support the recovery of the species is located within the action area. As stated in the "Status of the Species" section above, Guam rails are believed to prefer secondary vegetation and forest edges for foraging and nesting. The Donnegan and others (2004) vegetation survey of Guam, indicates limestone forest, scrub forest, limestone scrub forest, and urban cultivated contain components that Guam rails may utilize for foraging and nesting and may be potential habitat for this species. Utilizing the available vegetation, it is estimated that approximately 4,926 ha (20,738 ac) of potential Guam rail habitat is available in northern Guam on the Guam National Wildlife Refuge overlay land. Approximately 3,872 ha (16,301 ac) of this habitat are located on Andersen AFB.

Threats to the Species in Action Area

Many of the threats to the Mariana fruit bat, Mariana crow, Guam Micronesian kingfisher, and Guam rail in the action area are similar. Therefore, to avoid repetition, these threats are divided into two general categories with information on how each threat impacts each species.

Habitat Loss and Degradation – Mariana fruit bat, Mariana crow, and Guam Micronesian kingfisher habitat within the action area is being impacted by feral ungulates, invasive weeds and insects, and typhoons. On Andersen AFB, densities of Philippine deer (*Cervus mariannus*) and feral pigs (*Sus scrofa*) were estimated at 1.8 deer per ha (0.8 deer per acre) and 0.4 pigs per ha (0.2 pigs per acre), some of the highest densities recorded in the world (Knutson and Vogt, unpubl. manuscript). These introduced ungulates are suspected of significantly impacting native floral communities on Andersen AFB by consuming seeds, fruits, and foliage, ingesting or trampling seedlings, and promoting the spread of introduced weeds (Wiles, *et al.* 1999; Wiles 2005). These impacts as well as damage to forests on the base from naturally occurring typhoons and introduced weeds and insects, are degrading the quality of the remaining forest. How this degradation impacts how these forests can sustain Mariana fruit bat, Mariana crow, and Guam Micronesian kingfisher populations is unknown.

Habitat for the Mariana fruit bat, Mariana crow, Guam Micronesian kingfisher, and Guam rail on Andersen AFB will also be impacted by the Air Force's development of a training area in the

Northwest Field area of the base. The Air Force (2006c) estimates 26 ha (64 ac) of potential Mariana fruit bat, Mariana crow, and Guam Micronesian kingfisher habitat will be lost as a result of the training area construction. The Air Force also expects a total of 137 ha (330 ac) of potential Mariana fruit bat, Mariana crow, and Guam Micronesian kingfisher habitat may be indirectly impacted by intense training activities and clearing at the training facility. Once the new training area is operational, it is expected that the amount of habitat remaining for the Mariana fruit bat, Mariana crow, and Guam Micronesian kingfisher on Andersen AFB will be 4,571 ha (11,295 ac), 4,223 ha (10,435 ac), and 4,571 ha (11,295 ac), respectively. The Guam rail prefers secondary habitat; therefore, the habitat for this species may increase.

Predation – Brown treesnake predation is the primary factor in the decline of the Mariana crow, Guam Micronesian kingfisher, and Guam rail (USFWS 1990a, 2004a, 2005a). Brown treesnake predation on juvenile Mariana fruit bats may also be an important factor in the poor recruitment of this species on Guam (Wiles 1987a; USFWS 2005b). Snake densities within the action area are not known specifically. However, density estimates for snakes over 800 millimeters (31 inches) snout-vent length in tangantangan (*Leucaena leucocephala*) scrub forest on Guam range from 20 to 60 snakes per ha (nine to 26 snakes per acre), while densities in grassland, ravine forest, or native forest vegetation types range from 10 to 20 snakes per ha (four to 9 snakes per ac) (Rodda, *et al.* 1999). These high snake densities continue to hamper recovery efforts for the Mariana fruit bat, Mariana crow, Guam Micronesian kingfisher, and Guam rail.

In addition to impacts from brown treesnakes, the Mariana fruit bat population in the action area may also be impacted by illegal hunting of adult bats, and Guam rail recovery is limited by feral cat populations in the action area. Illegal hunting at the Pati Point fruit bat colony has not been noted in the last decade. However, opportunistic hunting of solitary bats roosting throughout Andersen AFB is believed to occur in conjunction with legal hunting of feral ungulates (Brooke, A., pers. comm. 2005). Predation of Guam rails by feral cats has been found to be a problem on Rota and Guam (Beauprez and Brock 1999a, b; Wenninger, P., pers. comm. 2006). Experimental reintroduction efforts on Guam determined that cat predation was a major limiting factor to recovery efforts (Beauprez and Brock 1999b; Wenninger, P., pers. comm. 2006).

Conservation Needs of the Species in the Action Area

Due to the similarity in threats to the Mariana fruit bat, Mariana crow, Guam Micronesian kingfisher, and Guam rail, many of their conservation needs in the action area overlap. Therefore, to avoid repetition, these needs are summarized below for all species.

Reduce Predation – As noted above, brown treesnake predation is considered a primary factor in the decline of the Mariana fruit bat, Mariana crow, Guam Micronesian kingfisher, and Guam rail on Guam. Therefore, large-scale control and/or eradication of brown treesnakes is essential for these species to recover. Guam rail recovery is also limited by feral cat predation on Guam, and large-scale cat control will also be needed to help recover this species. Illegal hunting of Mariana fruit bats is also a major factor in their decline and will need to be controlled to help recover this species. Potential measures for reducing and/or eliminating illegal hunting are increased protection of Mariana fruit bat roosting colonies and individual bats by limiting access to roost sites and foraging areas and increased efforts by law enforcement to reduce illegal hunting.

Protect and Increase Habitat – Habitat loss and degradation are believed to be important factors in the decline of the Mariana fruit bat, Mariana crow, and Guam Micronesian kingfisher (USFWS 2004a; 2005 a,b). Protection of the remaining habitat for these species is needed along with efforts to increase the quality of the remaining habitat. Due to the high populations of feral pigs and deer, control and/or eradication of these feral ungulates will help improve the quality of the remaining habitat in the action area. Preventing and controlling introduced insect pests and weeds will also increase the quality of the remaining habitat. Reforestation of degraded areas will also improve the amount of habitat available to support the eventual recovery of these species.

Reintroduction – The recovery criteria for the Mariana crow, Guam Micronesian kingfisher, and Guam rail call for establishing populations of each species in northern Guam (USFWS 1990a, 2004a, 2005a). The Guam Micronesian kingfisher and Guam rail are both extinct in the wild on Guam and will need to be reestablished in northern Guam through reintroduction efforts. The low population of Mariana crows on Guam also requires that additional Mariana crows be translocated from Rota to Guam to help reestablish a stable population in northern Guam.

Ongoing Conservation Actions for the Species in the Action Area

In conjunction with the proposed Northwest Field training facility, the Air Force will construct a 54-ha (133-ac) ungulate exclosure and eradicate ungulates to increase the quality of the habitat for Mariana fruit bats, Mariana crows, and Guam Micronesian kingfishers (Air Force 2006c). The Air Force will also set aside approximately 60 ha (148 ac) of forested land in a new experimental habitat management unit (Air Force 2006c). A brown treesnake exclosure will be constructed around this area and ungulates and other introduced predators will be eradicated from this site to help support listed species recovery efforts on Guam. The Air Force will also be initiating the same native foraging tree planting, ungulate management plan, and Wildlife Management Specialist hiring described in the conservation measures for this project (see Air Force (2006c) and "Project Description" for more information about these measures).

Brown treesnake control measures are currently being undertaken in the Munitions Storage Area on Andersen AFB and around individual Mariana crow nests to help conserve this species. Brown treesnake barriers are currently being applied to all nest trees to limit predation of Mariana crow eggs and chicks (Aguon, *et al.* 2002; Quitigua, J., pers. comm. 2006). Large-scale control of brown treesnakes within the Munitions Storage Area utilizing traps and toxicants has been underway since 2000. This area is currently utilized for releasing hand-reared Mariana crows back into the wild.

The Guam Division of Aquatic and Wildlife Resources is actively managing the remaining Mariana crows on Guam to increase the population. Mariana crows have been released on Guam since approximately 1997 (USFWS 2005a). Eggs were collected on Rota, hand-reared on Guam, and released into the wild on Guam until 2003. Currently, eggs are collected from nesting crows on Guam, hand-reared, and later released on Guam (Quitigua, J., pers. comm. 2006).

Effects of the action

Facilities and Construction

The construction, maintenance, and operation of the proposed Aircraft Staging Area, Commercial Entry Gate, and Truck Inspection Facility are expected to have both direct and indirect impacts on the Mariana fruit bat, Mariana crow, Guam Micronesian kingfisher, Guam rail, and/or their habitats. Direct impacts include habitat loss in areas cleared for construction of the proposed facilities. Indirect impacts include the reduced use of habitat adjacent to the proposed facilities due to auditory and visual disturbance associated with their construction, operation, and maintenance. Many studies have demonstrated that certain species will avoid areas where human disturbance is present (Klein, *et al.* 1995; Reijnen, *et al.* 1995; Gill 1996; Gill, *et al.* 1996; de la Torre, *et al.* 2000; Dyer. *et al.* 2001). The extent of this indirect habitat loss is expected to vary based on the activities at each facility, the quality of habitat adjacent to the proposed facilities, the availability of suitable habitat in other areas, and tolerance of each species to different types of auditory and visual disturbance (Rodgers and Smith 1995; Gill, *et al.* 2001). An assessment of potential direct and indirect loss of habitat for each species is presented below.

Mariana Fruit Bat – Based on the vegetation assessment for the proposed project and the habitat requirements of the Mariana fruit bat, approximately 58 ha (143 ac) of potential foraging and roosting habitat will be lost due to the construction of facilities. Approximately 48 ha (118 ac) of the foraging and roosting habitat is found in the proposed Aircraft Staging Area site while the remaining 10 ha (25 ac) is in the Commercial Entry Gate and Truck Inspection Facility areas.

No studies on Mariana fruit bat habitat use in relation to human disturbance have been conducted. Species may react to human disturbance in a manner similar to how they react to predation risk (Frid and Dill 2002). Therefore, Mariana fruit bat shifts in habitat use based on perceived threats may occur due to the species' history of being hunted (Kitchen, *et al.* 2000; Kilgo, *et al.* 1998). Observations by biologists on Guam indicate that foraging Mariana fruit bats can be fairly tolerant of human disturbance at night if they are not being actively bothered (Wiles, G., pers. comm. 2006). However, this tolerance can vary based upon the type and extent of the disturbance (Wiles, G., pers. comm. 2006) as has been reported in other species (Lafferty 2001; Rees, *et al.* 2005).

Mariana fruit bats primarily forage at night (see "Species Status" above). All construction and maintenance for the proposed facilities will occur during the day and the Commercial Entry Gate and Truck Inspection Facility will only be operational during the day. In addition, the Air Force will be installing shielded lights at the proposed facilities to reduce potential impacts of lighting on foraging bats. Therefore, these activities and proposed facilities are not expected to have severe impacts on foraging Mariana fruit bats, except post-typhoon when food resources may be limited and bats forage during the day (Pierson, *et al.* 1996). Therefore, significant impacts to foraging bats are only expected to occur from the operation of the Aircraft Staging Area facility, which will include aircraft entering and leaving the facility, vehicles, and personnel working in the area.

Observations of foraging individuals indicate that Mariana fruit bats are likely to avoid areas within 100 m (328 ft) of the Aircraft Staging Area facility due to the aircraft noise and moderate human activity at night (Wiles, G., pers. comm. 2006). Currently foraging habitat for the species is available to the north, east, and west of the Aircraft Staging Area facility and approximately 80 ha (197 ac) of potential foraging habitat (*i.e.*, limestone forest; Donnegan, et *al.* 2004) could be impacted by the operation of the facility.

In addition, to foraging habitat, roosting habitat is also expected to be impacted by the construction, maintenance, and operation of the Aircraft Staging Area, Commercial Entry Gate, and Truck Inspection Facility. Observations of roosting bats near construction activities indicate that bats were not disturbed by activities 150 m (492 ft) away from the roost site (Janeke, D., pers. comm. 2006). Currently roosting habitat for the species is available to the north, east, and west of the proposed Aircraft Staging Area site and approximately 93 ha (231 ac) of potential roosting habitat (*i.e.*, limestone forest; Donnegan *et al.* 2004) could be impacted by the operation of the facility. In addition, approximately 35 ha (86 ac) of potential roosting habitat (*i.e.*, limestone forest; Donnegan *et al.* 2004) could be impacted at the Commercial Entry Gate (19 ha, 48 ac) and Truck Inspection Facility (15 ha, 38 ac).

Of the proposed facilities, only the proposed Aircraft Staging Area is known to be occupied by Mariana fruit bats at this time (see "Environmental Baseline" above). Currently, this area is the foraging territory of a female Mariana fruit bat. Since this territory will be cleared as part of the proposed project it is expected that this bat will be forced to establish a new foraging territory in another area. This change in territory may affect the bats reproductive output for the year and/or effect its foraging success until it establishes a new territory. Therefore, we expect that this bat will be adversely impacted by the direct loss of approximately 48 ha (118 ac) of foraging habitat. This adverse impact is expected to result in take through harassment. To help minimize this impact and avoid potential take by killing the bat during clearing, the Air Force will only construct the facilities during the day and will coordinate with the Guam Division of Aquatic and Wildlife Resources and the Guam National Wildlife Refuge to conduct surveys of the project site and adjacent area the week prior to construction/clearing and during construction/clearing to determine if Mariana fruit bats are present in the action area. If Mariana fruit bats are found within 150 m (492 ft) of the project site, the Air Force will postpone construction within 150 m (492 ft) of the bat until the bat has left the area.

In summary, we expect 58 ha (143 ac) of foraging and roosting habitat will be unavailable to the species due to the proposed facilities (Table 4). Approximately 48 ha (118 ac) of the habitat that will be lost includes the known foraging territory of a female Mariana fruit bat. Loss of this habitat is expected to result in take through harm of the female fruit bat. In addition to direct loss of habitat, approximately 80 ha (197 ac) of potential foraging and 128 ha (317 ac) of potential roosting habitat may also be indirectly impacted due to human disturbance and may reduce the quantity of habitat available to support recovery of the species (see Table 4).

Table 4. Estimated Direct and Indirect Habitat Loss for Listed Species Associated with ISR/Strike Project.

Species	Habitat Type	Direct Loss		Indirect Loss		Total Loss	
		Hectares	Acres	Hectares	Acres	Hectares	Acres
Mariana Fruit Bat	Foraging	58	143	80	197	138	340
	Roosting	58	143	128	317	186	460
Mariana Crow	Foraging	58	143	147	363	201	506
	Nesting	58	143	147	363	201	506
Guam Micronesian kingfisher	Foraging	58	143	135	334	193	477
	Nesting	58	143	101	249	159	392
Guam Rail	Nesting and Foraging	23	57	-[1]	-	23	57

[1] *Indirect habitat loss was not calculated for the Guam rail due to lack of information on potential impacts of human disturbance on habitat use.*

Mariana Crow – Based on the vegetation assessment for the proposed project and the habitat requirements of the Mariana crow, approximately 58 ha (143 ac) of potential foraging and nesting habitat will be lost due to the construction of the proposed facilities. Approximately 48 ha (118 ac) of foraging and nesting habitat is found in the proposed Aircraft Staging Area site while the remaining 10 ha (25 ac) is found in both the Commercial Entry Gate and Truck Inspection Facility areas.

No studies on Mariana crow habitat use in relation to human disturbance have been conducted. However, observations of nesting on Guam and Rota indicate some tolerance of human activities (Morton, *et al.* 1999; Dicke, B., pers. comm. 2005). For example, Mariana crow nests were on average 290 m (n=75, range 25-1,454 m [950 ft, range 82-4,770 ft]) away from paved or graded roads, but only 62 m (n=77, range 0-210 m [203 ft, range 0-689 ft]) from the nearest forest edge on Rota (Morton, *et al.* 1999). Effects of disturbance on Mariana crow foraging are not known; however, their tolerance for human disturbance during foraging may be greater than their tolerance while nesting. Because tolerance of disturbance is affected by the type, duration, and occurrence of the disturbance (Lafferty 2001; Rees, *et al.* 2005) we expect it to vary between the proposed Aircraft Staging Area, Commercial Entry Gate, and Truck Inspection Facility.

Operation activities at the Aircraft Staging Area facility include aircraft entering and leaving the facility, vehicles, personnel working in the area, and lights. This activity is expected to occur during the day and night. Due to the level of disturbance, we expect at a minimum, all habitat within 300 m (984 ft) of the Aircraft Staging Area facility will not be utilized for nesting. Some of this area may be utilized for foraging, but the extent is unknown at this time. Currently, potential foraging and nesting habitat for this species is available to the north, west, and east of the proposed facility; therefore, approximately 135 ha (334 ac) of potential nesting habitat will be impacted by operations of the Aircraft Staging Area facility.

Activities at the Commercial Entry Gate and Truck Inspection Facility will include vehicles entering and leaving and personnel working in the area during the day. No activity is expected at night. Because the level of visual disturbance is high but the auditory disturbance is lower due to the lack of aircraft, we expect that all potential nesting habitat within 60 m (198 ft) of these facilities will not be utilized by nesting Mariana crows. This distance from this disturbance is

less due to the potential cover the intervening forest provides nesting birds from visual disturbance. We therefore calculated approximately 12 ha (29 ac) of potential Mariana crow nesting habitat will be indirectly impacted by the Commercial Entry Gate and Truck Inspection Facility.

As noted in the "Environmental Baseline" section above, the proposed project sites for each facility are not currently known to be occupied by Mariana crows. However, as added measures to help avoid any potential impacts to Mariana crows if the status of the species in the action area should change, the Air Force will initiate construction outside the Mariana crow breeding season (October to April). In addition, the Air Force will coordinate with the Guam Division of Aquatic and Wildlife Resources and the Guam National Wildlife Refuge to conduct surveys of the project site and adjacent area the week prior to construction/clearing and during construction/clearing to determine if Mariana crows are present in the action area. If Mariana crows are nesting within 300 m (984 ft) of the project site, the Air Force will postpone construction within 300 m (984 ft) of the nest until the breeding attempt is completed (*e.g.*, fledging or nest failure).

In summary, we expect 58 ha (143 ac) of potential foraging and nesting habitat will be impacted and unavailable to the species due to the proposed facilities (see Table 4). In addition to direct loss of habitat, approximately 147 ha (363 ac) of potential foraging and nesting habitat will also be indirectly impacted due to human disturbance and made unavailable to support the species (see Table 4). The proposed action areas for the Aircraft Staging Area, Commercial Entry Gate, and Truck Inspection Facility and the areas adjacent to these sites are not currently occupied by Mariana crows. Therefore, we do not expect any adverse effects of the proposed facilities to the population currently found on the base.

Guam Micronesian Kingfisher – Based on the vegetation assessment for the proposed project and the habitat requirements of the Guam Micronesian kingfisher, approximately 58 ha (143 ac) of potential nesting habitat and approximately 74 ha (183 ac) of potential foraging habitat will be lost due to the proposed project. Approximately 48 ha (118 ac) of the nesting and 66 ha (164 ac) of the foraging habitat is found in the proposed Aircraft Staging Area site while the remaining nesting and foraging habitat is found in the Commercial Gate and Truck Inspection Facility areas.

No studies on Micronesian kingfisher habitat use in relation to human disturbance have been conducted. However, anecdotal observations of disturbance impacts on Pohnpei Micronesian kingfisher (*Halcyon cinnamomina reichenbachii*) habitat are available. Dr. Dylan Kesler (pers. comm. 2006) notes that Pohnpei Micronesian kingfishers were sensitive to the presence of human traffic within 100 m (328 ft) when foraging. Nests were also typically 50 to 100 m (164 to 328 ft) away from forest edges, roads, and houses. The impact of noise, like jet aircraft noise, is unknown. However, disturbance distances may be greater due to the impacts of noise on vocalizations (Patricelli and Blickley 2006; Kesler, D., pers. comm. 2006). Based on this information, we estimate that potential foraging and nesting habitat (*i.e.*, limestone forest, urban cultivated) (Donnegan, *et al.* 2004) within 100 m (328 ft) of each facility may be impacted. This is equal to approximately 101 ha (249 ac) of nesting and 135 ha (334 ac) of foraging habitat.

In summary, we expect 58 ha (143 ac) of potential nesting and 74 ha (183 ac) of potential foraging habitat will be impacted and unavailable to support the species due to the proposed facilities (see Table 4). We also estimate that approximately 101 ha (249 ac) of potential nesting and 135 ha (334 ac) of potential foraging habitat may be indirectly impacted by noise (see Table 4). The Guam Micronesian kingfisher is currently extinct in the wild. Therefore, we do not expect any adverse effects of the proposed facilities to individual Guam Micronesian kingfishers.

Guam Rail – Based on the vegetation assessment for the proposed project and the habitat requirements of the Guam rail, approximately 23 ha (57 ac) of potential nesting and foraging habitat will be lost due to the proposed project. Approximately 19 ha (46 ac) of the nesting and foraging habitat is found in the proposed Aircraft Staging Area site while the remaining nesting and foraging habitat is found in the Commercial Entry Gate and Truck Inspection Facility areas.

No studies on Guam rail habitat use in relation to human disturbance have been conducted. The Guam rail is a secretive species, but observations by Paul Wenninger (pers. comm. 2006), the Guam rail biologist for the Guam Division of Aquatic and Wildlife Resources, indicate that rails are tolerant of some human disturbance if sufficient cover is available. This tolerance may vary based on the type, intensity and duration of the disturbance (*e.g.*, aircraft noise versus vehicle traffic) but no information is available to determine if this is the case. Due to the lack of information, we have not calculated indirect habitat loss.

In summary, we expect 23 ha (57 ac) of potential nesting and foraging habitat will be impacted and unavailable to support the recovery of the species due to the construction of the proposed facilities (see Table 4). We did not calculate potential indirect impacts of human disturbance on breeding and foraging habitat (see above for explanation). The Guam rail is currently extinct in the wild. Therefore, we do not expect any adverse effects of the proposed facilities to individual Guam rails.

Aircraft Operations

The proposed project will increase aircraft operations around Andersen AFB, which will increase auditory and visual disturbance to Mariana fruit bats and Mariana crows. In addition, increased air traffic could also lead to a higher incidence of aircraft strikes or an increased chance that an aircraft could crash and impact the Mariana fruit bat colony at Pati Point or a Mariana crow nest. Guam Micronesian kingfishers and Guam rails may also be impacted by increased aircraft operations. However, because these species are extinct in the wild and no studies on aircraft impacts on these species are available or possible, the impacts of these operations are not addressed in this biological opinion. Therefore, only the potential effects of increased aircraft operations on Mariana fruit bats and Mariana crows are described below.

Aircraft Disturbance – Studies on the impacts of aircraft overflights to wildlife have been primarily limited to work on ungulates (*e.g.*, Krausman, *et al.* 1998; Maier, *et al.* 1998; Frid 2003; Landon *et al.* 2003; Krausman *et al.* 2004; Lawler *et al.* 2005) birds of prey (*e.g.*, Andersen, *et al.* 1989; Watson 1993; Trimper, *et al.* 1998; Delaney, *et al.* 1999; Palmer, *et al.* 2003), and waterbirds (*e.g.*, Ward, *et al.* 1999; Conomy, *et al.* 1998 a,b; Komenda-Zehnder, *et al.* 2003). These studies report a wide range of reactions to overflights depending on the biology of the species, its previous exposure to overflights, whether the species is breeding, the type of

aircraft, the altitude of the aircraft, and the lateral distance between aircraft and the species. The variability in these reactions and their specific circumstances make it difficult to be certain how a particular species, such as the Mariana fruit bat or Mariana crow, will react to aircraft overflights. However, there are two broad generalizations about the effects of overflights on wildlife that can be used to help assess potential impacts on the Mariana fruit bat and Mariana crow.

First, individuals with previous exposure to aircraft overflights may display less reaction to overflights then individuals without previous exposure (Andersen, *et al.* 1989, Conomy, *et al.* 1998b). This reduced reaction is believed to be a sign that these individuals have habituated to these overflights. This habituation, however, may be individual or species specific. For example, Conomy and others (1998b) found that black ducks (*Anas rubripes*) became habituated to aircraft noise with continued exposure while wood ducks (*Aix sponsa*) did not become habituated. In addition, the degree of disturbance to which a species can habituate may also be limited (National Park Service 1994).

The second generalization is that an individual's reaction to an overflight may be reduced when the aircraft is farther away then when it is closer (Watson 1993; Delaney, *et al.* 1999; Ward, *et al.* 1999; Komenda-Zehnder, *et al.* 2003). This distance may depend on the species, the type of aircraft, and other variables, so no set standard can be developed for all species. However, once determined for a species, it could be used as a measure to minimize or avoid impacts to that species.

Mariana Fruit Bat

The majority of the fruit bat population on Guam is located in one colony at Pati Point below the north runway of Andersen AFB. The Air Force assessments of flight operations over this area indicate that the number of daily flight operations will increase from approximately two operations to 54 operations. The average daily sound levels for this area will increase from 66 A weighted decibel levels (dBA) to 83 dBA, and the maximum sound levels will increase from 116 dBA to 122 dBA.

Information on the effects of overflights on Mariana fruit bats is primarily limited to a study by Morton (1996) and anecdotal observations by Wiles (1991, 1993, 1994). Behavioral observations collected by Morton (1996) before and after several overflights over the colony indicate that as much as 42 percent of the colony flushed from their roosts and flew for up to five minutes before returning to roost. Morton (1996) also observed that activity 30 minutes after the overflight increased significantly as more bats were alert, agonistic, or moving instead of resting. Sound information gathered at a site adjacent to the colony during overflights ranged from 51 to 116 dBA. Morton (1996) also noted that all overflights that elicited flushing were from four engine aircraft (B-1, C-5, C-141, KC-135, Boeing 747) and not fighter aircraft. However, anecdotal observations by other biologists reported in Morton (1996) and Wiles (1991, 1994) indicate that Mariana fruit bats do respond to fighter aircraft. Wiles (1991, 1994) also notes some circumstantial evidence that the bat colony may have abandoned a former colony site on the east side of Pati Point due to increased aircraft operations associated with training missions. However, no direct correlation can be made.

Since Andersen AFB has been active since 1945, Mariana fruit bats at the Pati Point colony have been exposed to aircraft overflights, and Morton (1996) theorized that they may be habituated, to some degree, to overflights. However, as noted above, bats were still observed flushing from their roosts and reacting to the overflights and may have even abandoned a roost site due to increased aircraft operations associated with training exercises. How Mariana fruit bats will react to an increase in aircraft operations at Andersen AFB due to the proposed project is uncertain. Eventual habituation to overflights and no long-term adverse impacts to Mariana fruit bats is a possible outcome. Alternatively, if bats continue to react to all overflights that may occur it is possible that this could lead to chronic stress which could have long-term impacts on their survival (*e.g.*, reproductive and immune system suppression [Wingfield, *et al.* 1997; Tilbrook, *et al.* 2000]). It is also possible that the colony site will be abandoned due to the increase in aircraft disturbance and be forced to move to another area on Guam or go to the neighboring island of Rota.

Abandonment of roost sites has been observed previously on Guam. From approximately 1981 to 1994, multiple roost sites in northern Guam, including the current site at Pati Point, were abandoned for various reasons, including poor weather conditions (*e.g.*, typhoons), human disturbance (*e.g.*, illegal hunting), and potential disturbance from fighter aircraft training (Wiles 1981, 1983, 1985, 1986, 1987c, 1989, 1990, 1991, 1992, 1994). After abandoning their roost, these bats would often re-form into a colony or colonies at a new roost location or locations after a short period (Wiles 1985). These alternate roost sites were all located along the cliffline in northern Guam on Andersen AFB, though small groups were also observed in other areas. Between 1981 and 1994, some roost sites, including the current site, were reused and abandoned multiple times depending on the level of disturbance or other factors (Wiles 1981, 1983, 1985, 1986, 1987c, 1989, 1990, 1991, 1992, 1994).

Gill and others (2001) noted that the decision of whether an individual moves away from disturbance at their current location is dependent on the quality of the current site, distance to and quality of other suitable sites, the relative risk of predation or density of competitors at different sites, and the investment an individual has made to a site. To assess the likelihood of bats abandoning the current roost site, we examined each of these factors.

The current colony site has been used consistently since 1994 and has been considered a favored site since at least 1981 (Wiles 1987c, 1999). Therefore, we expect this site is currently a high-quality site. However, this quality is expected to change as aircraft operations increase due to the increased number of aircraft flying over the site. The observations of the Mariana fruit bat colony during and immediately after overflights noted above indicate that bats decreased the amount of time they were resting and became more active, for at least a short period, during and after an overflight. At current operation levels, see above, this reaction may occur twice a day. After the proposed project is fully implemented, it could occur as many as 54 times a day (*i.e.*, once per flight operation). This is expected to decrease the quality of this site for fruit bats because it will reduce the amount of time available for the bats to conduct their normal functions of sleeping, grooming, breeding, and intra-specific interactions at the site. This decrease in quality could be sufficient for the bats at this roost site to abandon the roost site.

As noted earlier, alternate roost sites have been utilized along the cliffline at Pati Point and to the west and northwest of Pati Point. The quality of these alternate sites is unknown and is likely dependent on the availability of roost trees at the site and level of human disturbance. We have no information that would indicate that roost trees would not be available at all of these sites or at potential new roost sites. Therefore, we expect roost trees will be available at some sites. Based on the available information, the only change in human disturbance from previous conditions at previous roost sites and the forests along the cliffline are increased aircraft operations. The largest increase in aircraft operations is expected in the areas near the runway; therefore, alternate roost sites to the west and northwest of Pati Point should experience lower aircraft operations than the Pati Point site. Based on this information, we expect that suitable alternate roost sites, other than the Pati Point site, may be available.

No other colonies exist on Guam, so no competition exists for alternate sites. The two main sources of predation for the Mariana fruit bat are illegal hunting and brown treesnake predation of juveniles. It is unlikely that Mariana fruit bats will perceive a difference in the likelihood of predation by brown treesnakes, because the predation events probably occur when the bats are foraging and not at the roost site. Illegal hunting has been observed at many of the alternate roost sites in the past, but it is not known if the bats at the current site have experienced these events. The reuse of sites after poaching events indicates, however, that past experience may not be a major factor in selecting roosts. Therefore, it is uncertain how bats will perceive the likelihood of illegal hunting. The majority of the areas to the west and northwest of Pati Point are undeveloped and probably do not experience a significant level of human activity. However, bats may avoid roosting near Tarague Beach, the rifle and explosive ordnance range, main airfield, and roads connecting these areas because of the level of human activity at these sites and perceived predation risks. Finally, Mariana fruit bats are colonial and therefore do not exert a large amount of energy or time in defending and establishing a new colony site.

Based on the available information we believe the current roost site will likely be abandoned due to the proposed action. This is because: 1) the increase in aircraft operations will reduce the quality of the current site for normal roosting due to increases in bat activity levels throughout the day; 2) alternate sites of sufficient quality are available to the west and northwest of Pati Point; and 3) the current colony site, and other roost sites, have been abandoned in the past due to human disturbance and other factors. This abandonment will, in turn, have several adverse impacts on the Mariana fruit bat population.

First, we believe the bats at the current site will likely move to alternate roost sites to the west and northwest of Pati Point. The records of abandonment of Mariana fruit bats from Guam indicate that the bats have always moved to alternate sites on Guam, primarily roost sites along the northern cliffline. Therefore, we expect the bats to remain on Guam and not migrate to Rota. Because the cliffline areas to the west and northwest of Pati Point are near public hunting areas and roads, we believe these areas are more accessible to humans and therefore, bats roosting in these areas may be subject to illegal hunting. This illegal hunting would likely result in loss of individuals and cause the new roost site to eventually be abandoned. This impact may also be cumulative because roost sites established after an illegal hunting may also be susceptible to illegal hunting because they are expected to be established to the west and northwest of Pati Point. In addition to illegal hunting, juvenile bats may be left behind at roost sites that are

abandoned because they are too heavy for their mother to support. This is also expected to have cumulative adverse impacts on the bat population if each new roost site is abandoned.

The numerical impact of the abandonment of the current roost site on the Guam Mariana fruit bat population is difficult to access due to uncertainties in how many juvenile bats might be abandoned, how many bats might be taken by illegal hunting, and how often illegal hunting and abandonment might occur. Lemke (1992) reported that the preferred method of hunting bats involves approaching a roost and firing buckshot at the colony several times before the bats leave the site. Each shot could kill several bats; therefore, we expect one poaching event may cause the death or injury of at least nine individuals (*i.e.*, three shots and three bats taken per shot). Several incidents of illegal hunting at roost sites along the cliffline in northern Guam occurred between 1981 and 1994 (Wiles 1981, 1983, 1985, 1986, 1987c, 1989, 1990, 1991, 1992, 1994). Therefore, we expect at least two illegal hunting events could occur after the bats abandon the current roost site. Between 10 and 20 percent of the female Guam bats had young (Wiles 1987c, 1989, 1990), and of the female bats on Rota with young, approximately 10 to 14 percent had large young (Wiles 1987c, 1990). Therefore, if we assume half the current population (40 animals) is female, 20 percent of the females have young, and 14 percent are large young that cannot be carried, approximately one juvenile could be left behind when a roost site is abandoned. If three roost sites are abandoned, then up to three juvenile bats could be adversely impacted.

In addition to the Mariana fruit bats at the Pati Point colony, bats from Rota may fly to Guam from Rota after typhoon events due to increased illegal hunting on Rota and/or reduced food availability due to impacts of the storm on fruit bat habitat (Wiles and Glass 1990; Stinson, *et al.* 1992; Pierson, *et al.* 1996; Esselstyn, *et al.* 2006). The first evidence of potential movement of Mariana fruit bats from Rota to Guam occurred in 1979 when a Mariana fruit bat colony of about 225-250 bats was first observed at Pati Point (Wiles 1987a; Wiles and Glass 1990). For several years prior to 1979 the population was estimated to be less than 50 animals (Wheeler and Aguon 1978). In 1981, bat numbers at Pati Point increased from 240 bats to 508 bats, presumably due to hunting activity on Rota (Wiles 1987a; Wiles and Glass 1990). Temporary increases in Mariana fruit bat numbers at the Pati Point colony after typhoons hit Rota were observed in January to May 1988 (Wiles and Glass 1990) and in December 2002 to January 2003 (Esselstyn, *et al.* 2006). The bats that move from Rota to Guam may not have previous exposure to overflights and may be more susceptible to disturbance from overflights. These bats could then move to other areas on Guam or back to Rota where they may be exposed to increased poaching pressure and/or reduced food availability due to the impacts of tropical storms on food resources.

In summary, we believe that the abandonment of the Pati Point roost site by Mariana fruit bats is likely to occur due to the increased aircraft operations under the proposed action. Mariana fruit bats have abandoned the site previously for various reasons and a former roost site at east Pati Point may have been abandoned due to aircraft activity. We expect the current Pati Point colony would relocate to a new site or sites to the west and/or northwest of Pati Point due to the previous use of these areas as roost sites, although the exact location(s) are uncertain due to changes in the forest structure over the past two decades. Due to the accessibility of roost sites to the west and northwest of Pati Point, we believe that one of the new colonized roost sites

could be abandoned because of human disturbance and other factors. In total, we expect up to two roosts to be abandoned and three juveniles and 18 adults to be killed due to the proposed project.

We also believe that Mariana fruit bats that have migrated from Rota to Guam after a typhoon will also be disturbed by increased aircraft activities at Pati Point and will prematurely return to Rota (less than one month after a storm). We believe these bats will be exposed to illegal hunting and/or poor habitat conditions on Rota which could lead to the death of at least nine individuals. We expect this will only occur after a severe storm on Rota and when aircraft operations have increased. We also expect this to only occur while the Pati Point roost site is occupied by bats from Guam because this species is gregarious and previous observations of bats from Rota were noted with existing colonies of bats from Guam. Based on the proposed timeline for the project (see Table 1) and average number of typhoons for Guam over a ten-year period, we believe this is only likely during approximately eight years of the project. Based on the timeframe and annual likelihood of a storm affecting both Guam and Rota (37 years out of the last 50 years) we believe this could occur up to six times. Utilizing estimates of illegal hunting provided above, we believe that up to 36 bats from Rota could be killed by the proposed action.

Mariana Crow

Currently, nine of the remaining 11 Mariana crows on Guam are located in the Munitions Storage Area on Andersen AFB. One pair is also located to the northeast of Northwest Field runways. Information on ground tracks provided by the Air Force indicates that 13 ground tracks pass over or near these locations (see Figure 3). Assessments of altitudes and sound levels for the loudest aircraft that utilize these ground tracks indicate 12 of the flight paths will be at or above 305 m (1,000 ft) above ground level. One ground track over the northern end of the Munitions Storage Area (6LA8, see Figure 3), an approaching flight path for a C-5, is 169 m (553 ft) above ground level. Maximum sound levels for the different flight paths ranged from 70 to 111 dBA, the maximum sound level was for the C-5 aircraft over the lowest above ground level flight path discussed above. Assessments of aircraft operations over or immediately adjacent to the areas currently occupied by Mariana crows indicate operations will increase between 0 and 0.40 times per day under the proposed action. Assessments of operations over unoccupied areas but near occupied areas indicate operations will increase 1.92 and 2.74 times per day along the 6LA6 and 6LD4 ground tracks, respectively, under the proposed action (see Figure 3).

Morton (1996) conducted a study on the potential impact of aircraft overflights on Mariana crows from 1994 to 1995. He found no evidence that aircraft overflights contributed directly to nest abandonment or nest failure during the study. In fact, one nest was constructed within 1 km (0.6 mi) of the north runway during a large aircraft training exercise (Tandem Thrust). However, Morton (1996) did report three observations of Mariana crows reacting to aircraft. One observation was of alarm calling and an increase in vigilant, alert, and standing behavior from an adult attending a nest after an unknown aircraft (76-92 dBA, >305 m [1,000 ft] above ground level) flew over the nest. Another observation was of a Mariana crow returning to a nest while an unidentified cargo aircraft flew overhead. The adult remained standing at the nest and alarm calling for the duration of the overflight (approximately two minutes). No sound levels or altitude was reported for the aircraft. The final observation was of a pair of Mariana crows

responding to six F-16s and four KC-135s (≤86 dBA, no altitude reported) departing the base. The pair was observed alarm calling and flying for 12 minutes after the overflights.

In addition to these observations, Morton (1996) also summarized previous observations of Mariana crow and aircraft interactions by other biologists on Guam. The most severe of these interactions was a pair leaving their nest several times in response to a helicopter flying less than or equal to 120 m (400 ft) above the ground. Other observations also included adults flushing from the nest and leaving eggs unattended. In general, the observations of Mariana crows flushing from nests were all due to aircraft below 305 m (1,000 ft) above the ground (see Table 12 of Morton 1996). Mariana crows reacting to aircraft by alarm calling and other minor behaviors were for aircraft above this elevation.

Based on the available information, Morton (1996) concluded that adverse impacts to nesting Mariana crows could occur and recommended that aircraft be restricted to above 305 m (1,000 ft) above ground level over forested areas used by Mariana crows to minimize these impacts. Other studies on nesting bird responses to aircraft indicate that this distance from the nest had only minor impacts to nest success (Andersen, *et al.* 1989; Watson 1993; Delaney, *et al.* 1999; Palmer, *et al.* 2003). For example, Palmer and others (2003) noted subtle differences in male and female peregrine falcon nest attendance due to jet aircraft overflights less than 300 m (984 ft), but it was not enough to affect productivity.

In general, the altitudes of the ground tracks over the current distribution of Mariana crows are at or above the recommended altitude, except for one. Therefore, we do not predict adverse impacts from aircraft along these ground tracks. In addition, the information provided by the Air Force indicates there will only be small increases (less than one a day) in flight operations over these areas. Therefore, we do not expect any adverse impacts from increased flight operations over these areas.

Currently, one ground track near the Mariana crow's current distribution is below the recommended 305 m (1,000 ft) altitude and is utilized by aircraft arriving at Andersen AFB. In addition, several ground tracks located near the ends and northwest side of the runways are below the recommended altitude but are outside the current distribution of Mariana crows. In addition, several ground tracks outside the Mariana crows' current distribution will experience moderate (2 a day) to large (35 a day) increases in aircraft operations which may impact Mariana crow nesting if they move into these areas before the project is fully implemented. Aircraft utilizing these ground tracks may impact Mariana crows nesting below it and cause Mariana crows to not utilize potential breeding habitat under these ground tracks due to aircraft disturbance. To avoid impacts to the current Mariana crow population, the Air Force has agreed to increase the altitude along the ground track for arriving aircraft to the north of the Munitions Storage Area during the Mariana crow breeding season (October to April). Also, because the proposed project is expected to develop over a long period, the Air Force has agreed to develop an Adaptive Management Strategy to avoid, minimize, and/or offset potential impacts to nesting Mariana crows as the project is implemented over time (see "Project Description" above). This strategy will be developed and implemented prior to initiation of Phase 1 of the proposed project when increased air operations are expected. The Service has approval of the Adaptive

Management Strategy to assure implementation of the plan by the Air Force will avoid, minimize, and/or offset impacts to the Mariana crows.

In summary, we expect no adverse impacts to nesting Mariana crows due to the proposed project. The Air Force will avoid utilizing flight lines below 305 m (1,000 ft) during the breeding season (October to April) and will develop an Adaptive Management Strategy with measures to avoid, minimize, and/or offset potential impacts to Mariana crows.

Aircraft Strikes and Crashes – Increased aircraft operations at Andersen AFB could lead to potential aircraft collisions with Mariana crows and Mariana fruit bats as well as provide the potential for an aircraft crash to impact these species. No aircraft collisions with Mariana crows have been reported, but in 1982, a WC-130H struck a fruit bat while departing Andersen AFB at 1815, just after sunset (reported in Morton 1996). No subsequent collisions with Mariana fruit bats have been reported. Sodhi (2002) reported that bird strikes typically occur four to six times per 10,000 aircraft movements. Approximately 54 percent of the bird strikes on military aircraft occur in or near airfields, and 56 percent occur at less than 300 m (984 ft) above the ground (Neubauer 1990). An assessment of the flight tracks for the base indicate that aircraft collisions with Mariana fruit bats and Mariana crows are likely to occur when aircraft are arriving or departing the airfield. Currently Mariana crows are not found in this area so the potential for impact is insignificant. The Mariana fruit bat colony is situated almost directly below the north runway, so the likelihood of collision is higher for this species as they exit and return to their roost site after sunset and before dawn, respectively (USFWS 1990b). Estimates of aircraft operations from the north runway indicate that they are expected to increase by 3.8 operations a day 30 minutes after sunset and 30 minutes before sunrise. Therefore, the increase in operations during the several hour time period when bats are moving to and from the roost site is expected to be lower than 3.8. Because, no collisions between fruit bats and aircraft have been reported since 1982, the bat population is currently small, the expect increase in aircraft operations is small, and the earlier finding that bats are expected to abandon the Pati Point roost site prior to the full increase in aircraft operations under the proposed project (see "Aircraft Disturbance" above) it appears unlikely that collisions would occur; therefore, we believe this impact to be discountable.

An Air Force study found that 61 percent of all aircraft accidents were related to landing operations and 39 percent occurred during takeoff (Air Force 1999). This study also found that fighter and trainer aircraft accounted for 80 percent of the accidents, with large aircraft and helicopters accounting for the remaining 20 percent. The Air Force defines five categories of aircraft flight mishaps; the most relevant is an aircraft crash, which is defined as a Class A mishap due to destruction of the aircraft or damage beyond economical repair. The 10-year average Class A mishap rate for each aircraft associated with the proposed action is 2.04 mishaps every 10 years for F-15s, 0.09 mishaps every 10 years for KC-135s, 2.40 mishaps every 10 years for B-1s, 0.00 mishaps every 10 years for B-2s, and 0.41 mishaps every 10 years for B-52s (Air Force 2006b). No data are available for the Global Hawk UAV or the F-22 (Air Force 2006b).

It is not possible to predict the precise location of an aircraft accident. However, the Air Force (2006b) evaluated the likelihood of an F-15 fighter crashing into the Pati Point colony by using the 10-year average Class A mishap rate for a fighter (2.04); its definable impact area (2.73 ac);

the size of the accident potential zone containing the colony (344 ac); and the percent of accidents within that accident zone (10.1 percent). It is estimated that 0.005 fighter accidents would occur annually in the accident potential zone containing the colony. It is also estimated that the impact area for a fighter crash would equate to approximately 0.6 percent of the accident potential zone. The Mariana fruit bat colony is also limited to an area of several acres in the accident potential zone. Therefore, we conclude that the likelihood of an aircraft crashing directly into the Pati Point colony as a result of the proposed action is very low. The likelihood of an aircraft crashing near the Pati Point colony and adversely impacting the colony as a result of the proposed action is also minimal but a contingency plan will be addressed in the Adaptive Management Strategy.

Personnel, Household Goods, Equipment, and Aircraft Movement

The brown treesnake was believed to have been introduced to Guam in the late 1940s in military goods (Savidge 1987; Rodda, *et al.* 1992). This introduced predator became established on the island and is believed to have caused extirpation of most of the native birds on Guam (Savidge 1987), as well as many other native and non-native animal species (Fritts and Rodda 1998). The snake is an excellent disperser, stowing away in ships and aircraft leaving Guam (Fritts 1988). Efforts are currently being undertaken to prevent snakes from leaving Guam. However, all outgoing cargo and vessels from Guam currently are not fully inspected, and brown treesnakes are found at destinations served from Guam several times a year (Fritts, *et al.* 1999). As a result, brown treesnakes originating from Guam have been recorded in locations as diverse as the neighboring Commonwealth of the Northern Mariana Islands, Hawaii, Diego Garcia, Federated States of Micronesia, Republic of the Marshall Islands, Spain, Texas, and Oklahoma (Fritts, *et al.* 1999; Tummons 2005). Recently, it was also determined that the brown treesnake is now established on the Island of Saipan (Colvin, *et al.* 2005). If the brown treesnake is established elsewhere, similar impacts to those recorded on Guam's wildlife may occur.

The increase in aircraft operating and/or rotating from Andersen AFB is expected to result in an increase in Air Force personnel, household goods, equipment, and cargo coming and going from Guam. Due to the high populations of brown treesnakes on Guam (Rodda, *et al.* 1999) and increased traffic leaving Guam, it is expected that the likelihood of snakes being transported off island to any areas where Air Force goods, cargo, and equipment are transported will also be increased. For example, Hickam AFB on the Island of Oahu, Hawaii is expected to receive Air Force goods, cargo, and equipment from Guam. The endangered Oahu elepaio (*Chasiempis sandwichensis ibidis*) is endemic to the Island of Oahu and is one species that will be susceptible to brown treesnake predation if it became established there.

To prevent the accidental transportation of brown snakes from Guam in Air Force goods, cargo, and equipment, the Air Force will program for and facilitate a 100 percent inspection rate for all cargo, vehicles, munitions, household goods, and other items departing Guam from the Andersen AFB or other sites on Guam where these items are staged for departure (see "Project Description" for additional information). In addition, the Air Force has agreed to develop a mechanism with Wildlife Services and the Service to ensure that funding is available to consistently sustain the 100 percent inspection rate, adequately support sustained brown treesnake trapping, capture, and toxicant use by Wildlife Services in the vicinity of all Air Force items leaving Guam, and will actively seek sustained funding to support applied brown treesnake

research efforts (see "Project Description" above). Due to these efforts, we believe that the potential adverse impacts of the proposed action on listed species found outside Guam (*e.g.*, Oahu elepaio) are insignificant or discountable.

Conservation Measures

Habitat Improvement – The Air Force will eradicate pigs and deer from two ungulate exclosures that incorporate approximately 200 ha (494 ac) of land near the northern tip of Guam to offset the loss of habitat from the proposed project (see Figure 2). In addition, the Air Force will develop a plan to reduce pig and deer populations in non-fenced areas on the base, outplant tree species utilized for foraging by Mariana fruit bats and Mariana crows within the ungulate exclosures, and hire a Wildlife Management Specialist to administer these programs (see "Project Description" above). These proposed measures are expected to increase the quality of existing habitat for the Mariana fruit bat and Mariana crow and habitat for the Guam Micronesian kingfisher which will help offset the impacts the proposed project on these species. The Guam rail primarily utilizes secondary growth areas and is not expected to be negatively or positively impacted by these activities. The proposed ungulate exclosure areas are expected to remove approximately 0.1 ha (0.2 ac) of potential Mariana fruit bat, Mariana crow, Guam Micronesian kingfisher, and Guam rail habitat. However, the expected increase in habitat quality within these areas will offset the loss of habitat for the Mariana fruit bat, Mariana crow, and Guam Micronesian kingfisher. In addition to habitat loss, the proposed exclosures will be constructed within the territory of one Mariana crow pair and an area that may be utilized by foraging Mariana fruit bats. The process of eradicating ungulates (*e.g.*, gunfire) within these exclosures could disturb nesting Mariana crows and foraging Mariana fruit bats. To avoid or minimize these potential impacts, the Air Force will schedule ungulate eradication in the exclosures during the day and outside the Mariana crow breeding season (October to April) or when Mariana crows are not nesting within 300 m (984 ft) of the exclosure. Based on these measures we conclude that these proposed habitat improvement activities will not adversely affect listed species.

Studies and Research – The Air Force will conduct a vegetation assessment of Andersen AFB and determine brown treesnake control strategies to develop and implement techniques to avoid, minimize, and/or offset impacts of the proposed project on listed species (see "Project Description" above). The vegetation assessment and brown treesnake control strategies could potentially disturb nesting Mariana crows or roosting Mariana fruit bats if researchers are in the area. However, the Air Force has agreed to avoid nesting Mariana crows by conducting the research in crow territories outside the breeding season (October to April) or not conducting research within 300 m (984 ft) of an active nest. The Air Force will also ensure that all snake control strategies will avoid impacts to the Mariana fruit bat colony at Pati Point. In addition, the outcome of these research efforts will be used to benefit these species. Therefore, we do not expect any adverse impacts associated with the brown treesnake control strategies and vegetation assessment.

Brown Treesnake Interdiction and Control – The Air Force will program for and facilitate a 100 percent inspection rate for all cargo, vehicles, munitions, household goods, and other items leaving Guam from Andersen AFB or other sites on Guam where these items are staged for departure (see "Project Description" and for additional information). In addition, the Air Force

has agreed to develop a mechanism with Wildlife Services and the Service to ensure that funding is available to consistently sustain the 100 percent inspection rate, adequately support sustained brown treesnake trapping, capture, and toxicant use by Wildlife Services in the vicinity of all Air Force items leaving Guam, and actively seek sustained funding to support applied brown treesnake research efforts (see "Project Description" above). Mariana crows and Mariana fruit bats may be disturbed by brown treesnake control activities. However, the majority of these activities are occurring in and around developed areas (*e.g.,* airports, cargo holding areas) where Mariana crows and Mariana fruit bats are not expected to occur. Therefore, we expect no adverse effects from these proposed activities on listed species.

Minimization and Avoidance Measures – The Air Force will develop an Adaptive Management Strategy and to implement various measures to avoid, minimize, and/or offset potential project impacts to listed species (see "Project Description" above). The goals of this Adaptive Management Strategy are to minimize and avoid project impacts to listed species and maintain and increase listed species populations on Andersen AFB. Potential management measures that may be included in the Adaptive Management Strategy are: 1) aircraft noise reduction (*e.g.*, modifying ground track location and flight profile of aircraft without creating a flight hazard or noncompliance with the aircraft flight manual and potential efforts to increase populations), 2) threat removal (*e.g.*, controlling brown treesnake populations at Mariana fruit bat roost sites, Mariana crow nests, and Mariana crow breeding territories, and preventing illegal Mariana fruit bat hunting on Andersen AFB), 3) population enhancement (*e.g.*, supporting Mariana crow aviculture enhancement and reintroduction efforts for listed species), and 4) efforts to establish and maintain Mariana fruit bat, Mariana crow, Guam Micronesian kingfisher, and Guam rail populations on Guam. The Adaptive Management Strategy will be developed by the Air Force and will include an Adaptive Management Team, which includes the Service, and the Service will have approval regarding changes to the Adaptive Management Strategy to ensure it meets the goals of the consultation. Because the nature of these measures is to reduce, avoid, and/or offset adverse impacts, we expect no adverse impacts to occur from these actions.

Monitoring – The Air Force will conduct a multi-year program to monitor Mariana fruit bats and Mariana crows. The goals of this program are to monitor the status of Mariana fruit bats and Mariana crows and evaluate project impacts on these two species (see "Project Description" above). The specific methodology utilized for the monitoring will be developed and incorporated into the Adaptive Management Strategy by the Adaptive Management Team with input from appropriate species and conservation experts as needed. Because the Service will have final approval for all techniques used in monitoring, we expect no adverse impacts to occur from these actions.

Cumulative effects

Cumulative effects include the effects of future Territory of Guam, local, or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA. The Service is unaware of any cumulative effects in the project area that may impact Mariana fruit bats, Mariana crows, Guam Micronesian kingfishers, and Guam rails.

Conclusion

After reviewing the current status, the environmental baseline, the effects of the proposed action, and the cumulative effects, it is our biological opinion that the implementation of the proposed action discussed herein is not likely to jeopardize the continued existence of the Mariana fruit bat, Mariana crow, Guam Micronesian kingfisher, Guam rail, and other off-site species listed under the ESA. This conclusion is based on the following factors for each species.

Mariana Fruit Bat

1) The Service's finding of no jeopardy in this biological opinion for the Mariana fruit bat is based in large part on the conservation measures described in the proposed project. Measures that will offset adverse impacts include: 1) ungulate eradication in approximately 200 ha (494 ac) of potential Mariana fruit bat foraging and roosting habitat; 2) reducing ungulate populations on the base outside the proposed exclosure; 3) outplanting of native tree species utilized by foraging Mariana fruit bats; 4) development and implementation of measures to control brown treesnakes at roost site; 5) providing travel assistance for law enforcement on Rota after typhoons; and 6) protecting roost sites from illegal hunting by limiting access.
2) Although 1 Mariana fruit bat will be harmed, 21 bats will be killed, and 2 bat colonies will be harassed on Guam and 36 bats on Rota (or 6 premature re-migrations to Rota) will be killed by actions discussed in this biological opinion, the potential effects on Mariana fruit bats have been minimized by incorporating measures to minimize disturbance, injury, and death to Mariana fruit bats due to the proposed activities.
3) Additional actions that may be necessary to avoid, minimize, and/or offset potential project impacts on the Mariana fruit bat and to maintain or increase their population will be developed and implemented through the Adaptive Management Strategy and will be based on the best available science with approval by the Service.
4) The Air Force actions described in this biological opinion are not anticipated to compromise the conservation and recovery process described for the Mariana fruit bat in the Guam population recovery plan (USFWS 1990b) and designation of critical habitat on Guam (USFWS 2004b). Recovery of the Mariana fruit bat is based on: a) protection of sufficient habitat to support viable populations in the Mariana archipelago, b) eliminating illegal hunting, c) preventing the accidental introduction of brown treesnakes to other islands in the Mariana archipelago, and d) eradicating brown treesnakes on Guam and Saipan. The proposed conservation measures are expected to assist with brown treesnake control efforts and help minimize illegal hunting. The proposed action is expected to result in direct and indirect loss of up to approximately 186 ha (460 ac) of potential Mariana fruit bat habitat in northern Guam. Estimates of current forest cover based on Donnegan and others (2004) within the area identified as essential habitat by the Service (USFWS 2002; 2004b) are approximately 4,730 ha (11,687 ac). This loss of habitat (up to four percent) associated with the proposed action is expected to be partially offset by the Air Force's proposed ungulate control and eradication activities and other measures to avoid impacts to roosting and foraging Mariana fruit bats. In addition, the Guam population currently makes up approximately two percent of the total Mariana fruit bat population and four percent of the population in the southern islands (*i.e.,* Guam, Rota, Aguiguan, Tinian, and Saipan). Consequently, the Service has determined that the

adverse effects to the Mariana fruit bat that may result from the proposed project will not contribute to an appreciable reduction in the likelihood of survival and recovery of the Mariana fruit bat throughout its range.

Mariana Crow

1) The Service's finding of no jeopardy in this biological opinion for the Mariana crow is based in large part on the conservation measures described in the proposed project. Measures that will offset adverse impacts include: 1) eradicating ungulates in approximately 200 ha (494 ac) of Mariana crow foraging and nesting habitat; 2) reducing ungulate populations on the base outside the proposed exclosure; and 3) outplanting native tree species utilized by foraging Mariana crows.
2) The effects on Mariana crows have been reduced and avoided by incorporating measures to minimize disturbance to Mariana crows from the proposed activities.
3) Additional actions that may be necessary to avoid, minimize, and/or offset potential project impacts on the Mariana crow and to maintain or increase their population will be developed and implemented through the Adaptive Management Strategy and will be based on the best available science with approval by the Service.
4) The Air Force actions described in this biological opinion are not anticipated to compromise the conservation and recovery process described for the Mariana crow in the draft revised recovery plan (USFWS 2005a) and designation of critical habitat on Guam and Rota (USFWS 2004b). Recovery of the Mariana crow is based on: a) maintaining a population of Mariana crow consisting of 75 territorial pairs on Rota and northern and southern Guam; b) sufficient habitat to sustain populations on Rota and northern and southern Guam; c) preventing the accidental introduction of brown treesnakes to Rota; d) sufficient control of brown treesnakes and other predators to achieve population goals; and e) resolution of Mariana crow and landowner conflicts. The proposed conservation measures are expected to assist with brown treesnake control efforts and improve the quality of existing habitat on Guam. The proposed action is also expected to result in a direct and indirect loss of up to approximately 205 ha (507 ac) of Mariana crow habitat in northern Guam. Estimates of current forest cover based on Donnegan and others (2004) within the area identified as essential habitat by the Service (USFWS 2002, 2004b) are approximately 4,223 ha (10,435 ac). Therefore, approximately 4,018 ha (9,928 ac) of essential Mariana crow habitat will not be affected by the proposed project. Utilizing the maximum Mariana crow territory size reported by Morton and others (1999; 37 ha) on Rota, we estimate that sufficient habitat to support 75 territorial Mariana crow pairs will still be available in northern Guam. In addition, this loss of five percent of the available habitat is expected to be partially offset by the Air Force's proposed ungulate control and eradication activities so total impacts may be less. No take of Mariana crows is expected as a result of the proposed action. Consequently, the Service has determined that the effects to the Mariana crow that may result from the proposed project will not contribute to an appreciable reduction in the likelihood of survival and recovery of the Mariana crow.

Guam Micronesian Kingfisher

1) The Service's finding of no jeopardy in this biological opinion for the Guam Micronesian kingfisher is based in part on the conservation measures described in the proposed

project. Measures that will offset adverse impacts include ungulate eradication in approximately 200 ha (494 ac) of potential Guam Micronesian kingfisher foraging and nesting habitat, reducing ungulate populations on the base outside the proposed exclosure, and the Air Force's continued support for reintroducing Guam Micronesian kingfishers to Andersen AFB.

2) The Guam Micronesian kingfisher is currently extinct in the wild and no take is expected as a result of the proposed project.

3) The Air Force actions described in this biological opinion are not anticipated to compromise the conservation and recovery process described for the Guam Micronesian kingfisher in the revised recovery plan (USFWS 2004a) and designation of critical habitat on Guam (USFWS 2004b). Recovery of the Guam Micronesian kingfisher is based on: a) maintaining two subpopulations (one in northern Guam and one in southern Guam) consisting of 1,000 individuals, b) sufficient habitat to sustain subpopulations in northern and southern Guam, and c) sufficient control of brown treesnakes and other predators to achieve population goals. The proposed conservation measures are expected to assist with brown treesnake control efforts and improve the quality of existing habitat on Guam. The proposed action is also expected to result in direct and indirect loss of up to approximately 159 ha (393 ac) of potential Guam Micronesian kingfisher breeding habitat in northern Guam. Estimates of current forest cover and potential Guam Micronesian kingfisher breeding habitat based on Donnegan and others (2004) within the area identified as essential habitat by the Service (USFWS 2002, 2004b) are approximately 4,730 ha (11,687 ac). Therefore, approximately 4,571 ha (11,295 ac) of essential Guam Micronesian kingfisher breeding habitat will not be affected by the proposed project. Utilizing the Micronesian kingfisher pair territory sizes reported by Kesler (2005) for cooperatively breeding (11 ha; 27 ac) and non-cooperatively breeding (8 ha, 20 ac) kingfishers on Pohnpei and average density reported by Engbring and Ramsey (1984; 0.38 per ha, 0.15 per ac) on Guam, we estimate that sufficient essential habitat to support 1,000 Guam Micronesian kingfishers will still be available in northern Guam. In addition, the four percent loss of potential habitat is expected to be partially offset by the Air Force's proposed ungulate control and eradication activities so total impacts may be less. No take of Guam Micronesian kingfishers is expected as a result of the proposed action. Consequently, the Service has determined that the effects to the Guam Micronesian kingfisher that may result from the proposed project will not contribute to an appreciable reduction in the likelihood of survival and recovery of the Guam Micronesian kingfisher.

Guam Rail

1) The Service's finding of no jeopardy in this biological opinion for the Guam rail is based in part on the Air Force's continued support for reintroducing Guam rails to Andersen AFB.

2) The Guam rail is currently extinct in the wild on Guam and no take is expected as a result of the proposed project.

3) The Air Force actions described in this biological opinion are not anticipated to compromise the conservation and recovery process described for the Guam rail in the recovery plan (USFWS 1990a). Recovery of the Guam rail is based on: a) maintaining

two subpopulations (one in northern Guam and one in southern Guam) consisting of 1,000 individuals; and b) sufficient control of brown treesnakes and other predators to achieve population goals. The Guam rail prefers secondary habitat, which is widely available in northern and southern Guam (Jenkins 1979; Donnegan, *et al.* 2004). Therefore, the direct loss of approximately 23 ha (57 ac) of potential Guam rail habitat is not expected to contribute to an appreciable reduction in the likelihood of survival and recovery of the Guam rail.

Off-site Species

The Service's finding that adverse impacts to species listed under the ESA found outside of Guam are discountable is based the Air Force's commitment to program for and facilitate an 100 percent inspection rate for all cargo, vehicles, munitions, household goods, and other items leaving Guam from Andersen AFB or other sites on Guam where these items are staged for departure from Guam (see "Project Description" for additional information). In addition, the Air Force has agreed to develop a mechanism to ensure that funding is available to consistently sustain the 100 percent inspection rate, adequately support sustained brown treesnake trapping, capture, and toxicant use by Wildlife Services in the vicinity of all Air Force items leaving Guam, and actively seek sustained funding to support applied brown treesnake research efforts (see "Project Description" above).

INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and federal regulations pursuant to Section 4(d) of the ESA prohibit the take of endangered or threatened species, respectively, without special exemption. Take is defined as harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct. Harm is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including, breeding, feeding, or sheltering. Harass is defined by the Service as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns, which include, but are not limited to, breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, carrying out an otherwise lawful activity. Under the terms of Section 7(b)(4) and Section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered a prohibited taking under the ESA, provided such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The measures described below are non-discretionary, and must be undertaken by the Air Force so they become binding conditions of the proposed project for the exemption in Section 7(o)(2) of the ESA to apply. The Air Force has a continuing duty to regulate the activity covered by this Incidental Take Statement. If the Air Force (1) fails to assume and implement the terms and conditions; or (2) fails to require the applicant to adhere to the terms and conditions of the Incidental Take Statement through enforceable terms added to the permit or grant document, the protective coverage of Section 7(o)(2) of the ESA may lapse. To monitor the impact of incidental take, the Air Force must report the progress of the action and its impact on the species to the Service as specified in the Incidental Take Statement [50 CFR 402.14(i)(3)].

Amount or Extent of Take Anticipated

The Service will not refer the incidental take of any migratory bird for prosecution under the Migratory Bird Treaty Act of 1918, as amended (16 USC §703-712) if such take is in compliance with the terms and conditions specified herein.

This biological opinion anticipates the following forms of incidental take:

1. The Service anticipates that take of one Mariana fruit bat foraging territory will occur in the form of harm as a result of clearing and construction of the Aircraft Staging Area facility.

2. The Service anticipates that take of 2 Mariana fruit bat colonies and 21 Mariana fruit bats on Guam and 36 Mariana fruit bats from Rota (or 6 premature re-migrations to Rota) will occur in the form of harassment and death as a result of aircraft disturbance associated with overflights and subsequent illegal hunting impacts.

3. The Service anticipates that no take of Mariana crows, Guam Micronesian kingfishers, or Guam rails will occur from the proposed action.

Effect of the Take

The Service has determined in this biological opinion that this level of anticipated take is not likely to jeopardize the continued existence of the Mariana fruit bat.

Reasonable and Prudent Measures

The Service believes the following reasonable and prudent measures are necessary and appropriate to minimize impacts of incidental take of the Mariana fruit bat:

1. Minimize and avoid impacts of the proposed construction and operation of the Aircraft Staging Area on Mariana fruit bats.
2. Minimize, avoid, and/or offset the impacts of increased aircraft operations on Mariana fruit bats.

Terms and Conditions

To be exempt from the prohibitions of Section 9 of the ESA, the Air Force must comply with the following terms and conditions, which implement the reasonable and prudent measures described above and specify reporting requirements. These terms and conditions are non-discretionary.

1. Minimize and avoid impacts of the proposed construction and operation of the Aircraft Staging Area on Mariana fruit bats.
    a. One week prior to clearing and during the first week of construction/clearing, the Air Force will have a biologist (whose selection will be coordinated with the Service and Guam Division of Aquatic and Wildlife Resources) survey the proposed project area and areas within 150 m (492 ft) of the proposed project site at night and during the day to determine if Mariana fruit bats are present. If Mariana fruit bats are observed in the project area, the Air Force will notify the Service and the Guam Division of Aquatic and Wildlife Resources within two (2) days of their observation, and construction will be postponed until these bats have left the area and the Service and the Guam Division of Aquatic and Wildlife Resources have been notified.
    b. No construction activities will occur at night (*i.e.*, between sunset and sunrise).
    c. Shielded lights will be used on the outside of the Aircraft Staging Area.
    d. The Air Force will monitor the status of Mariana fruit bats observed within the project site to ensure no additional take of Mariana fruit bats occurs due to construction activities.
        i. A qualified biologist (whose selection will be coordinated with the Service and Guam Division of Aquatic and Wildlife Resources) must monitor the status of the Mariana fruit bat(s) that utilize the Aircraft Staging Area facility area (at a minimum of every other day) until one (1) year after the construction/clearing in Aircraft Staging Area site is completed. The specific methodology utilized for monitoring will be developed by the Adaptive Management Team with input from appropriate species experts one (1) year prior to the start of clearing activity at the site. The monitoring methodology should include attempting to capture, mark, and attach a radio transmitter to bats that utilize the Aircraft Staging Area at least one (1) month prior to construction/clearing at the project sites. The capture and monitoring of all bats will be conducted by a qualified

biologist (whose selection will be coordinated with the Service and Guam Division of Aquatic and Wildlife Resources), and all activities will be coordinated with the Guam Division of Aquatic and Wildlife Resources and the Guam National Wildlife Refuge.

ii. A report summarizing the methods and results of the above monitoring efforts shall be sent to the Service's Pacific Islands Fish and Wildlife Office (300 Ala Moana Blvd., Room 3-122, Box 50088, Honolulu, Hawaii 96850) within three (3) months after monitoring is completed. Results will include maps of where individuals were observed before, during, and after construction/clearing.

2. Minimize, avoid, and/or offset the impacts of increased aircraft operations on Mariana fruit bats.

   a. The Air Force will increase patrols by security personnel and conservation officers near all Mariana fruit bat roost sites that are established after the roost site at Pati Point is abandoned.

   b. The Air Force will modify its public hunting program to ensure that public hunting does not occur near any Mariana bat roosts.

   c. The Air Force will provide financial assistance to the Service's Law Enforcement Office in Honolulu, Hawaii, to help pay for the travel costs of sending a special agent to Rota after a typhoon to reduce the incidences of illegal hunting on Rota.

   d. The Air Force will implement the brown treesnake control measures being developed at Mariana fruit bat roosts. The implementation of this measure will be part of the Adaptive Management Strategy and will be developed with us to ensure this measure does not adversely impact Mariana fruit bats.

   e. The Air Force will monitor the number of Mariana fruit bats at all roost sites to ensure no additional take of Mariana fruit bats occurs due to aircraft operations associated with the proposed project.

      i. A qualified biologist (whose selection will be coordinated with the Service and Guam Division of Aquatic and Wildlife Resources) must monitor the number of the Mariana fruit bats at all roost sites until one (1) year after the proposed ISR/Strike is fully implemented. Monitoring will occur at a minimum of once a week except after a typhoon event occurs on Rota when monitoring will occur at a minimum of three times a week, for eight (8) weeks after the typhoon, to more accurately monitor potential migration of bats between Rota and Guam. The specific methodology utilized for monitoring will be developed by the Adaptive Management Team with input from appropriate species experts one (1) year prior to the increase in aircraft operations (FY09). The monitoring methodology should include direct counts of Mariana fruit bats at roost sites utilizing a spotting scope at an appropriate distance to avoid impacts to the bats.

ii. Reports summarizing the methods and results of the above monitoring efforts shall be sent to the Service's Pacific Islands Fish and Wildlife Office (300 Ala Moana Blvd., Room 3-122, Box 50088, Honolulu, Hawaii 96850) every four (4) months until the monitoring is completed. Results will include a table of count results and weekly summary of the number of aircraft operations (by aircraft type) over occupied roost sites.

The Air Force shall inform the Field Supervisor of the Service's Pacific Islands Fish and Wildlife Office in Honolulu, Hawaii in writing of take of any federally listed species within three (3) working days. The depository designated to receive specimens of any Mariana fruit bats and Mariana crows that are killed is the B.P. Bishop Museum, 1525 Bernice Street, Honolulu, Hawaii, 96817 (telephone: 808/547-3511). If the B.P. Bishop Museum does not wish accession to the specimens, the permittee should contact the Service's Division of Law Enforcement in Honolulu, Hawaii (telephone: 808/861-8525; fax: 808/861-8515) for instructions on disposition. The Service's Pacific Islands Fish and Wildlife office (telephone: 808/792-9400) will also be informed within 3 working days of any injured Mariana fruit bats and Mariana crows found and the actions taken.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs Federal agencies to utilize its authority to further the purposes of the ESA by carrying on conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

The Service provides the following conservation recommendations:

a. Recovery of the Mariana fruit bat is dependent on establishing viable populations of Mariana fruit bats in the southern Mariana archipelago. The Island of Aguiguan is currently uninhabited and could support a large Mariana fruit bat population if sufficient habitat is available. Currently the island is being modified by browsing pressure form goats. We recommend that the Air Force lease Aguiguan from the Commonwealth of the Northern Mariana Islands and eradicate goats on the island to help support Mariana fruit bat populations and offset the loss of Mariana fruit bats on Guam.

b. Recovery of the Mariana fruit bat, Mariana crow, Guam Micronesian kingfisher, and Guam rail is dependent on reducing and/or eliminating brown treesnakes in northern Guam. We recommend that the Air Force develop and implement measures to control brown treesnakes at a landscape level on Andersen AFB to support recovery efforts for these species.

c. Recovery of the Mariana fruit bat, Mariana crow, and Guam Micronesian kingfisher is dependent upon having sufficient habitat to support these species in northern Guam. We recommend that the Air Force eradicate ungulates and implement a native tree reforestation program throughout Andersen AFB to support the recovery of these species.

In order for the Service to be kept informed of actions minimizing or avoiding adverse effects or that benefit listed species or their habitats, the Service requests notification of the implementation of any conservation recommendation.

REINITIATION-CLOSING STATEMENT

This concludes formal section 7 consultation on this action. As required by 50 CFR § 402.16, reinitiation of consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: 1) the amount or extent of incidental take is exceeded; 2) new information reveals effects of the agency action that may affect listed species in a manner or to an extent not considered in this opinion(*e.g.*, Mariana crows are taken as a result of the action or brown treesnakes become established in Hawaii as a result of Air Force activities associated with this proposed action); 3) the agency action is subsequently modified in a manner that causes an effect to the listed species that was not considered in this biological opinion (*e.g.*, conservations measures like 100 percent brown treesnake interdiction are not implemented); or 4) a new species is listed or critical habitat designated that may be affected by this action. In instances where the amount or extent of incidental take is exceeded, any operations causing take must cease pending reinitiation.

As stated in the conclusion of the "Effects of the Action on Listed Species" section (above), the Service's finding of no jeopardy is based in large part on the conservation measures built into the project by the Air Force. Should there be a failure to carry out any or all of the described measures, or if the measures are not effective, or if these measures are modified in any way beyond that accepted by the Service, reinitiation of consultation will be required. We appreciate your cooperation and assistance in helping us prepare this biological opinion. If you have further questions concerning this biological opinion, please contact Fish and Wildlife Biologist Fred Amidon or Consultation Coordinator Patrice Ashfield, of this office at (808) 792-9400.

Sincerely,

Patrick Leonard
Field Supervisor

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Appendix 1
Department of Defense Transportation Regulations 505 and 506

CHAPTER 505

AGRICULTURAL CLEANING AND INSPECTION REQUIREMENTS

A. SCOPE

1. This chapter prescribes procedures, assigns responsibilities, and defines requirements for the prevention of the introduction of agricultural pests into the US by the DOD. Destructive pests such as gypsy moths, brown tree snakes, several varieties of snails, and other species can hitchhike on military equipment and personal effects. Foreign soil attached to equipment can harbor pests and animal diseases. These pests can cause immense damage to America's natural resources, destroy crops, and disrupt the export of agricultural commodities.
2. Foreign agricultural restrictions are specified by country in appropriate chapters of this regulation, however the same general responsibilities of DOD activities for the prevention of agricultural pest movements apply to export shipments from the US to foreign countries as well as on imports to the US.

B. POLICY

It is the policy of the DOD that all organizations and personnel involved in the movement of DOD-sponsored cargo, personal property, and accompanied baggage will take those steps necessary to prevent the spread of agricultural pests from one location to another. This includes movement not only across national borders, but any movement that has the potential to introduce invasive species to a new area. It includes shipments from DOD installations and vendor locations by both military and commercial carriers.

C. RESPONSIBILITIES

1. Office of the Deputy Under Secretary of Defense (Environmental Security) (DUSD (ES)) is responsible for furnishing technical guidance and recommendations to the DOD on means of preventing the return of quarantine pests and organisms that may disrupt agriculture and the natural ecosystem.
2. USDA APHIS is responsible to provide guidance, informational materials, and to conduct training for DOD personnel. APHIS will provide personnel to assist in pre-clearances and to train DOD personnel for inspection, cleaning, and disinfecting of material and personnel. APHIS and the DOD will establish reimbursable agreements as required to accomplish this mission. APHIS is the final authority on the pest risk status of material.
3. Unit commanders are responsible for ensuring that the requirements specified in this chapter are met and that procedures are followed to prevent agricultural pests from entering the US when that unit is returning personnel and/or equipment to the US.
4. Port and transportation commanders will ensure that the requirements specified in this chapter are met and that procedures are followed. They will not allow the movement of cargo or cargo containers from their facilities unless they are apparently free of soil, pest infestation, and prohibited agricultural items.

D. REQUIREMENTS

1. All personnel involved in the movement of ships, aircraft, personnel, cargo (including ordnance), containers, packing material, POVs, personal property and Army/Air Force/Navy Post Office (APO/FPO) mail will assure the following requirements are satisfied prior to that movement:

   a. Baggage. Baggage of all crew, passengers, or troops will be presented for inspection by USDA officers or designees. Commanders must ensure crew, passengers and troops are instructed not to carry prohibited plant and animal material. Foot and web gear of all personnel is also required to be soil and pest free.

   b. Cargo. Cargo will not be loaded aboard any conveyance in a foreign country, for movement to the US, unless it is free of animal and plant contamination or pest infestations as required by the USDA.

   c. Packing Material. All wood packing material, dunnage, pallets and crating, must be soil and bark free and apparently free of pest infestations.

   d. Stores. Stores and in-flight meals are prohibited entry into the US and must be disposed or safeguarded IAW with USDA requirements upon entry.

   e. Garbage. Garbage will be placed in tight, leak proof, covered containers and disposed of following port procedures authorized by, or under surveillance of the USDA representative. Disposal facilities to incinerate or sterilize must be available before military conveyances will be allowed landing or docking at a US base or port.

   f. Containers and Pallets. Cargo containers/pallets will not be stored directly on bare ground unless provisions are made to clean the containers/pallets of soil and pests before movement.

2. Detailed cleaning and inspection procedures can be found in the Armed Forces Pest Management Board Technical Guide No. 31, Contingency Retrograde Washdowns: Cleaning and Inspection Procedures. This document is available on the following web site URL: http://www.afpmb.org/pubs/tims/tim31.htm.

E. REQUEST FOR MCI-E PROGRAMS FOR AGRICULTURAL INSPECTIONS

APHIS allows for MCI-E programs at selected bases in the US. These bases are usually remote from local APHIS offices or receive low risk conveyances or shipments. In these programs, APHIS trains and certifies local DOD personnel to do inspections for APHIS. If a base commander is interested in establishing a program, the local APHIS should be contacted at USDA APHIS PPQ, Port Operations, 4700 River Rd., Riverdale, Md. 20737-5000. Telephone number: 301 734-8295. APHIS HQ can supply contact telephone numbers.

F. ARMED FORCES PEST MANAGEMENT BOARD

The Armed Forces Pest Management Board (AFPMB) was established by DOD Directive 4715.1, Environmental Security, and operates under DOD Instruction 4150.7, DOD Pest Management Program. The AFPMB recommends policy, provides guidance, and coordinates the exchange of information on all matters related to pest management throughout the DOD. This board has representation of each of the military departments and the DLA. As such, this permanently staffed organization is an important source of assistance related to the prevention of movement of invasive species, especially incidents involving quarantine, fumigation, dis-insectization, etc. Their web site is located at the following URL: http://www.acq.osd.mil/afpmb/. In the event that quarantine becomes necessary, additional guidance is provided in Air Force Instruction (AFI) 48-104/AR 40-12/Secretary of the Navy Instruction 6210.2A/, Quarantine Regulations of the Armed Forces.

CHAPTER 506

DOD PRE-CLEARANCE PROGRAM CUSTOMS AND AGRICULTURE INSPECTIONS

A. POLICY

1. The MCI program from OCONUS shore-based locations has been cancelled and is no longer recognized by the USCS. However, the USCS will support pre-clearance for major unit redeployments in conjunction with FTX or contingencies. This chapter outlines the policy and procedures to conduct those pre-clearance operations.

2. To effectively and efficiently conduct redeployment operations for exercises, contingencies, or other special airlift/sealift operations, theater Commanders may request USCS and USDA pre-clearance for redeployments of units, their equipment and sustaining supplies. Timelines for pre-clearance of redeployments should be established during the planning phase of the exercise or concurrently with the deployment phase during crisis action planning for a contingency. The theater Commander and the component commands involved in the redeployment must ensure that there are adequate facilities available for pre-clearance operations and work with the Services to identify military law enforcement personnel to be trained as CBCAs. Costs incurred by implementing provisions of this section (e.g., transportation, per diem, overtime charges) will normally be borne or furnished in kind by the requesting Service or Agency. If the supported command determines that pre-clearance of redeploying cargo and passengers will enhance mission effectiveness, the following request procedure must be followed.

B. PROCEDURES FOR REQUESTING PRE-CLEARANCE

1. The supported unit will submit requests for pre-clearance processing to the office of the appropriate theater command's Customs, Agriculture, and Border Clearance Staff Coordinator. Theater directives will prescribe procedures for processing such requests within the responsible unified command.

2. Requests must include, as a minimum:

   a. The dates, times, and places of departure from foreign country.

   b. Date, time, and proposed place of CTUS arrival.

   c. The number and type of aircraft or ships.

   d. The number of passengers, and amount and type of cargo, to include vehicles and other unit equipment.

   e. Identification of all en route stops between the foreign departure point and the CTUS port of entry, and whether the border clearance integrity of the aircraft or ship will be maintained during those stops. If pre-clearance integrity cannot be maintained, pre-clearance authority is lost.

3. Requests should be electronically transmitted, to the appropriate theater command as part of the initial planning of the redeployment, but not later than 75 days prior to the execution. The theater Customs, Agriculture, and Border Clearance Staff Coordinator will forward the approved request to USTRANSCOM/J5-LT, Scott AFB, IL not less than 60 days prior to the first movement. USTRANSCOM/J5-LT will coordinate with the USCS for support.

4. The responsible unified command Customs, Agriculture, and Border Clearance Coordinator will review the requests. The review will include an assessment of the capability of the theater

command to accommodate the request for pre-clearance. In those instances where the unified command determines contingency or exercise pre-clearance can not be accommodated or is not cost effective, the unit will be required to return to the CTUS through a predetermined CTUS port of entry where US border clearance can be accomplished.

5. Approval of pre-clearance requests under the provisions of this section does not negate any requirements for the carrier to ensure that entry is accomplished at an established CTUS port of entry. This port of entry may be a Regular or Limited Foreign Clearance Base, an international commercial airport or seaport of entry, or any other airport or seaport where a FIS capability exists or can be arranged for on an exception basis. (Refer to DOD 4500.54-G, DOD Foreign Clearance Guide, North and South America, for United States of America aircraft entry requirements (http://www.fcg.pentagon.mil).)

6. If use of any CTUS port of entry other than those regularly staffed by FIS personnel is planned, the requesting organization or carrier operator is responsible for coordinating necessary requirements with the appropriate Customs Management Center or Port Directors office of the USCS, USDA, and other US border clearance agencies.

C. TRAINING AND CERTIFICATION OF CBCAS

1. The theater Commander and the Service component will coordinate the request to the appropriate Service for sourcing of military law enforcement personnel to act as CBCAs for the duration of the redeployment. Personnel should be E-4 and above.

2. Training will be provided and approved by USCS and USDA.

3. Training may be accomplished in the CONUS or at an overseas location, if necessary.

4. Upon successful completion of the training, USCS and USDA will provide certification for trainees.

5. Trained personnel will be appointed on orders as CBCAs by the sponsoring Service component command. Orders should include an effective termination date.

6. USCS and USDA will provide advisors to oversee actual pre-clearance operations.

D. RESPONSIBILITIES OF CBCAS

1. CBCAs are responsible for:

   a. Performing their duties IAW this regulation and US and/or foreign country border clearance requirements.

   b. Inspecting and certifying that DOD-owned materiel, personal property, and passengers are acceptable for entry into the US. If contraband is discovered during the inspection process, the CBCA is to notify proper legal authority.

   c. Representing the commander in performance of inspections, and ensuring that the documentation for which they are responsible accompanies all shipments or personnel.

   d. Ensuring that customs/border clearance violations are expeditiously reported to the appropriate legal authority or military agency for disposition.

   e. Conducting all inspections and examinations in a professional, expeditious, and courteous manner.

   f. CBCAs will not, under any circumstances, collect or accept duty payments.

E. PRE-CLEARANCE REQUIREMENTS

1. CBCAs, in conjunction with USCS/USDA personnel, will inspect all crews, troops, passengers, and their accompanied baggage, professional equipment, issued weapons, cargo and aircraft prior to departure from overseas bases (airfields/ports) when the planned destination is the CTUS. To expedite clearance upon redeployment to the CTUS:

   a. Accompanied baggage and professional equipment excess to immediate personal needs will be inspected in the presence of the member by a CBCA /USCS team one or two days prior to unit redeployment. The baggage will then be secured and held in a sterile area from the time of the inspection until arrival at the US port of entry.

   b. The CBCA/USCS team will inspect hand-carried baggage at the time passengers are processed into a sterile area for isolation until actual departure. If a sterile area is not available, the CBCA/USCS team will inspect the personnel and hand-carried baggage at the ocean or air terminal immediately prior to embarkation. If someone who has been inspected and is waiting in the sterile area finds it necessary to depart the area, that person must undergo a new inspection when they return to the sterile area.

   c. The CBCA/USCS team will inspect unit equipment prior to its being loaded on the ship or aircraft to insure the equipment meets USCS and USDA border clearance requirements. The redeploying unit will ensure that personal property, such as footlockers, is readily identified and retains its individual integrity distinct from military cargo during shipment.

   d. Personal customs declarations will be completed while en-route.

2. Immediately upon completion of the inspection/examination, DD Form 2855, U.S. Military Preclearance Program, Figure 506-1, will be properly executed, authenticated by official stamp and signature, and securely affixed to the outside of each container/vehicle/equipment inspected/examined. The CBCA or USCS/USDA inspector will accomplish the execution and attachment of the label. This form is to be used only for cargo that has been pre-inspected and certified by CBCA/USCS/USDA personnel at OCONUS locations as part of an exercise or contingency operation IAW Chapter 505 and 506 of this regulation and meets USCS and USDA CONUS pre-clearance entry requirements. DD Form 2855 can be found at http://www.doir.whs.mil/forms/DD2855.PDF.

U.S. MILITARY PRECLEARANCE PROGRAM

AUTHORIZED USE ONLY IN ACCORDANCE WITH DOD 4500.9-R, PART V, CHAPTERS 505 AND 506

The U.S. Government property to which this label has been affixed meets the entry requirements of U.S. Customs and U.S. Agriculture.

1. INSPECTOR'S RANK AND NAME

2. DATE

3. ORIGIN

4. DESTINATION

5. INSPECTOR'S STAMP

DD FORM 2855, JUN 2002

Figure 506-1. DD Form 2855, U.S. Military Preclearance Program

F. PRE-CLEARANCE COORDINATION AND COMMUNICATION

1. Coordination with, and notification of affected organizations of actual pre-cleared passengers, baggage and cargo shipments is critical to the successful implementation of the pre-clearance program for exercises, contingencies, or other special airlift/sealift operations. At a minimum, the following communications must occur after pre-clearance operations have been approved.

   a. Upon approval and agreement of the USCS and USDA to support pre-clearance operations, the theater command customs and border clearance coordinator will notify affected organizations using the message format shown in Figure 506-2.

   b. Airlift and sealift schedulers will keep the USCS and USDA notified of redeployment routing and schedules as soon as they are developed. USCS and USDA will notify regional and local port directors to notify of pre-cleared status of passengers, baggage, cargo, and/or conveyance to expedite Port of Embarkation (POE) procedures.

SAMPLE

```
FROM:   (Theater Customs, Agriculture, and Border Clearance Coordinator)

TO:     (Theater aerial ports)
        (Theater water ports)
        (Theater component customs and agriculture clearance offices and/or
         activities)

        INFO:  CDR MTMC ALEXANDRIA VA//MTOP//
               HQ AMC TACC SCOTT AFB IL//XOC/XOO/XOP//
               COMSC WASHINGTON DC//PM-5//
               USTRANSCOM SCOTT AFB IL//JMOCC/TCJ5-LT//
               DA WASHINGTON DC//DALO-TSP//
               HQ USAF WASHINGTON DC//ILGD//
               CMC WASHINGTON DC//LFT/LPO//
               CNO WASHINGTON DC//N41//

SUBJ:  US CUSTOMS/AGRICULTURE PRECLEARANCE FOR (NAME OF EXERCISE OR OPERATION)

1.  US CUSTOMS/AGRICULTURE PRECLEARANCE OPERATIONS HAVE BEEN COORDINATED AND
APPROVED FOR (NAME OF EXERCISE OR OPERATION) IAW DOD 4500.9-R, DEFENSE
TRANSPORTATION REGULATION, PART V.

2.  POLICY AND PROCEDURES OUTLINED IN DOD 4500.9-R, PART V, CHAPTERS 505 AND 506
APPLY.

3.  USCS ADVISORS WILL BE DEPLOYED TO (LOCATION) FROM (DATE) TO (DATE) TO
SUPERVISE PRE-CLEARANCE ACTIVITIES.

4.  AERIAL AND WATER PORTS SHOULD SET UP STERILE AREAS TO STORE PRE-CLEARED
BAGGAGE AND CARGO PRIOR TO REDEPLOYMENT.

5.  REQUEST AIRLIFT AND SEALIFT SCHEDULERS NOTIFY USCS AND USDA OF FLOW SCHEDULES
AND ROUTINGS TO AVOID UNNECESSARY RE-INSPECTIONS IN CONUS.

6.  ADDITIONAL INSTRUCTIONS:

7.  POC IS (NAME, ORGANIZATION, TELEPHONE NUMBER, DSN & COMMERCIAL).
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Figure 506-2. Sample Customs and Agriculture Pre-clearance Announcement Message

G. REQUESTS FOR CUSTOMS AND AGRICULTURE PRE-CLEARANCE

1. USCS and USDA, in cooperation with the DOD, will pre-clear cargo and passengers returning to the CTUS. This pre-clearance program is available for redeployments from major exercises or contingencies. Pre-cleared exercises will require little or no USCS or APHIS inspection into the US. Pre-clearance will lessen the contraband and pest risk and expedite the movement of personnel and equipment into the US. If the supported command determines that pre-clearance of redeploying cargo and passengers will enhance mission effectiveness, the following request procedure must be followed:

   a. The supported unit will submit requests for USDA pre-clearance processing to USDA HQ, APHIS PPQ, Port Operations, 4700 River Rd., Riverdale, Md. 20737-5000, telephone number: 301 734-8295. For USCS, coordinate requests through HQ USTRANSCOM TCJ-5/LTC. Defense Switched Network (DSN): 312 779-1985, Commercial: 618 229-1985 for coordination. Theater directives will prescribe procedures for processing such requests within the responsible unified command (see paragraph G.3. for United States European Command (USEUCOM) requirements).

   b. Requests must include, as a minimum: (1) the date, time, and place of overseas departure; (2) date/time of CTUS arrival; (3) the number and type of aircraft or ships; (4) the number of passengers and amount and type of cargo, to include vehicles and other unit equipment; (5) identification of all en route stops between the overseas departure point and the CTUS port of entry; and whether the border clearance integrity of the aircraft or ship will be maintained.

   c. Requests should be electrically transmitted, to the appropriate theater command as part of the initial planning of the redeployment, but not later than 45 days prior to the execution. Theater commands will forward the approved request to APHIS HQ not less than 30 days prior to the first movement. Direct contact with APHIS HQ is authorized. USTRANSCOM/J5-LT will assist with coordination as needed.

   d. Approval of pre-clearance requests under the provisions of this section does not negate any requirements for the carrier to ensure that entry is accomplished at an established CTUS port of entry. This port of entry may be a Regular or Limited Foreign Clearance Base, an international commercial airport or seaport of entry, or any other airport or seaport where a FIS capability exists or can be arranged for on an exception basis.

   e. If use of any CTUS port of entry other than those regularly staffed by FIS personnel is planned, the requesting organization or carrier operator is responsible for coordinating necessary requirements with USCS and APHIS HQ.

2. Agreements must be in place to support USCS and APHIS advisors conducting pre-clearance duties in conjunction with returning personnel and equipment from contingencies and training exercises. The agreement will include provisions for overtime fees, car rental, transportation to/from site, per diem, and lodging entitlements.

3. USEUCOM Procedures. USEUCOM, with the cooperation of in-theater USDA representatives has established a pre-clearance program to enforce USDA requirements and have made agricultural pre-clearances mandatory. If exercise redeployments are originating in the USEUCOM AOR, the supporting unit should contact the EUCOM Customs/Agriculture Executive Agent (HQ USAREUR/ECJ1-CEA) directly to coordinate for pre-clearance assistance. Their web site URL is: http://www.hqusareur.army.mil/opm/customs.htm.

H. AGRICULTURE PRE-CLEARANCE PROCEDURES

1. Ships, aircraft, personnel, cargo (including ordinance) packing material, POVs, personal effects, and APO/FPO mail must be free of prohibited and restricted plants, animals, and plant and animal products when returned to the US.
2. Inspectors: USDA inspectors, or trained and certified CBCA or MCI-E inspectors will conduct these inspections.
3. Training: USDA will conduct training for DOD personnel. The DOD will be responsible for providing reimbursement for training in OCONUS sites. The USDA will fund routine training of MCI-E or other designees in the US.
4. Facilities: Inspections must be conducted in natural or well-lighted areas. Cleaning and disinfecting must be conducted in areas approved by USDA or designees. Commodities or equipment that have been approved for return to US must be stored in such a manner as to prevent re-infestation by pests or contaminants. USDA officers or designees must approve these areas.
5. Reporting: Numbers of inspection, cleaning and disinfecting should be reported, through the chain of command, to DUSD (ES) and APHIS. APHIS and DUSD (ES) must be informed of interceptions of significant pests. APHIS will assist in the identification of pests.
6. During exercises, unit moves, deployments, redeployments, or other special airlift/sealift operations, CBCAs, in conjunction with USCS/USDA personnel, will inspect all crews, troops, passengers, and their accompanied baggage, professional equipment, issued weapons, cargo and aircraft prior to departure from overseas bases (airfields/ports) when the planned destination is the CTUS. To expedite clearance upon redeployment to the CTUS:
    a. Accompanied baggage and professional equipment excess to immediate personal needs will be inspected in the presence of the member by an CBCA/APHIS team one or two days prior to unit redeployment. The baggage will then be secured and held in a sterile area from the time of the inspection until arrival at the US port of entry.
    b. The CBCA/APHIS team will inspect hand-carried baggage at the time passengers are processed into a sterile area for isolation until actual departure. If a sterile area is not available, the CBCA/APHIS team will inspect the personnel and hand-carried baggage at the ocean or air terminal immediately prior to embarkation. If someone who has been inspected and is waiting in the sterile area finds it necessary to depart the area, that person must undergo a new inspection when they return to the sterile area.
    c. The CBCA/APHIS team will inspect unit equipment prior to its being loaded on the ship or aircraft to insure the equipment meets USCS and USDA border clearance requirements. The redeploying unit will ensure that personal property, such as a footlocker, is readily identified and retains its individual integrity distinct from military cargo during shipment.
    d. DD Form 2855, Figure 506-1, is authorized to be used only for cargo that has been pre-inspected and certified by CBCA/USCS/USDA personnel at OCONUS locations as part of an exercise or contingency operation IAW Chapter 505 and 506 of this regulation and meets USCS and USDA CONUS pre-clearance entry requirements.
7. Some exercises may be pre-cleared for APHIS and not for US Customs. In these circumstances, US Customs clearance may be required upon arrival in the US. Personnel and equipment should not require additional APHIS inspection. APHIS always retains the right to do integrity checks in the US.
8. Any after action reports should include input from APHIS.

I. AIRBORNE TROOPS

Procedures described above are applicable to airborne troop movements with an airdrop upon return to the CTUS so long as the airdrops have been coordinated with USCS director in the district involved. The annotated customs declaration of these personnel must be provided to a member of the aircrew, preferably the aircraft commander, prior to the airdrop. The CBCA/USCS team will advise the aircrew member that the declarations must be turned over to USCS inspectors at the port of entry for the aircraft.

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F1B USFWS, Request for Informal Section 7 Consultation for the Beddown of Training and Support Initiatives at Northwest Field Project on Andersen AFB, Guam (May 2006)

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United States Department of the Interior

FISH AND WILDLIFE SERVICE
Pacific Islands Fish and Wildlife Office
300 Ala Moana Boulevard, Room 3-122, Box 50088
Honolulu, Hawaii 96850

In Reply Refer To:
1-2-2006-I-281

MAY 19 2006

Lieutenant Colonel Marvin W. Smith, Jr.
Department of the Air Force
36th Civil Engineer Squadron (PACAF)
Unit 14007
APO AP 96543-4007

Subject: Request for Informal Section 7 Consultation for the Beddown of Training and Support Initiatives at Northwest Field Project on Andersen Air Force Base, Guam

Dear Lieutenant Colonel Smith:

We received your letter and biological assessment dated March 17, 2006, on April 13, 2006, requesting our concurrence with your finding that the proposed Beddown of Training and Support Initiatives at Northwest Field Project may affect, but is not likely to adversely affect any federally listed species on Andersen Air Force Base, Guam. Species that may be affected include the endangered Mariana crow (*Corvus kubaryi*), Guam rail (*Gallirallus owstoni*), and Guam Micronesian kingfisher (*Halcyon cinnamomina cinnamomina*) and the threatened Mariana fruit bat (*Pteropus mariannus mariannus*). The Air Force has determined that the proposed project will have no effect on the endangered tree, *Serianthes nelsonii*.

On May 2, we met with the Air Force to obtain additional information about the proposed project and discuss potential direct and indirect impacts to listed species. The following week we participated in a conference call to further address measures to reduce noise impacts to the Mariana crow. On May 12, 2006, we received the supplemental data we requested on the proposed project from Mr. Jonathan Wald. Due to the timing of the receipt of the requested materials, Mr. Jonathan Wald extended our 30-day timeline to May 19, 2006.

The Air Force is proposing to relocate the Rapid Engineer Deployable Heavy Operations Repair Squadron (Red Horse) and its Silver Flag training unit, the Pacific Air Force (PACAF) Security Forces Commando Warrior training program, and the Combat Communications squadron to Andersen Air Force Base. As part of this relocation, an administrative area, Field Training Exercise (FTX) site, and bivouac area will be constructed in the Northwest Field area of the base and utilized for these training programs (Figure 1). Approximately 47 hectares (116 acres) of vegetation will be cleared for the construction of facilities, roads, a Defensive Fighting Position (DFP) line, entry control points, base defense operations centers, sector command posts, and a bivouac training area. The proposed training activities are described below by program:

TAKE PRIDE® IN AMERICA

a) Red Horse – Approximately 160 students will take part in heavy equipment training, including ground disturbance, in the proposed bivouac area and adjacent quarry four times a year beginning in 2009. Each training session will last from seven to ten days and students will reside in the proposed bivouac area. Ground disturbing activities during training will occur only within the quarry. To simulate operating equipment during combat operations, ground-burst-simulators will be set off one time per training session within a two hour period and blank ammo will be fired occasionally throughout the training session.

b) Silver Flag – Approximately 166 students will take part in simulated military deployment and airfield recovery training, involving heavy equipment, twelve times a year beginning in 2012. Each training session is expected to last seven days and will include approximately five days of training in the administrative area and two days training in the FTX area. Heavy equipment operation and drilling activities would occur only on existing paved surface and the quarry. To simulate an enemy attack on an airfield, ground-burst-simulators, smoke grenades, small arms blank ammunition, and an 18-kilogram cratering charge will be used during a 24-hour base recovery exercise between the DFP line and the airfield. All smoke grenades and ground-burst simulators will be set off on paved surfaces and the 18-kilogram cratering charge will be detonated in the same area along the paved taxiway/aircraft parking area of the airfield for all training exercises. None of the weapons will be fired continuously during the exercise, but once or twice during the 24-hour training period there will be a one to two hour period of intense firing. One cratering charge will be detonated every 15 calendar days (once a training session) for a total of 25 detonations a year. In addition, firefighters from the unit will undergo structural fire training within a metal structural training building, in which several live fires would be extinguished, within the administrative area. Either wood/paper products or a propane-fired system in a ceramic-lined room would be used within the building.

c) PACAF Security Forces Commando Warrior – Approximately 150 students will take part in electronic system security, expeditionary Air Force predeployment, simulations instructor, non-lethal weapons, close precision engagement, and anti-terrorism level II/ expeditionary anti-terrorism skills training ten times a year beginning in 2009. Each training session is expected to last 18 days and will include several days of academic training and culminates in a 72-hour FTX involving approximately 88 students. The proposed training is expected to occur throughout the FTX area but will be focused along the DFP line. To simulate defense of the airfield and DFP, munitions (blank ammunition, hand grenade fuses, explosive simulators, ground-burst-simulators, hand grenade simulators, surface trip flares, smoke grenades, surface to air simulators, slap flares, illumination rounds, and marking cartridges) will be used during the 72-hour training period. None of the weapons will be fired continuously during the exercise, but once or twice during the training period there will be one to two hour periods of intense firing. Ground-burst-simulators will only be set off in pits constructed along the defensive fighting position line and all vehicle traffic will be restricted to unpaved roads and trails.

d) Combat Communications – Students will take part in training to build and complete communications sites from the ground up and defend these sites from assault beginning in 2011. This training will involve academic and FTX training and combat communications personnel will participate in air base defense training with either PACAF Security Forces Commando Warrior or Silver Flag organizations. Therefore, the use of munitions will correspond with PACAF Security Forces Commando Warrior or Silver Flag training described above.

Historically, the proposed project area was utilized by the endangered Mariana crow, Guam rail, and Guam Micronesian kingfisher and the threatened Mariana fruit bat. The endangered tree, *Serianthes nelsonii*, is not located within any of the construction or training areas for this project. However, one individual was found within the ungulate exclusion area (see Habitat Enhancement below). The Guam rail and Guam Micronesian kingfisher no longer occur at the project site, however, the site contains potential breeding and foraging habitat for these two species. Therefore, they were included in this consultation pursuant to the Cooperative Agreement between the U.S. Air Force and the U.S. Fish and Wildlife Service for establishment and management of the Guam National Wildlife Refuge, dated March 10, 1994.

The Mariana crow population on Guam currently consists of approximately eleven individuals, primarily within the Munitions Storage Area on Andersen Air Force Base. During surveys for the proposed project, a Mariana crow was observed in the proposed FTX area, but no crow pairs have been reported nesting in the area recently. However, recent communications with the Guam Division of Aquatic and Wildlife Resources indicate that a Mariana crow pair may have established a territory to the northeast of the project area. The Mariana fruit bat population consists of less than 50 individuals. Recent surveys of the main colony indicate only 26 bats persist at this location; however, small numbers of individual bats do roost in other locations in northern and southern Guam. The main Mariana fruit bat colony is located over nine kilometers from the project area and Mariana fruit bats were not observed during the project survey period. However, bats have been observed in areas adjacent to the project site and a Guam National Wildlife Refuge employee observed a bat flying from the project area in February 2006 indicating bats may use this area for foraging.

The proposed project is expected to have the following potential impacts on these listed species and/or their habitats: (1) direct loss of potential breeding, foraging, and/or roosting habitat through vegetation clearing for construction of the administrative area, FTX site, and bivouac area; (2) increased auditory and visual disturbance during construction and maintenance of the training areas; and (3) increased auditory and visual disturbance during training, especially combat simulation exercises. In order to minimize and avoid these potential project impacts to federally listed species, the Air Force is proposing to undertake the following measures:

a) Habitat Enhancement – To offset the loss of potential breeding and foraging habitat from the proposed action, the Air Force is proposing to construct a 54 hectare (113 acre) ungulate exclosure to the northeast of the proposed FTX area and assist with completing a pig, deer, and brown treesnake barrier around a 22 hectare (54 acre) habitat management unit located near Potts junction. The Air Force is proposing to develop and implement an ungulate control plan to remove deer and pigs from these areas and to

reduce ungulate populations in non-fenced areas to promote natural forest regeneration. In addition, the Air Force is proposing to establish five 50-square meter plots in the ungulate control exclosure for outplanting native tree species utilized by foraging Mariana fruit bats and Mariana crows. The goal of these outplantings is to offset the loss of native tree species utilized by foraging Mariana fruit bats and Mariana crows lost during vegetation clearing for the proposed project.

b) Post-Typhoon Training Schedule – After a typhoon event, when food resources for the Mariana crow and Mariana fruit bat may be reduced, the Air Force will coordinate with this office and the Guam Division of Aquatic and Wildlife Resources to determine if training schedules should be modified or reduced. In addition, to avoid training impacts on crow nesting after a typhoon event, the Air Force has developed three conditions that will modify training activities. First, if crows are nesting between the 114 unweighted peak noise level (dBP) cratering (approximately 1,800 meters from the noise source) and 104 dBP small arms fire (approximately 500 meters from the noise source) noise contours (Figure 1) and typhoon event occurred with two to three months of the training, no cratering charges will be detonated. Second, if crows are nesting between the 114 dBP cratering and 104 dBP small arms fire noise contours and typhoon event occurred with one to two months of the training, no cratering charges will be detonated and no M2, M115A, and M116A munitions will be used. Finally, if crows are nesting within the 104 dBP small arms fire noise contour and a typhoon event occurred within 1 month of the training, no training will occur (see Figure 1).

c) Mariana Crow Nesting and Training Schedule – To avoid potential impacts to nesting Mariana crows, the Air Force has developed three conditions that will modify the proposed training activities. First, if crows are nesting between the 114 dBP and 118 dBP cratering charge noise contours (see Figure 1), no cratering charges will be detonated. Second, if crows are nesting between the 118 dBP cratering and 110 dBP small arms fire noise contours, no cratering charges will be detonated and no M2, M115A, and M116A munitions will be used. Finally, if crows are nesting within the 110 dBP small arms fire noise contour, no FTX training will occur. In addition, the Air Force will initiate the first training program outside the Mariana crow breeding season (October – April) to limit training impacts on crows that may have initiated breeding prior to the training (see Figure 1).

d) Construction Schedule – To avoid potential impacts to the Mariana crow and Mariana fruit bats during construction, the beginning of the construction will be initiated outside the Mariana crow breeding season (October – April) and no construction will occur at night.

e) Monitoring – To better assess potential project impacts on nesting Mariana crows and in order to develop adaptive management techniques for the training program, the Air Force will develop and initiate a nest monitoring program in coordination with this office and the Guam Division of Aquatic and Wildlife Resources. This program will be initiated prior to the proposed training program in order to gather baseline information.

The increase in the shipment of goods from Guam due to personnel and activities associated with the proposed project would increase the likelihood that brown treesnakes (*Boiga irregularis*) may be transported from Guam to other locations. The introduction of this highly invasive snake to other islands would be devastating to native fauna, particularly listed species. As part of the proposed action, the Air Force has committed to 100-percent inspection of all outbound cargo, supplies, household goods, and aircraft from Guam for brown treesnake interdiction. This action is extremely critical for reducing the risk of brown treesnakes being moved off of Guam from Air Force activities. We concur that the complete implementation of the proposed brown treesnake interdiction program reduces the action area to the island of Guam since the risk of snake movement has been adequately minimized.

We have reviewed all information provided and concur with your finding that the proposed project is not likely to adversely affect the Guam rail, Guam Micronesian kingfisher, Mariana crow, and Mariana fruit bat. The *Serianthes nelsonii* located within the ungulate exclosure area will benefit from fencing and ungulate removal. As stated earlier, the Guam rail and Guam Micronesian kingfisher are currently not extant on Guam, though efforts continue to reestablish wild populations on the island. We anticipate there will be some level of disturbance to these species due to construction and training activities. However, research on military training noise impacts on the endangered red-cockaded woodpecker (*Picoides borealis*) and Oahu elepaio (*Chasiempis sandwichensis ibidis*) and threatened bald eagle (*Haliaeetus leucocephalus*) indicate that impacts are minimal if the disturbance is a sufficient distance away and the species has previous exposure to the disturbance events (Stalmaster and Kaiser 1997, Brown *et al.* 1999, VanderWerf and Ebisu 2000, Delaney *et al.* 2002). For example, Delaney and others (2002) reported that red-cockaded woodpeckers on Fort Stewart, Georgia, did not flush from the nest when noise sources were over 152 meters (500 feet) away from the nest.

Therefore, impacts from the proposed project have been minimized due to the following measures: 1) training modification measures for reducing noise disturbance to nesting Mariana crows based on the distance of nests from training activities; 2) the relatively short duration of these disturbance events; 3) the availability of sufficient habitat to support listed species' life history requirements outside the impact area; and 4) scheduling of construction and training to avoid disturbance to listed species. Disturbance associated with training could become significant after a typhoon event when foraging resources for the Mariana fruit bat and Mariana crow may be limited. However, the Air Force's proposed measures to coordinate with this office and the Guam Division of Aquatic and Wildlife Resources after a typhoon event to evaluate changes in the training schedule and limit training based crow nest locations and the amount of time that has passed after a typhoon are expected to avoid these potential impacts.

We appreciate your efforts to conserve endangered species. If you have any questions please contact Fred Amidon, Fish and Wildlife Biologist, by phone at 808-792-9400.

Sincerely,

Patrick Leonard
Field Supervisor

Enclosure

References Cited

Brown, B. T., G. S. Mills, C. Powels, W. A. Russell, G. D. Therres, and J. J. Pottie. 1999. The Influence of Weapons-Testing Noise on Bald Eagle Behavior. Journal of Raptor Research 33:227-232.

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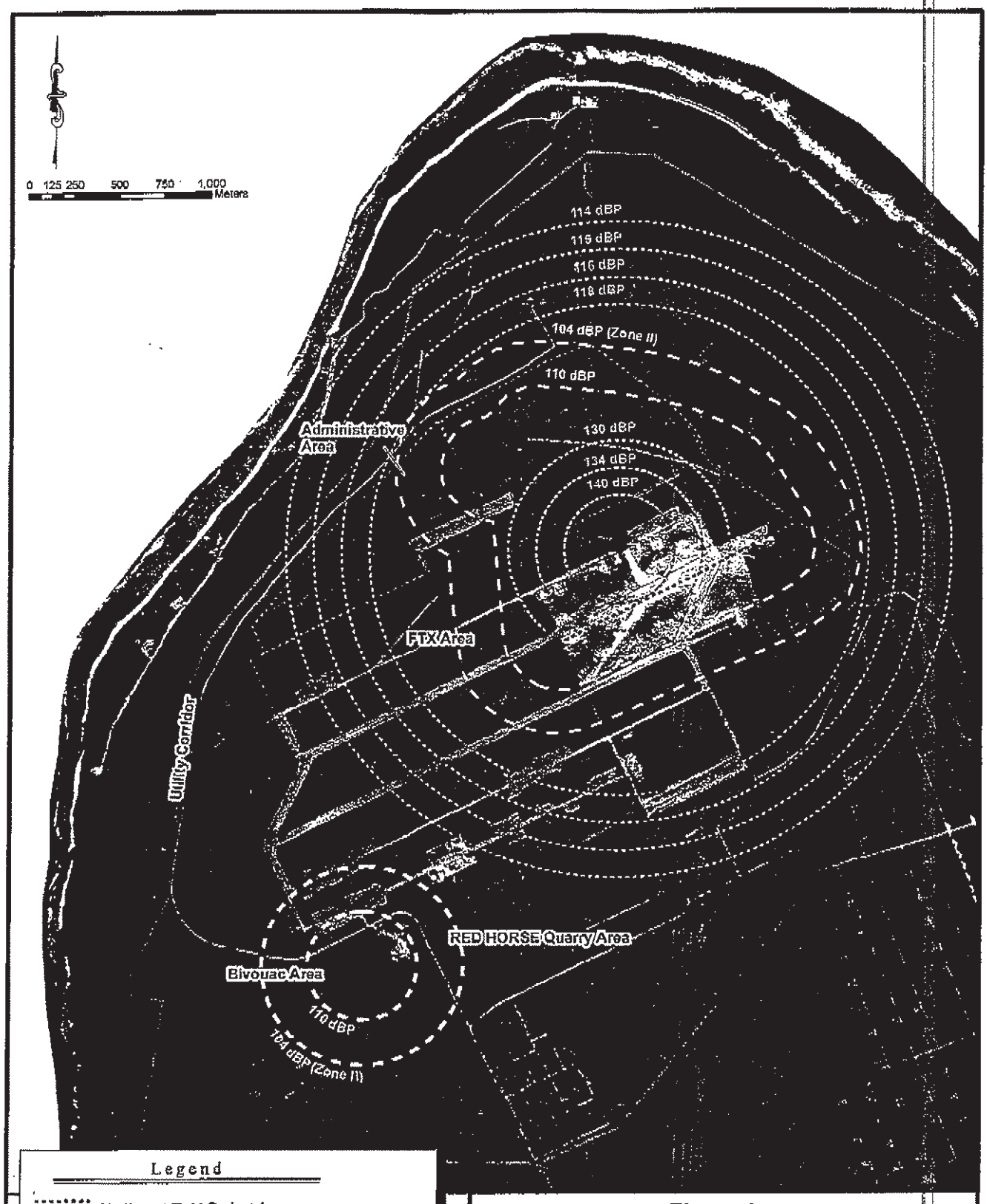

Figure 1

Location of Proposed Cleared Areas and Areas Subject to Training Events

Andersen AFB, Guam

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F1C USFWS, Reinitiation of Informal Section 7 Consultation Regarding Beddown of Training and Support Initiatives at Northwest Field, Andersen AFB, Guam (March 2009)

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United States Department of the Interior

FISH AND WILDLIFE SERVICE

Pacific Islands Fish and Wildlife Office
300 Ala Moana Boulevard, Room 3-122, Box 50088
Honolulu, Hawaii 96850

In Reply Refer To:
2009-I-0112
2006-I-0281

MAR 0 6 2009

Mr. Russell Littlejohn
Andersen Air Force Base
U.S. Department of the Air Force
Headquarters, 36th Wing (PACAF)
Unit 14007, APO AP 96543-4007

Subject: Reinitiation of Informal Section 7 Consultation Regarding Beddown of Training and Support Initiatives at Northwest Field, Andersen Air Force Base, Guam
Andersen Air Force Base, Guam

Dear Mr. Littlejohn:

This letter is in response to an electronic mail (email) received on February 10, 2009, requesting reinitiation of section 7 consultation for the beddown of training and support initiatives at Northwest Field, Andersen Air Force Base (AAFB), Guam (Beddown Project). At issue are the potential effects of the proposed project on the threatened Mariana fruit bat (*Pteropus mariannus mariannus*) (bat) and the endangered Mariana crow (*Corvus kubaryi*) (crow), endangered Guam rail (*Gallirallus owstoni*) (rail), and endangered Guam Micronesian kingfisher (*Halcyon cinnamomina cinnamomina*) (kingfisher). Although the rail and kingfisher are extirpated in the wild from Guam, they must be considered in consultation requests on AAFB due to the requirements identified in the Cooperative Agreement between the U.S. Air Force and the U.S. Fish and Wildlife Service (Service) or the establishment and management of the Guam National Wildlife Refuge (Air Force and Service 1994).

The findings and recommendations in this consultation are based on: (1) your letter dated February 11, 2009, received by email on February 10, 2009; (2) the May 19, 2006, informal consultation for the Beddown Project, and (3) other information available to us. A complete administrative record is on file in our office. This response is in accordance with section 7 of the Endangered Species Act of 1973 (Act), as amended (16 U.S.C. 1531 *et seq.*).

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Project Description
The original Beddown Project consisted of relocating the Rapid Engineer Deployable Heavy Operations Repair Squadron (Red Horse) and its Silver Flag training unit, the Pacific Air Force (PACAF) Security Forces Commando Warrior training program, and the Combat Communications squadron to Andersen Air Force Base. As part of this relocation, an administrative area, Field Training Exercise (FTX) site, and bivouac area will be constructed in the Northwest Field area of the base and utilized for these training programs. Approximately 47 hectares (116 acres) of vegetation will be cleared for the construction of facilities, roads, a Defensive Fighting Position (DFP) line, entry control points, base defense operations centers, sector command posts, and a bivouac training area. See the informal consultation for a full description of the original Beddown Project (Service File No. 2006-I-0281).

The reinitiation is necessary as the project description has been slightly modified. Specifically the military working dog facility and Commando Warrior Military Operations in Urban Terrain (MOUT) facility were both evaluated within the Beddown Project; however, the size of the project footprint was underestimated and did not include infrastructure to support these facilities (i.e., parking lots, building grounds, dog exercise and training yards, corridors between MOUT buildings, and access roads). Therefore, the proposed project will remove an additional 1.06 hectares (2.6 acres) of habitat to accommodate the proposed infrastructure footprint within the project description. Habitat to be removed includes: hibiscus scrub community vegetation (0.65 hectare, 1.61 acre); secondary mixed limestone forest community (0.24 hectare, 0.6 acre); and hibiscus scrub, secondary mixed limestone forest, mixed herbaceous scrub community (0.15 hectare, 0.37 acre).

Conservation Measures
The following conservation measures are designed to avoid or minimize effects to the bat and habitat for the bat, crow, kingfisher, and rail. These conservation measures are considered part of the project description. Any changes to, modifications of, or failure to implement these conservation measures may result in a need to reinitiate this consultation.

1. All conservation measures identified in the prior Beddown Project informal consultation (Service File No. 2006-I-0281) will still be implemented as described in the prior consultation.

2. All construction work will begin just after dawn and will end prior to dusk, between the hours of 7:00 am and 4:00 pm. No activities will occur at night.

3. No new staging areas or access roads will be constructed. Existing roads and disturbed areas will be used.

4. No chemicals will be used on site.

5. No contamination (i.e., trash or debris disposal) or introduction of non-native species to adjacent terrestrial environments will result from project-related activities.

6. A litter-control program will be implemented during construction. All trash will be bagged and disposed of offsite at the end of each day.

7. All tools, gear, and construction scrap will be removed upon completion of work in order to prevent the attraction of non-native pests (i.e., rats).

8. All onsite personnel will receive instruction from AAFB environmental flight personnel regarding endangered species and brown treesnake (*Boiga irregularis*) and what to do in case of a sighting.

9. Native landscape vegetation will be planted on the facility's grounds at completion of the construction of the buildings. The contractor will select vegetation from the list of recommended vegetation provided by the Guam Department of Agriculture, Forestry Division.

10. A qualified biologist will survey the project site and a 150-meter buffer zone around the project site, each morning, prior to any vegetation clearing. If a roosting bat is present, workers will not conduct any activities, including vegetation removal within the 150-meter buffer radius until the bat leaves on its own volition.

11. Although not anticipated, if nesting crows are detected, workers will avoid the crows by 300 meters.

12. The presence of the bat or crow will be reported to the Service and the Guam Division of Aquatic and Wildlife Resources immediately, but the location of the bat or crow will not be revealed to any other outside party.

Species Affected

Bats utilize limestone and coastal forest and coconut plantations for foraging and roosting. Crows were known to use secondary, coastal, ravine, and agricultural forests, including coconut plantations for foraging and nesting. The forest located within Northwest Field provides essential habitat for the bat and crow. The action area and surrounding forest has been used for foraging and roosting of individual bats, and foraging and nesting of crows.

The project footprint includes and is surrounded by an area of forest that is essential to the survival and recovery of the bat, crow, kingfisher, and rail. While the additional vegetation clearing that will be completed is small, it contributes to and exacerbates the overall decline of essential habitat on AAFB (see Table 1). However, the conservation measures are designed to improve existing essential habitat for the bat, crow, kingfisher, and rail in nearby areas on AAFB and prevent the spread of non-native invasive species. Vegetation clearing will not occur within 150 meters of an individual bat or 300 meters of an individual crow to minimize affects from human disturbance to the individual.

Summary

Based on the above information, we have determined that the additional removal of 1.06 hectare (2.6 acres) of vegetation may affect, but is not likely to adversely affect the Mariana fruit bat, Mariana crow, Guam Micronesian Kingfisher, or Guam rail. Unless the project description changes, or new information reveals that the effects of the proposed action may affect a listed species or its habitat in a manner or to an extent not considered, or a new species or critical habitat is designated that may be affected by the proposed action, no further action pursuant to the Act is necessary.

If you have questions regarding this consultation, please contact Holly Herod, Fish and Wildlife Biologist, at 808-792-9400.

Sincerely,

Christy Russell

for Patrick Leonard
Field Supervisor

cc: Celestino Aguon, Guam Division of Aquatic and Wildlife Resources

Table 1. Habitat available for the Mariana fruit bat, Mariana crow, Guam Micronesian kingfisher and the Guam rail.

		Acres (Hectares) of Foraging, Roosting, Breeding, or Sheltering Habitat or Potential Habitat			
Baseline Habitat	**Service File Number**	**Bat**	**Crow**	**Rail**	**Kingfisher**
Essential Habitat on Guam (2002)		14,338 (5,803)	12,540 (5,075)	---	14,338 (5,803)
Baseline of Essential Habitat that is *Available* on Guam (2004)		12,026 (4,867)	10,774 (4,360)	12,172 (4,926)	12,026 (4,867)
Baseline of Essential Habitat that is *Available* on AAFB (2004)		**9,508 (3,848)**	**9,508 (3,848)**	**9,568 (3,872)**	**9,508 (3,848)**
Projects with Habitat Removal or Other Impacts					
ISR Strike	06-F-0266	460 (186)	506(201)	57 (23)	477 (193)
NW Field Beddown	06-I-0281	116 (47)	116 (47)	116 (47)	116 (47)
Vegetation Removal AAFB	07-I-0181	62 (25)	62 (25)	62 (25)	62 (25)
Vegetation Clearing at Pati Point	08-TA-0011	1.5 (0.06)	1.5 (0.06)	1.5 (0.06)	1.5 (0.06)
Multiple IRP Remedial Sites NW Field	08-I-0098	14.27 (5.77)	14.27 (5.77)	14.27 (5.77)	14.27 (5.77)
Site 12/Landfill 17	08-I-0071	0.97 (0.4)	0.97 (0.4)	0.97 (0.4)	0.97 (0.4)
Tarague Beach Improvement Project	08-I-0153	1.28 (0.52)	1.28 (0.52)	1.28 (0.52)	1.28 (0.52)
Cell Tower at Tarague Beach Overlook	08-I-0308	2.5 (1)	2.5 (1)	2.5 (1)	2.5 (1)
Reinitiation of NW Field Beddown	09-I-0112	2.6 (1.06)	2.6 (1.06)	2.6 (1.06)	2.6 (1.06)
Total Habitat Removed or Impacted		**661.1 (267.06)**	**707.1 (282.06)**	**258.1 (104.06)**	**678.1 (274.06)**
Remaining Habitat on AAFB		**8,846 (3,581)**	**8,800 (3,566)**	**9,309 (3,768)**	**8,829 (3,574)**

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F1D USFWS, Second Reinitiation Informal Section 7 Consultation for the Beddown of Training and Support Initiatives at Northwest Field, Andersen AFB, Guam (September 2009)

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United States Department of the Interior

FISH AND WILDLIFE SERVICE

Pacific Islands Fish and Wildlife Office
300 Ala Moana Boulevard, Room 3-122, Box 50088
Honolulu, Hawaii 96850

In Reply Refer To:
2009-I-0294
2009-I-0112
2006-I-0281

September 11, 2009

Mr. Russell Littlejohn
Andersen Air Force Base
U.S. Department of the Air Force
Headquarters, 36th Wing (PACAF)
Unit 14007, APO AP 96543-4007

Subject: Second Reinitiation of Informal Section 7 Consultation for the Beddown of Training and Support Initiatives at Northwest Field, Andersen Air Force Base, Guam

Dear Mr. Littlejohn:

This letter is in response to an electronic mail (email) received on August 26, 2009, requesting reinitiation of section 7 consultation for the beddown of training and support initiatives at Northwest Field, Andersen Air Force Base (AAFB), Guam (Beddown Project). At issue are the potential effects of the proposed project on the threatened Mariana fruit bat (*Pteropus mariannus mariannus*) (bat) and the endangered Mariana crow (*Corvus kubaryi*) (crow), endangered Guam rail (*Gallirallus owstoni*) (rail), and endangered Guam Micronesian kingfisher (*Halcyon cinnamomina cinnamomina*) (kingfisher). Although the rail and kingfisher are extirpated in the wild from Guam, they must be considered in consultation requests on AAFB due to the requirements identified in the Cooperative Agreement between the U.S. Air Force and the U.S. Fish and Wildlife Service (Service) or the establishment and management of the Guam National Wildlife Refuge (Air Force and Service 1994).

The findings and recommendations in this consultation are based on: (1) your letter dated August 26, 2009, received by email on August 25, 2009; (2) the May 19, 2006, informal consultation for the Beddown Project; (3) the March 6, 2009, reinitiation of the informal consultation for the Beddown Project; and (4) other information available to us. A complete administrative record is on file in our office. This response is in accordance with section 7 of the Endangered Species Act of 1973 (Act), as amended (16 U.S.C. 1531 *et seq*.).

Project Description

The original Beddown Project consisted of relocating the Rapid Engineer Deployable Heavy Operations Repair Squadron (Red Horse) and its Silver Flag training unit, the Pacific Air Force

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Security Forces Commando Warrior training program, and the Combat Communications squadron to Andersen Air Force Base. As part of this relocation, administrative buildings, Field Training Exercise site, and bivouac area will be constructed in the Northwest Field area of the base and utilized for these training programs. Approximately 116 acres (47 hectares) of habitat within the Guam National Wildlife Refuge Overaly will be cleared for the construction of facilities, roads, a Defensive Fighting Position line, entry control points, base defense operations centers, sector command posts, and a bivouac training area. See the informal consultation for a full description of the original Beddown Project (Service File No. 2006-I-0281).

The first reinitiation was necessary as the size of the project footprint was underestimated and did not include infrastructure to support the military working dog facility and Commando Warrior Military Operations in Urban Terrain facility (Service File No. 2009-I-0112). These activities resulted in the additional removal of 2.6 acres (1.06 hectare) of habitat within the Guam National Wildlife Refuge Overlay.

The second reinitiation was requested to accommodate further changes to the project description. Specifically, the original project included a Small Unit Training area. However, the proposed size of the original Small Unit Training area is too small to meet the minimum requirements for troop training. Therefore, additional land use is necessary (Table 1). The obstacle course that was proposed in the original consultation will not be constructed in a separate location and will instead use the Small Unit Training Area in order to minimize forest clearing in multiple areas. Additionally, two Individual Tactics and Training lanes were requested in the original consultation. Again, the size of this footprint is too small to meet training requirements and an increase is necessary. The Base Defense Operations Control Facility (BDOCF) also requires additional area to meet mission needs. However, the training at the BDOCF is tactical in nature and the intent is not to clear the entire area but rather to allow flexibility with the location and to maneuver through the forest. A utility corridor is also needed for the BDOCF for a communications line. Once the utility lines are in place the corridor will be re-planted with native species. Lastly, the access road from Highway 3A is no longer needed. The proposed changes in this reinitiation will increase the loss of habitat within the Guam National Wildlife Refuge Overlay by approximately 0.9 acres (0.3 hectares).

Table 1. Summary of habitat impacts in acres (hectares) from the proposed reinitiation and the original consultation.

Facility Name	Original Consultation 2006-I-0281	Second Reinitiation 2009-I-0294
Obstacle Course	1.5 (0.6)	0
Highway 3A Access Corridor	2.1 (0.8)	0
Small Unit Training Site	1.2 (0.5)	2.7 (1.1)
Individual Tactics and Training Lane 1	0.05 (0.02)	0.5 (0.2)
Individual Tactics and Training Lane 2	0.05 (0.02)	0.3 (0.1)
BDOCF Communications Line Corridor	0	0.6 (0.2)
BDOCF Site Flexibility	0	1.7 (0.7)
Total	4.9 (2.0)	5.8 (2.3)

Conservation Measures

The following conservation measures are designed to avoid or minimize effects to the bat and habitat for the bat, crow, kingfisher, and rail. These conservation measures are considered part

of the project description. Any changes to, modifications of, or failure to implement these conservation measures may result in a need to reinitiate this consultation.

1. All conservation measures identified in the prior Beddown Project informal consultation (Service File No. 2006-I-0281 and 2009-I-0112) will still be implemented as described in the prior consultations.

2. All construction work will begin just after dawn and will end prior to dusk, between the hours of 8:00 am and 4:30 pm. No activities will occur at night.

3. No staging areas or access roads will be constructed. Existing roads and disturbed areas will be used.

4. No trees that are considered essential to the recovery of the bat, crow, kingfisher, and rail will be removed for the BDOCF area.

5. All vegetation removed will be burned and excess topsoil will be taken to the quarry.

6. No contamination (i.e., trash or debris disposal) or introduction of non-native species to adjacent terrestrial environments will result from project-related activities.

7. A litter-control program will be implemented during construction. All trash will be bagged and disposed of offsite at the end of each day.

8. No chemicals will be used onsite.

9. All tools, gear, and construction scrap will be removed upon completion of work in order to prevent the attraction of non-native pests (i.e., rats).

10. All vegetation planted in the area, including the utility corridor, will be selected from the Guam Division of Forestry approved list of native and endemic species.

11. To minimize impacts to adjacent habitat, blaze orange construction fencing will be used to delineate the construction site and signs will be posted indicating no one is allowed beyond the barriers to prohibit personnel or equipment from damaging the habitat. These barriers will be removed upon project completion.

12. All onsite personnel will receive instruction from AAFB environmental flight personnel regarding endangered species and brown treesnake (*Boiga irregularis*) and what to do in case of a sighting.

13. A qualified biologist or environmental flight personnel will survey the project site and a 150-meter buffer zone around the project site, each morning, prior to any vegetation clearing. If a roosting bat is present, workers will not conduct any activities, including vegetation removal within the 150-meter buffer radius until the bat leaves on its own volition.

14. Although not anticipated, if nesting crows are detected, workers will avoid the crows by 300 meters.

15. The presence of the bat or crow will be reported to the Service and the Guam Division of Aquatic and Wildlife Resources immediately, but the location of the bat or crow will not be revealed to any other outside party.

Species Affected
Bats utilize limestone and coastal forest and coconut plantations for foraging and roosting. Crows were known to use secondary, coastal, ravine, and agricultural forests, including coconut plantations for foraging and nesting. The forest located within Northwest Field provides essential habitat for the bat and crow. The action area and surrounding forest has been used for foraging and roosting of individual bats, and foraging and nesting of crows.

The project footprint includes and is surrounded by an area of forest that is essential to the survival and recovery of the bat, crow, kingfisher, and rail. While the additional vegetation clearing that will be completed is small, it contributes to and exacerbates the overall decline of essential habitat on AAFB (see Table 2). Vegetation clearing will not occur within 150 meters of an individual bat or 300 meters of an individual crow to minimize affects from human disturbance to the individual.

Summary
Based on the above information, we have determined that the additional removal of 0.9 acres (0.3 hectares) of vegetation may affect, but is not likely to adversely affect the Mariana fruit bat, Mariana crow, Guam Micronesian Kingfisher, or Guam rail. Unless the project description changes, or new information reveals that the effects of the proposed action may affect a listed species or its habitat in a manner or to an extent not considered, or a new species or critical habitat is designated that may be affected by the proposed action, no further action pursuant to the Act is necessary.

The Beddown project in its entirety will result in a loss of approximately 120 acres (49 hectares) in addition to other projects planned and proposed for AAFB. We are very concerned about the incremental loss of essential habitat within the Guam National Wildlife Refuge Overlay due to actions implemented by AAFB since much of the loss that has occurred and is proposed to occur is avoidable. We recommend that AAFB coordinate with our office to develop a programmatic consultation that evaluates routine, temporary, and permanent vegetation clearing in order to minimize future impacts to essential habitat and streamline future project activities.

The programmatic consultation will facilitate section 7 consultation for AAFB while ensuring that AAFB does not preclude the survival of these threatened and endangered species. If you have questions regarding this consultation, please contact Holly Herod, Fish and Wildlife Biologist, at 808-792-9400.

Sincerely,

Loyal Mehrhoff
Field Supervisor

cc:
Celestino Aguon, Guam Division of Aquatic and Wildlife Resources
Christian Eggleston, Guam National Wildlife Refuge

Table 2. Habitat available for the Mariana fruit bat, Mariana crow, Guam Micronesian kingfisher and the Guam rail.

		Acres (Hectares) of Foraging, Roosting, Breeding, or Sheltering Habitat or Potential Habitat			
Baseline Habitat	**Service File Number**	**Bat**	**Crow**	**Rail**	**Kingfisher**
Essential Habitat on Guam (2002)		14,338 (5,803)	12,540 (5,075)	---	14,338 (5,803)
Baseline of Essential Habitat that is *Available* on Guam (2004)		12,026 (4,867)	10,774 (4,360)	12,172 (4,926)	12,026 (4,867)
Baseline of Essential Habitat that is *Available* on AAFB (2004)		**9,508 (3,848)**	**9,508 (3,848)**	**9,568 (3,872)**	**9,508 (3,848)**
Projects with Habitat Removal or Other Impacts					
ISR Strike	06-F-0266	460 (186)	506 (201)	57 (23)	477 (193)
NW Field Beddown	06-I-0281	116 (47)	116 (47)	116 (47)	116 (47)
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Vegetation Clearing at Pati Point	08-TA-0011	1.5 (0.06)	1.5 (0.06)	1.5 (0.06)	1.5 (0.06)
Multiple IRP Remedial Sites NW Field	08-I-0098	14.27 (5.77)	14.27 (5.77)	14.27 (5.77)	14.27 (5.77)
Site 12/Landfill 17	08-I-0071	0.97 (0.4)	0.97 (0.4)	0.97 (0.4)	0.97 (0.4)
Tarague Beach Improvement Project	08-I-0153	1.28 (0.52)	1.28 (0.52)	1.28 (0.52)	1.28 (0.52)
Cell Tower at Tarague Beach Overlook	08-I-0308	2.5 (1)	2.5 (1)	2.5 (1)	2.5 (1)
1st Reinitiation of NW Field Beddown	09-I-0112	2.6 (1.06)	2.6 (1.06)	2.6 (1.06)	2.6 (1.06)
Munitions Response Area Site Investigation	09-I-0151	9.58 (3.9)	9.58 (3.9)	9.58 (3.9)	9.58 (3.9)
Infrastructure corridor from NW Field to AAFB	09-I-0300	0.79 (0.32)	0.79 (0.32)	0.79 (0.32)	0.79 (0.32)
2nd Reinitation of NW Field Beddown	09-I-0294	0.9 (0.3)	0.9 (0.3)	0.9 (0.3)	0.9 (0.3)
Total Habitat Removed or Impacted *		**673 (272)**	**719 (287)**	**270 (109)**	**690 (279)**
Remaining Habitat on AAFB		**8,835 (3,576)**	**8,789 (3,561)**	**9,298 (3,763)**	**8,818 (3,569)**

*Acres and hectares were rounded to the nearest whole number

F1E USFWS, Third Reinitiation of Informal Section 7 Consultation for the Beddown of Training and Support Initiatives at Northwest Field, Andersen AFB, Guam (March 2010)

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United States Department of the Interior

FISH AND WILDLIFE SERVICE

Pacific Islands Fish and Wildlife Office
300 Ala Moana Boulevard, Room 3-122, Box 50088
Honolulu, Hawaii 96850

In Reply Refer To:
2010-I-0181
2009-I-0294
2009-I-0112
2006-I-0281

MAR 1 6 2010

Mr. Russell Littlejohn
Andersen Air Force Base
U.S. Department of the Air Force
Headquarters, 36th Wing (PACAF)
Unit 14007, APO AP 96543-4007

Subject: Third Reinitiation of Informal Section 7 Consultation for the Beddown of Training and Support Initiatives at Northwest Field, Andersen Air Force Base, Guam

Dear Mr. Littlejohn:

This letter is in response to an electronic mail (email) received on February 10, 2009, requesting reinitiation of section 7 consultation for the Beddown of Training and Support Initiatives at Northwest Field, Andersen Air Force Base (AAFB), Guam (Beddown Project). At issue are the potential effects of the proposed project on the threatened Mariana fruit bat (*Pteropus mariannus mariannus*) (bat) and the endangered Mariana crow (*Corvus kubaryi*) (crow), endangered Guam rail (*Gallirallus owstoni*) (rail), and endangered Guam Micronesian kingfisher (*Halcyon cinnamomina cinnamomina*) (kingfisher). Although the rail and kingfisher are extirpated in the wild from Guam, they must be considered in consultation requests on AAFB due to the requirements identified in the Cooperative Agreement between the U.S. Air Force and the U.S. Fish and Wildlife Service (Service) or the establishment and management of the Guam National Wildlife Refuge (Air Force and Service 1994).

The findings and recommendations in this consultation are based on: (1) electronic mail exchanges between February 1, 2010, and February 25, 2010; (2) the March 6, 2009, reinitiation of the informal consultation for the Beddown Project (Service File No. 2009-I-0012); (3) the September 11, 2009, reinitiation of the informal consultation for the Beddown Project (Service File No. 2009-I-0294); (4) the May 19, 2006, informal consultation for the Beddown Project

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(Service File No. 2006-I-0281); (5) the 2006 Draft Environmental Assessment Beddown of Training and Support Initiatives at Northwest Field; and (6) other information available to us. A complete administrative record is on file in our office. This response is in accordance with section 7 of the Endangered Species Act of 1973 (Act), as amended (16 U.S.C. 1531 *et seq.*).

Project Description

The original Beddown Project consisted of relocating the Rapid Engineer Deployable Heavy Operations Repair Squadron (Red Horse) and its Silver Flag training unit, the Pacific Air Force (PACAF) Security Forces Commando Warrior training program, and the Combat Communications squadron to AAFB. As part of this relocation, an administrative area, Field Training Exercise (FTX) site, and bivouac area will be constructed in the Northwest Field area of the base and utilized for these training programs. Approximately 116 acres (47 hectares) of vegetation will be cleared for the construction of facilities, roads, a Defensive Fighting Position line, entry control points, base defense operations centers, sector command posts, and a bivouac training area. See the informal consultation for a full description of the original Beddown Project (Service File No. 2006-I-0281).

The first reinitiation was necessary as the size of the project footprint was underestimated and did not include infrastructure to support the military working dog facility and Commando Warrior Military Operations in Urban Terrain facility (Service File No. 2009-I-0112). These activities resulted in the additional removal of 2.6 acres (1.1 hectares) of habitat within the Guam National Wildlife Refuge Overlay.

The second reinitiation was requested to accommodate further changes to the project description. The proposed size of the original Small Unit Training, Two Individual Tactics and Training Lanes, and The Base Defense Operations Control Facility (BDOCF) areas were too small to meet the minimum requirements for troop training. A utility corridor was also needed for the BDOCF for a communications line. Therefore, additional land use was necessary. The proposed changes in this reinitiation increased the loss of habitat within the Guam National Wildlife Refuge Overlay by approximately 0.9 acres (0.4 hectares).

The third reinitiation is necessary as the project description has been slightly modified again. The proposed expansion of the bivouac training area originally removed 15 acres of vegetation to the west of the existing Red Horse quarry area. According to the map on Page 3-43 in the Environmental Assessment, approximately 1.9 acres (0.8 hectares) directly west of the quarry was to be left intact. Vegetation in the area has since been removed to expand existing quarry operations. Therefore, the bivouac footprint has been modified to be 13.1 acres (5.3 hectares) of vegetation and the quarry expanded by 1.9 acres. The proposed project will offset the habitat loss from the quarry expansion by excluding the removal of 1.9 acres on the western boundary of the proposed bivouac training area. The vegetation communities of both plots are secondary limestone forest, dominated by *Vitex pariflora*. The proposed changes in this reinitiation will result in an equal exchange of land (i.e., 1.9 acres lost to the quarry and 1.9 acres of land will remain intact that was previously authorized for removal) within the Guam National Wildlife Refuge Overlay.

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Conservation Measures

The following conservation measures are designed to avoid or minimize effects to the bat and habitat for the bat, crow, kingfisher, and rail. These conservation measures are considered part of the project description. Any changes to, modifications of, or failure to implement these conservation measures may result in a need to reinitiate this consultation. All conservation measures identified in the prior Beddown Project informal consultations (Service File No. 2006-I-0281, 2009-I-0112, 2009-I-0294) will still be implemented as described in the prior consultations. No additional habitat will be removed that is not authorized. AAFB must check all boundaries prior to any clearing to ensure they are correct.

1. All construction work will begin just after dawn and will end prior to dusk, between the hours of 7:00 am and 4:00 pm. No activities will occur at night.

2. No new staging areas or access roads will be constructed. Existing roads and disturbed areas will be used.

3. No chemicals will be used on site.

4. No contamination (i.e., trash or debris disposal) or introduction of non-native species to adjacent terrestrial environments will result from project-related activities.

5. A litter-control program will be implemented during construction. All trash will be bagged and disposed of offsite at the end of each day.

6. All tools, gear, and construction scrap will be removed upon completion of work in order to prevent the attraction of non-native pests (i.e., rats).

7. All onsite personnel will receive instruction from AAFB environmental flight personnel regarding endangered species and brown treesnake (*Boiga irregularis*) and what to do in case of a sighting.

8. Native landscape vegetation will be planted on the facility's grounds at completion of the construction of the buildings. The contractor will select vegetation from the list of recommended vegetation provided by the Guam Department of Agriculture, Forestry Division.

9. A qualified biologist will survey the project site and a 150-meter buffer zone around the project site, each morning, prior to any vegetation clearing. If a roosting bat is present, workers will not conduct any activities, including vegetation removal within the 150-meter buffer radius until the bat leaves on its own volition.

10. Although not anticipated, if nesting crows are detected, workers will avoid the crows by 300 meters.

11. The presence of the bat or crow will be reported to the Service and the Guam Division of Aquatic and Wildlife Resources immediately, but the location of the bat or crow will not be revealed to any other outside party.

Species Affected
Bats utilize limestone and coastal forest and coconut plantations for foraging and roosting. Crows were known to use secondary, coastal, ravine, and agricultural forests, including coconut plantations for foraging and nesting. The forest located within Northwest Field provides essential habitat for the bat and crow. The action area and surrounding forest has been used for foraging and roosting of individual bats, and foraging and nesting of crows.

The project footprint includes and is surrounded by an area of forest that is essential to the survival and recovery of the bat, crow, kingfisher, and rail. Vegetation clearing contributes to and exacerbates the overall decline of essential habitat on AAFB. However, the conservation measures are designed to improve existing essential habitat for the bat, crow, kingfisher, and rail in nearby areas on AAFB and prevent the spread of non-native invasive species. Vegetation clearing will not occur within 150 meters of an individual bat or 300 meters of an individual crow to minimize affects from human disturbance to the individual.

Summary
Based on the above information, we have determined that not clearing 1.9 acres of habitat at the bivouac area for the 1.9 acres already cleared at Red Horse quarry may affect, but is not likely to adversely affect the Mariana fruit bat, Mariana crow, Guam Micronesian Kingfisher, or Guam rail. AAFB must contact our office prior to any new clearing and verbally discuss the measures implemented so that no unauthorized habitat removal occurs. Unless the project description changes, or new information reveals that the effects of the proposed action may affect a listed species or its habitat in a manner or to an extent not considered, or a new species or critical habitat is designated that may be affected by the proposed action, no further action pursuant to the Act is necessary.

If you have questions regarding this consultation, please contact Jodi Charrier, Fish and Wildlife Biologist, at 808-792-9400.

Sincerely,

Christa Russell

for Loyal Mehrhoff
Field Supervisor

cc: Celestino Aguon, Guam Division of Aquatic and Wildlife Resources

F1F USFWS, BO for the Joint Guam Program Office Relocation of the U.S. Marine Corps from Okinawa to Guam and Associated Activities on Guam and Tinian (September 2010)

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United States Department of the Interior

FISH AND WILDLIFE SERVICE

Pacific Islands Fish and Wildlife Office
300 Ala Moana Boulevard, Room 3-122, Box 50088
Honolulu, Hawaii 96850

In Reply Refer To:
2010-F-0122

SEP - 8 2010

Ms. Karen Sumida
U.S. Department of the Navy
Naval Facilities Engineering Command, Pacific
258 Makalapa Drive, Suite 100
Pearl Harbor, Hawaii 96860-3134

Subject: Biological Opinion for the Joint Guam Program Office Relocation of the U.S. Marine Corps from Okinawa to Guam and Associated Activities on Guam and Tinian

Dear Ms. Sumida:

This document represents the U.S. Fish and Wildlife Service's (Service) Biological Opinion (Biological Opinion) on the effects of the Joint Guam Program Office Relocation of the U.S. Marine Corps from Okinawa to Guam and related infrastructure construction and training actions on Guam and Tinian (JGPO) to the endangered and threatened species listed in Table 1. This Biological Opinion was prepared in accordance with section 7 of the Federal (Act) of 1973, as amended (16 USC 1531 *et seq.*). The U.S. Department of the Navy (DoN) was the designated lead Federal agency for this consultation. The DoN's January 4, 2010, request for formal consultation and a Biological Assessment were received on January 6, 2010. Actions by the U.S. Army (Army) and U.S. Air Force (Air Force), and interdependent actions by the Federal Highway Administration and the Army Corps of Engineers, outlined in the Project Description section of this Biological Opinion, are also addressed in this consultation. Training operations addressed in the Mariana Island Range Complex (MIRC) Biological Opinion (USFWS 2010, 96 pp.) which will not utilize new facilities developed as a result of the proposed action are not addressed in this Biological Opinion.

In addition, pursuant to the requirements identified in the Cooperative Agreement between the Air Force, DoN, and the U.S. Fish and Wildlife Service for the establishment and management of the Guam National Wildlife Refuge (U.S. Air Force and USFWS 1994, p. 6; DoN and USFWS 1994, p. 6), we have provided coordination regarding potential impacts to the Guam National Wildlife Refuge Overlay from the proposed project. This consultation reviews anticipated impacts to the listed species and their terrestrial habitats, including recovery habitat, on Guam and Tinian. In this consultation, recovery habitat is defined as the habitat that is currently suitable to support the recovery of listed species. Recovery habitat is defined separately for each species (see Status and Baseline section).

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Table 1. Threatened and endangered species addressed in this Biological Opinion and their geographic occurrence within the action area.

Common Name	Scientific Name	Listing Status	Island Occurrence	
			Guam	Tinian
DoN Likely to Adversely Affect Determinations Reviewed				
Guam Micronesian kingfisher (sihek)	*Todiramphus [=Halcyon] cinnamominus cinnamominus*	Endangered	Historical	
Guam rail (koko)	*Gallirallus owstoni*	Endangered	Historical	
Mariana common moorhen (pulattat)	*Gallinula chloropus guami*	Endangered	Current	Current
Mariana crow (aga)	*Corvus kubaryi*	Endangered	Current	
Mariana fruit bat (fanihi)	*Pteropus mariannus mariannus*	Threatened	Current	Current
DoN Not Likely to Adversely Affect Determinations Reviewed				
Mariana swiftlet (chachaguak)	*Aerodramus bartschi*	Endangered	Current	
Micronesian megapode	*Megapodius laperouse*	Endangered	Historical	Current
Green turtle (green sea turtle)	*Chelonia mydas*	Threatened	Current	Current
Hawksbill turtle (hawksbill sea turtle)	*Eretmochelys imbricata*	Endangered	Current	Current

Your January 4, 2010, letter, as updated by your staff (Cobb, pers. comm. 2010a, Cobb, pers. comm. 2010b), requested our concurrence with your determination that the subject action is not likely to adversely affect the Mariana swiftlet, the Micronesian megapode, the green turtle, or the hawksbill turtle (collectively referred to as sea turtles) pursuant to section 7 of the Act. Our assessments of project impacts to these species are addressed in the Not Likely to Adversely Affect Review section of this document.

This Biological Opinion is based on information contained in the Biological Assessment (DoN 2010a, 268 pp. plus Appendices) and other sources cited herein. A complete decision record for this consultation is on file at the Service's Pacific Islands Fish and Wildlife Office.

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Table 2. Proposed aircraft loading (DoN 2010b, vol 2, p. 2-91).

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Table 4. Daily and annual use of proposed demolition and explosive ranges.

Table 5. Daily and annual use of proposed small arms outdoor qualification ranges (DoN 2010b, vol 2, p.2-57).

Table 6. Proposed daily and annual use of small arms qualification ranges on Tinian (DoN 2010b, vol. 3, p. 11-23).

Table 7. Anticipated locations for temporary construction worker housing (DoN 2010b, vol. 2, p. 16-89).

Table 8. Anticipated human population increase on Guam resulting from the proposed project (DoN 2010b, vol. 1, page ES – 8).

Table 9. Estimated population sizes of the Mariana common moorhen in the Mariana Islands.

Table 10. Anticipated loss of listed species recovery habitat on Guam resulting from project-related development.

Table 11. Anticipated population growth and availability of housing on Guam during and following the JGPO construction period.

Table 12. USDA-Wildlife Services canine inspection results for fiscal year 2009.

1.0 CONSULTATION HISTORY

August 15, 2007. DoN and Service biologists met to discuss the possible DoN training in the northern Marianas Islands to include: Saipan, Tinian, Rota, Pagan and Agiguan. Discussions included the need for baseline information on the listed species on these islands and how those surveys would be accomplished.

September 21, 2007. A meeting was held at the Service's Pacific Islands Fish and Wildlife Office with DoN to discuss the proposed project and MIRC training issues.

February 8, 2008. Agency meeting with Environmental Protection Agency, National Marine Fisheries Service and the Service to discuss the National Environmental Policy Act (NEPA) process for this project and the issues that should be included in their Draft Environmental Impact Statement (DEIS).

February 12, 2008. At a JGPO Partnering Session on Guam, the DoN (Vanessa Pepi, Joe Hautzenroder, and Karen Sumida), Service (Earl Campbell, Michael Molina and Patrice Ashfield), Marines (Mary Hassel) and the DoN's consultant (Ed Lynch) met to discuss the brown treesnake (*Boiga irregularis*) issue and the responsibilities of the DoD to ensure proper snake interdiction.

March 28, 2008. The Service received a request from the DoN to initiate informal consultation on the proposed action.

May 2, 2008. The Service sent a letter to the DoN initiating informal consultation for the proposed action, confirming the species list, and providing additional information.

July 7, 2008. There was a DoN-sponsored JGPO Master Plan presentation by Marvan Wakabayashi with Holly Herod, Earl Campbell and Patrice Ashfield (Service) and Vanessa Pepi (DoN) in attendance.

January 7, 2009. Earl Campbell, Patrice Ashfield and Holly Herod (Service) met with Scott Vogt and Vanessa Pepi (DoN) and Glenn Metzler and Rick Spaulding (DoN contractors) regarding biological surveys and JGPO. At this meeting it was stated that temporary housing was part of the action.

March 3, 2009. DoN (Lisa Fiedler and Vanessa Pepi) and Service (Earl Campbell, Holly Herod and Patrice Ashfield) met to discuss the DEIS and Lisa asked for "show stoppers." Patrice commented on the need for a brown treesnake biosecurity plan prior to initiation of consultation. We also discussed impacts to habitat on Tinian and a restoration ratio of 4:1 was recommended to the DoN to offset their impacts to an already existing mitigation site.

November 17, 2009. The Service received a draft copy of the Biological Assessment for the proposed project for preliminary review.

November 25, 2009. Holly Herod (Service), Vanessa Pepi, Coralie Cobb (DoN) and Andrea VonBurg Hall (DoN contractor) met to discuss the consultation and specifically reviewed: previous consultations; the DEIS; initiation timelines; ongoing DoD projects; lack of conservation measures in the biological assessment; and tracking for mitigation and conservation measures.

December 7, 2009. Holly Herod (Service) held meeting with Vanessa Pepi (DoN) and Coralie Cobb (DoN) to discuss the consultation, specifically: updates on the DEIS review as applicable to the formal consultation and future meeting schedules.

December 8-10, 2009. Holly Herod (Service) sent emails to Coralie Cobb (DoN) containing comments on the draft Biological Assessment.

December 17, 2009. Holly Herod (Service) met with Coralie Cobb (DoN) to discuss the guidance for the proposed project and a framework for the analysis.

December 22, 2009. Holly Herod (Service) sent email to Coralie Cobb (DoN) containing suggestions for conservation measures, and Guam Micronesian kingfisher and Mariana crow habitat analyses. Holly Herod and Coralie Cobb met to discuss the status of the the proposed project consultation, specifically: the need for a definition of survival and recovery; existing habitat needed for recovery; conservation measures; inclusion of conservation measures for candidate species; and a resource map.

December 29, 2009. Holly Herod (Service) sent email to Coralie Cobb (DoN) containing draft definitions of habitat needed for survival and recovery of Guam Micronesian kingfisher and Mariana crow. Earl Campbell (Service), Daniel Clark (Service), Jeff Herod (DoN), and Vanessa Pepi (DoN) met to discuss the Service concerns with the DEIS, Micronesia Biosecurity Plan, and biosecurity.

January 6, 2010. The DoN formally requested initiation of formal consultation on the proposed action and provided a final Biological Assessment, dated January 2010, to the Service. Coralie Cobb (DoN) sent email to Earl Campbell (Service) to discuss invasive species for the Guam Military relocation on Tinian. Holly Herod (Service) met with Coralie Cobb (DoN) and Kristine Kutscher (contractor DoN) to discuss the initiation and the proposed project status, specifically: initiation of formal consultation; scheduling meetings for invasive species discussions; conservation measures; changes to the project footprint to minimize impacts; and mapping of recovery habitat.

January 11, 2010. Holly Herod (Service) sent an email to Coralie Cobb (DoN) requesting clarification regarding the construction of a stormwater pond for the decontamination training.

January 12, 2010. Coralie Cobb (DoN) sent multiple emails to Holly Herod (Service) containing responses to biological assessment comments and questions, additional questions, and impacts to recovery habitat. Coralie Cobb, Kristine Kutscher (DoN), Fred Amidon (Service) and Holly Herod met to discuss the status of the consultation, specifically: the Service requested a new project map to facilitate review; the need for a review of the classified portion of the DEIS;

comments on the DEIS as they relate to the section 7 consultation; and recovery habitat needs. Coralie Cobb, Kristine Kutscher, Jeff Herod (DoN) and Earl Campbell (Service) met to discuss invasive species issues pertaining to the biological assessment.
January 13-25, 2020. Holly Herod (Service) and Coralie Cobb (DoN) exchanged multiple emails regarding maps, timeline, the Biological Assessment and the Guam International Raceway.

February 1, 2010. Holly Herod (Service) sent Vanessa Pepi (DoN) an email to alert DoN that illegal action may be occurring at the "Detachment 5 Quarry" on Andersen Air Force Base. Anne Brooke (DoN) sent Holly Herod (Service) email confirming situation at "Detachment 5 Quarry AAFB" was being investigated.

February 2, 2010. Holly Herod (Service) reviewed the classified portion of the DEIS as it pertains to the section 7 consultation. Holly Herod met with Vanessa Pepi (DoN), Coralie Cobb (DoN), and Kristine Kutscher (DoN contractor) to discuss recovery habitat thresholds and the DoN policy for reintroduction of listed species. Coralie Cobb (DoN) sent Holly Herod (Service) an email containing additional clarification regarding the biological assessment

February 5, 2010. The Service sent a letter to the DoN acknowledging initiation of formal consultation on the proposed action. In addition, Coralie Cobb (DoN) informed Holly Herod (Service) that the DoN had modified its effects determination for the Mariana common moorhen from "no effect" to "not likely to adversely affect."

February 8-9, 2010. Holly Herod (Service) sent Coralie Cobb (DoN) multiple emails requesting clarification for: training and construction actions at Tinian, Route 15 ranges; main cantonment Naval Base Guam; Naval Munitions Site; Andersen Main Base; Northwest Field; general training on Guam; and clarification questions regarding the commercial port.

February 9, 2010. Coralie Cobb (DoN) sent Holly Herod (Service) email containing a revised project description for Naval Base Guam and Tinian training.

February 10, 2010. Holly Herod (Service) sent Coralie Cobb (DoN) emails requesting clarification regarding construction at: general locations on Guam, Andersen South, Route 15, Andersen Main Base, and Northwest Field. Holly Herod met with Coralie Cobb and Kristine Kutscher (DoN contractor) to discuss the status of the proposed project, specifically: additional information needed; conservation measures; and mapping of the proposed action within recovery habitat. Earl Campbell (Service), Josh Fisher (Service), Coralie Cobb (DoN), Jeff Herod (DoN), and Kristine Kutscher (DoN contractor) met to discuss biosecurity aspects of the project.

February 11, 2010. Holly Herod (Service) met with Vanessa Pepi, Coralie Cobb, and Kyle Fujimoto (DoN) to go over Service concerns with the classified portion of the DEIS and discuss language that could be incorporated in to the unclassified biological opinion.

February 12, 2010. Holly Herod (Service) and Coralie Cobb (DoN) met to define details and timelines for conservation measures for the proposed project. Earl Campbell and Josh Fisher (Service) discussed biosecurity aspects of the project with Jeff Herod (DoN) via conference call.

February 17, 2010. Holly Herod (Service) emailed Coralie Cobb (DoN) a request for clarification of additional conservation measures within the biological assessment and an update of additional conservation measures and interrelated, interdependent, and cumulative effects. February 18, 2010. Holly Herod (Service) and Coralie Cobb (DoN) met to review the proposed project status. The DoN provided a revised map of project footprint in recovery habitats. The Service also requested security fence variances similar to those proposed for the anti-terrorism, force protection fence for Andersen Air Force Base. Coralie Cobb provided draft information regarding the cumulative impacts.

February 19, 2010. Holly Herod (Service) asked Coralie Cobb (DoN) if aviation training could be moved from the Talafofo basin to the Ugum basin. Vanessa Pepi (DoN) emailed Holly Herod (Service) a draft version of the interrelated, interdependent, and cumulative effects analysis. Coralie Cobb (DoN) emailed additional information.

February 21, 2010. Coralie Cobb (DoN) emailed Holly Herod (Service) concurrence for pre-construction surveys for Mariana common moorhen for applicable road projects on Guam.

February 22, 2010. Coralie Cobb (DoN) emailed Holly Herod (Service) additional information regarding the Andersen South training; Naval Munitions Site, Main Cantonment, and Naval Base Guam construction project descriptions. Holly Herod emailed Vanessa Pepi (DoN) to request additional clarification regarding the commercial port and invasive species conservation measures. Jeff Herod (DoN) provided a response regarding existing invasive species measures at the commercial port. Holly Herod met with Coralie Cobb to review the consultation status, specifically: the Service requested a presentation regarding the project description and conservation measures as it relates to invasive species; issues with the commercial ports, and wetland impacts on Tinian.

February 23, 2010. Vanessa Pepi (DoN) sent multiple emails regarding population counts of Mariana fruit bat at Pati Point, Guam.

February 23-25, 2010. Holly Herod (Service) emailed Coralie Cobb (DoN) draft summaries of species status, baseline, and conservation measures for sea turtles; Micronesian megapode; Mariana common moorhen; Mariana swiftlet; a habitat analysis for *Serianthes nelsonii*, and information concerning the Mariana eight-spot butterfly, a candidate species. Holly also requested additional information for the outdoor recreation area and clarification of the preferred alternative for firing ranges on Tinian. Earl Campbell (Service), Jeff Herod (DoN), Coralie Cobb, and Kristine Kutscher (contractor DoN) met to discuss biosecurity issues related to the formal consultation.

February 24-25, 2010. Coralie Cobb (DoN) sent multiple emails to Holly Herod (Service) to: indicate that wetlands on Tinian could be avoided during construction and pre-construction surveys would be implemented; provide clarification on the Andersen South project description, Guam landfill and other non-action area specific projects; the Army Missile Defense Task Force; Northwest Field; and Naval Munitions Site project description. Information was also provided for the Ecological Reserve Area at Ritidian Point and Almagosa Springs.

February 26, 2010. Coralie Cobb (DoN) sent multiple emails to Holly Herod (Service) to provide information regarding the outdoor recreation area; Andersen South; Route 15; and a table quantifying impacts to recovery habitat. Coralie Cobb and Holly Herod exchanged emails regarding the location of the Tinian firing ranges. Coralie Cobb and Kristine Kutscher (DoN contractor) attended a meeting with Holly Herod to review project status. At the meeting the DoN provided the Service with official statements regarding interrelated, interdependent, and cumulative impacts; a list of documents regarding biosecurity and invasive species, and an electronic copy of all these documents.

February 28, 2010. Holly Herod (Service) sent multiple emails to Coralie Cobb (DoN) regarding: habitat impact assessment for Guam Micronesian kingfisher and Mariana crow; the follow up items from the February 26 meeting; and a revised draft of the introduction, consultation history, project description. Coralie Cobb emailed Holly Herod official positions related to the ports, invasive species, and conservation measures to address invasive species risk.

March 1, 2010. Holly Herod (Service) emailed Coralie Cobb (DoN) indicating that the DoN official position for the ports does not address all the risks from the proposed project to listed species. Holly Herod and Coralie Cobb met to gain understanding of the positions of both agencies. Coralie Cobb provided additional information via email. Fred Amidon (Service) exchanged emails with Rick Spaulding (contractor DoN) regarding the status of Mariana swiftlets and Mariana crow data.

March 2, 2010. Fred Amidon (Service) provided Coralie Cobb (DoN) with GIS shapefiles of recovery habitat for the Guam Micronesian kingfisher, Mariana crow, and Mariana fruit bat. Coralie Cobb (DoN) provided Holly Herod (Service) edits to the conservation measures.

March 3, 2010. Coralie Cobb (DoN) emailed Holly Herod (Service) information regarding worker housing, permits, and the DoN feral animal policy. Holly Herod, Coralie Cobb, and Kristine Kutscher (DoN contractor) met to discuss endangered species reintroduction language, candidate species, and invasive species risks at the ports.

March 4, 2010. Coralie Cobb (DoN) emailed Holly Herod (Service) the invasive species meetings consultation history to date; information regarding Andersen Main Base, Northwest Field, and the Route 15 Range complex; and candidate butterfly information.

March 5, 2010. Coralie Cobb (DoN) emailed Holly Herod (Service) with an update on the commercial ports. Holly Herod emailed Coralie Cobb to alert the DoN that a new revision to the Guam Micronesian kingfisher recovery habitat analysis was completed which indicated that the threshold for habitat loss has been exceeded.

March 6, 2010. Coralie Cobb (DoN) emailed Holly Herod (Service) edits to the draft project description and draft conservation measures.

March 8, 2010. Kristine Kutscher (DoN contractor) emailed Holly Herod (Service) the Route 15 Range complex project description. Vanessa Pepi (DoN), Anne Brooke (DoN), and Holly Herod (Service) exchanged emails regarding Area 50.

March 9, 2010. Holly Herod (Service) emailed Russell Littlejohn (Air Force) regarding the size of the Artero property. Holly Herod (Service) emailed Coralie Cobb (DoN) a revised impact assessment for the Mariana crow and Guam Micronesian kingfisher to account for cumulative impacts. Coralie Cobb provided Holly Herod with a summary of the proposed Ecological Reserve Areas.

March 10, 2010. Holly Herod (Service) emailed Coralie Cobb (DoN) maps depicting recovery habitat for the Guam rail and *Serianthes nelsonii* and a table of habitat available. Holly Herod emailed Coralie Cobb to indicate that a cumulative impact analysis may need to be completed for the Guam rail and request ungulate fencing to finish the antiterrorism-force protection fence from Andersen Air Force Base down through the Guam National Wildlife Refuge and from the Base down to the ocean by the Anao Conservation Area.

March 11, 2010. Holly Herod (Service) met with Coralie Cobb (DoN) to go over the project description and conservation measures. Coralie Cobb requested additional information regarding the Guam Micronesian kingfisher recovery habitat analysis. Coralie Cobb, Vanessa Pepi (DoN), and Jeff Herod (DoN) presented the project description and conservation measures (to date) to the Service (Earl Campbell, Loyal Mehrhoff, Marilet Zablan, Patrice Ashfield, Dawn Greenlee, Jodi Charrier, Gina Shultz, Pat Sousa, and Holly Herod).

March 12, 2010. Jeff Herod (DoN) provided information to Patrice Ashfield (Service) and Earl Campbell (Service) regarding inspection and quarantine practices currently implemented by the DoN. Holly Herod (Service), Dawn Greenlee (Service), and Coralie Cobb (DoN) met to finish reviewing the project description, conservation measures, and preliminary effects analysis for the draft biological opinion. Dawn Greenlee (Service) emailed Coralie Cobb (DoN) an example of a forest restoration that would also serve as a fuelbreak and provided telephone conversation records regarding shipping routes from Guam. Holly Herod (Service) emailed Coralie Cobb (DoN) the peer review comments related to the Guam Micronesian kingfisher and Guam rail recovery habitat analyses.

March 15, 2010. Russell Littlejohn (Air Force) emailed Holly Herod (Service) the Air Force position regarding the Artero property. Holly Herod (Service) emailed Coralie Cobb (DoN) methods used to calculate the number of juvenile Guam Micronesian kingfishers needed to support recovery goals. Holly Herod (Service) requested a copy of the March 11, 2010, presentation from Coralie Cobb (DoN). Coralie Cobb emailed Holly Herod regarding the potential use of tracers.

March 16, 2010. Holly Herod (Service) forwarded shapefiles of the Guam rail recovery habitat to Coralie Cobb (DoN). Holly Herod sent multiple emails to Coralie Cobb a list of outstanding issues for the consultation; providing a biological opinion completed for another species that was extirpated in the wild; and requesting the GIS shapefiles for the proposed project footprint.

March 17, 2010. Holly Herod (Service) emailed Coralie Cobb a second list of outstanding issues for the consultation and provided a revised preliminary draft of the project description and conservation measures for review and comment. Holly Herod also emailed Coralie Cobb and Vanessa Pepi (DoN) to gauge interest in a recovery crediting type program for Mariana fruit bat

and Mariana crow habitat on Guam. Rick Spaulding (contractor, DoN) provided the Service with line, point, and polygon GIS shapefiles of project components.

March 31, 2010. Dawn Greenlee, Fred Amidon, and Marilet Zablan (Service) met with Coralie Cobb and Angela Anders (DoN) to discuss Guam Micronesian kingfisher recovery habitat requirements.

April 1, 2010. Kerry Wells (DoN contractor) provided Dawn Greenlee (Service) with GIS polygons delineating areas within which vegetation clearing may occur as a result of DoD construction projects. Dawn Greenlee (Service) corresponded with Victor Torres (GIS Manager, Bureau of Statistics and Plans, Office of the Governor of Guam) and Victor provided the Service with GIS data layers delineating current land use zoning for northern and central Guam in addition to an image depicting land use zoning in southern Guam.

April 4, 2010. Dawn Greenlee (Service) sent Coralie Cobb (DoN) estimates of anticipated habitat loss based on civilian development information received from the DoN and Government of Guam and an assessment of wildfire impacts based on an analysis of historical aerial photographs.

April 6, 2010. Dawn Greenlee, Earl Campbell, Patrice Ashfield (Service) met with Coralie Cobb (DoN) to discuss biosecurity aspects of the project. Dawn Greenlee and Coralie Cobb also met to further refine estimates of ongoing development and wildfire impacts to forest habitats.

April 7, 2010. The Service sent a letter to the DoN discussing the status of this consultation and concerns regarding biosecurity measures and loss of recovery habitat on Guam likely to be caused by the proposed action. Coralie Cobb (DoN) sent Holly Herod (Service) email concerning duration of road and bridge construction from Federal Highways Administration projects due to the proposed project. Holly Herod (Service) met with Coralie Cobb and Kristine Kutscher (DoN contractor) to discuss the status of the proposed project, specifically: new DoD projects; reiteration of the need for reintroductions on DoD lands; interrelated actions; and footprints of proposed magazines.

April 7, 2010. The Service provided a letter to the DoN to acknowledge that at the conclusion of the 90-day formal consultation period, two aspects of the project, biosecurity and recovery habitat loss, require additional refinement.

April 8, 2010. Coralie Cobb (DoN) provided Dawn Greenlee (Service) with information regarding anticipated future non-project related population growth on Guam.

April 12, 2010. Kerry Wells (DoN contractor) provided Dawn Greenlee (Service) with GIS data delineating anticipated project-related noise levels. Dawn Greenlee (Service) forwarded information from Earl Campbell (Service) regarding recommended brown treesnake interdiction measures for the ports of Guam and for receiving ports.

April 14, 2010. Dawn Greenlee (Service) forwarded information from Earl Campbell (Service) regarding recommended brown treesnake interdiction measures for Guam and receiving ports.

April 16, 2010. The Service sent a letter informing the DoN that increased transportation through Guam ports without adequate brown treesnake interdiction could adversely affect listed species in the CNMI, Hawaii, and the continental United States. The letter outlined biosecurity measures to minimize the range and scope of project impacts to listed species. In addition, the letter summarized the Service's preliminary analysis of project impacts to recovery habitat and made mention of interagency progress to finalize language describing future reintroduction of listed species to DoD lands.

April 21, 2010. Dawn Greenlee (Service) received a revised Project Description from Coralie Cobb (DoN) which incorporated revisions to the approximately 30 items the DoN and Service had been coordinating on during the 90-day formal consultation period. The brown treesnake interdiction measures recommended in our April 16, 2010, letter were not incorporated into the Project Description.

April 28, 2010. Dawn Greenlee (Service) transmitted modifications to the DoN's endangered species reintroduction paragraph of the Project Description to Coralie Cobb (DoN) for the DoN's consideration. Fred Amidon (Service) and ornithologist Dylan Kesler (University of Missouri) completed their correspondence regarding data upon which the Service's Guam Micronesian kingfisher recovery habitat assessment is based.

May 13, 2010. Loyal Mehrhoff, Gina Shultz, Marilet Zablan, Patrice Ashfield, and Larry Salata (via telephone) (Service) met with Captain Chandler, Coralie Cobb, Vanessa Pepi and their staff (DoN) to discuss brown treesnake interdiction for project-related induced population growth on Guam. The Service informed DoN that the Pacific Islands Fish and Wildlife Office's preliminary analysis indicated project impacts may appreciably reduce the likelihood of both the survival and recovery of at least four species in addition to adversely impacting critical habitat on Rota and Oahu. The Service provided DoN with information regarding measures (Reasonable and Prudent Alternatives) that would avoid such brown treesnake effects.

May 21, 2010. Via conference call, DoN (Donald Schregardus, Ronald Borro, and others), the U.S. Department of Interior (Eileen Sobeck), the Service (Mike Roy, Loyal Mehrhoff, Barbara Maxfield, Marilet Zablan, Earl Campbell, Patrice Ashfield, Dawn Greenlee, Ken Foote), and the Council for Environmental Quality (Horst Greczmiel) discussed incorporation of addition of brown treesnake interdiction measures to minimize potential project impacts to listed species in the CNMI, Hawaii, and continental United States. DoN requested that the Service postpone issuance of the draft Biological Opinion to enable development and incorporation of additional biosecurity measures into the project.

May 28, 2010. Dawn Greenlee (Service) transmitted the latest version of the Project Description to Coralie Cobb (DoN) for DoN to review and refine.

June 17, 2010. Via email and telephone, the DoN (Donald Schregardus), Council for Environmental Quality (Horst Greczmiel), U.S. Department of Interior (Eileen Sobeck), and Service (Loyal Mehrhoff) agreed upon a conceptual framework for the DoN's implementation of brown treesnake interdiction.

June 21, 2010. Dawn Greenlee (Service) received an updated Project Description from Coralie Cobb (DoN). The brown treesnake interdiction language in the Project Description was inconsistent with the conceptual framework agreed upon via email on June 17, 2010.

June 24, 2010. The Service (Loyal Mehrhoff, Earl Campbell, and Dawn Greenlee) met with DoN (Coralie Cobb, Vanessa Pepi, and Jennifer Farley) to discuss the brown treesnake interdiction aspect of the proposed project.

June 29, 2010. Loyal Mehrhoff (Service) emailed Coralie Cobb and Vanessa Pepi (DoN) an assessment of outstanding aspects of the Project Description and the status of the Biological Opinion.

July 2, 2010. The Service (Loyal Mehrhoff, Earl Campbell, and Dawn Greenlee) met with DoN (Coralie Cobb and Patrick Chee) to refine the brown treesnake interdiction sections of the Project Description.

July 6, 2010. The Service (Loyal Mehrhoff, Earl Campbell, and Dawn Greenlee) met with DoN (Coralie Cobb) to refine the brown treesnake interdiction sections of the Project Description and to discuss modifications to the Project Description suggested by Guam Refuge Manager Joseph Schwagerl.

July 7 and 9, 2010. Coralie Cobb (DoN) discussed aspects of the DoN's proposed brown treesnake interdiction measures via telephone with Earl Campbell and Dawn Greenlee (Service).

July 12, 2010. Coralie Cobb (DoN) emailed the Project Description to the Service after incorporating brown treesnake interdiction aspects of the project finalized via telephone with Earl Campbell and Dawn Greenlee (Service). The Project Description did not include previously agreed-upon DoN funding of two biologists on Rota to conserve the Mariana crow and the Mariana fruit bat.

July 19, 2010. Dawn Greenlee (Service) emailed Coralie Cobb (DoN) to request additional information about DoN deletion of project funding Mariana crow and Mariana fruit bat conservation on Rota.

July 20, 2010. Coralie Cobb (DoN) emailed Dawn Greenlee (Service) to confirm DoN intends to delete the Rota biologist conservation measure.

July 29, 2010. The Service (Loyal Mehrhoff, Marilet Zablan, Earl Campbell, and Dawn Greenlee) met with the DoN (Karen Sumida, Coralie Cobb, Vanessa Pepi, and Jennifer Farley) to discuss the significance of the DoN's removal of funding for the two Rota biologists from the proposed project. In the meeting, DoN staff presented information indicating the duration of DoN implementation of a number of other long-term conservation measure may not be accurately described in the Project Description.

July 30, 2010. Karen Sumida (DoN) confirmed via email that the DoN would be unable to fund the Rota biologist positions for more than five years.

August 2, 2010. Loyal Mehrhoff (Service) responded to Karen Sumida's (DoN) email to provide alternatives to long-term funding of the two Rota biologists.

August 13, 2010. DoN (Don Chandler, Vanessa Pepi, Coralie Cobb, and Jennifer Farley) met with the Service (Loyal Mehrhoff, Marilet Zablan, Patrice Ashfield, Earl Campbell, and Dawn Greenlee) to refine the details of the DoN's assurance of funding for two biologists on Rota.

August 19, 2010. DoN (Coralie Cobb) provided the Service (Dawn Greenlee) with final modifications to the Project Description via email and telephone.

September 7, 2010. The Service provided the DoN with a Draft Biological Opinion.

2.0 BIOLOGICAL OPINION

2.1 PROJECT DESCRIPTION

In furtherance of an agreement with the Government of Japan, the DoN plans to relocate 8,000 Marine Corps personnel and 9,000 dependents from Okinawa to Guam by a target completion date of 2014. Additional facilities and infrastructure will be developed on Guam to accommodate berthing for a visiting aircraft carrier and an Army Air and Missile Defense Task Force. Additional military activities will take place on nearby Tinian Island, in the Commonwealth of the Northern Mariana Islands (CNMI). The relocation is estimated to temporarily increase Guam's population by approximately 79,000 (44%) by 2014. This number will decrease to about 33,000 residents after construction is completed (19% overall increase). Each component of the Proposed Action will require new and updated facilities and infrastructure improvements to support proposed training, operations, and quality of life. The project will be implemented as described in the "Biological Assessment of Potential Effects on USFWS-listed Species from Guam and Tinian Military Relocation" (DoN 2010a, 268 pp.) (Biological Assessment), the "Final Environmental Impact Statement/Overseas Environmental Impact Statement for Guam and CNMI Military Relocation: Relocating Marines from Okinawa, Visiting Aircraft Carrier Berthing, and Army Air and Missile Defense Task Force" (DoN 2010b, 10 vol.), and other correspondence in the administrative record for the proposed project, as refined in this Project Description.

The DoD has a long history of success in preventing the dispersal of the brown treesnake from Guam in its transport of personnel and cargo. After publication of the DEIS, various agencies within the U.S. Department of Interior (DoI) expressed concern regarding the adequacy of brown treesnake interdiction efforts in response to the relocation of Marine Corps forces to Guam. DoN agrees that it will fund the increase of current federally funded brown treesnake interdiction measures (in Guam, CNMI, and Hawaii) where the increase is related to direct, indirect and induced-growth caused by the Marine Corps relocation to Guam. That funding will continue and become part of the DoN's current brown treesnake interdiction funding under authority of the Brown Tree Snake Control and Eradication Act. The DoI agrees that it is not DoN's responsibility to fund increased interdiction measures that are identified more than one year after the end of the fiscal year in which both Marine Corps relocation construction undertaken to implement the proposed relocation decisions made in the Record of Decision (ROD) for the "Environmental Impact Statement/Overseas Environmental Impact Statement for Guam and CNMI Military Relocation: Relocating Marines from Okinawa, Visiting Aircraft Carrier Berthing, and Army Air and Missile Defense Task Force" has ended and the permanent non-transient Marine Corps military units relocated as a result of decisions made in that ROD have concluded their relocation to Guam. For the purposes of this Project Description, interdiction is defined as: "to hinder, prohibit, or prevent the brown treesnake from becoming established in new locations by conducting inspection and suppression processes."

The DoD will be using an adaptive project management approach to adjust the schedule for implementation of the various components of the Proposed Action. These adjustments are expected to reduce the peak population and other impacts currently identified for 2014 and spread some of these impacts into other years. This adaptive management approach may reduce

the magnitude of project effects, but is not expected to eliminate the project effects discussed in this Biological Opinion.

The Guam and Tinian training areas are currently used by the DoD for actions addressed in previous biological opinions such as the February 22, 2010, "Biological Opinion for the Mariana Islands Range Complex, Guam and the Commonwealth of the Northern Mariana Islands 2010-2015" (USFWS 2010, 96 pp.) (MIRC) and the October 3, 2006, "Biological Opinion on the Establishment and Operation of an Intelligence, Surveillance, Reconnaissance, and Strike Capability Project on Andersen Air Force Base, Guam" (USFWS 2006a, 73, 63 pp. + Appendix) (ISR Strike).

This Project Description outlines the construction and use of new facilities on Guam and Tinian as well as increased use of existing facilities. The Proposed Action will not conflict with prior section 7 consultations. Included in the proposed action are conservation measures that will be implemented to avoid and minimize impacts of facilities construction and operation to listed species.

2.1.1 CONSTRUCTION AND OPERATIONS ON GUAM INSTALLATIONS

Training areas, offices, housing, utility and road networks, and other facilities will be constructed and operated on the following properties on Guam: Andersen Air Force Base including the Northwest Field, Naval Munitions Site, Naval Computer and Telecommunications Station Finegayan, Naval Base Guam, Andersen South, Route 15 Range Complex and the Naval Munitions Site. Road and utility improvements will also be completed in areas adjacent to DoD installations. The footprint within which these DoD construction projects will be completed is shown in Figure 1. Construction projects are summarized by DoD property and measures that will be taken during construction in all areas are outlined.

<u>Construction Implementation at all Sites on Guam</u>

Construction will typically occur between 6 a.m. and 5 p.m. Heavy equipment will be used on project sites to clear and grade to prepare sites for building construction. Conservation measures including contractor education, inspection of construction equipment and supplies to ensure they are free of invasive species, and biological monitoring to ensure project impacts to listed species are avoided and impacts to their habitats do not occur outside of the designated project area (described in more detail in the conservation measures section of this Project Description) will be implemented.

Andersen Air Force Base

There are two airfields on Andersen Air Force Base: Andersen Air Force Base airfield with its north ramp and south ramp runways and Andersen Northwest Field. The proposed development will augment existing facilities and training areas on this installation. Wells and waterlines will be developed on Andersen Air Force Base to upgrade water capacity to provide potable water to the new facilities.

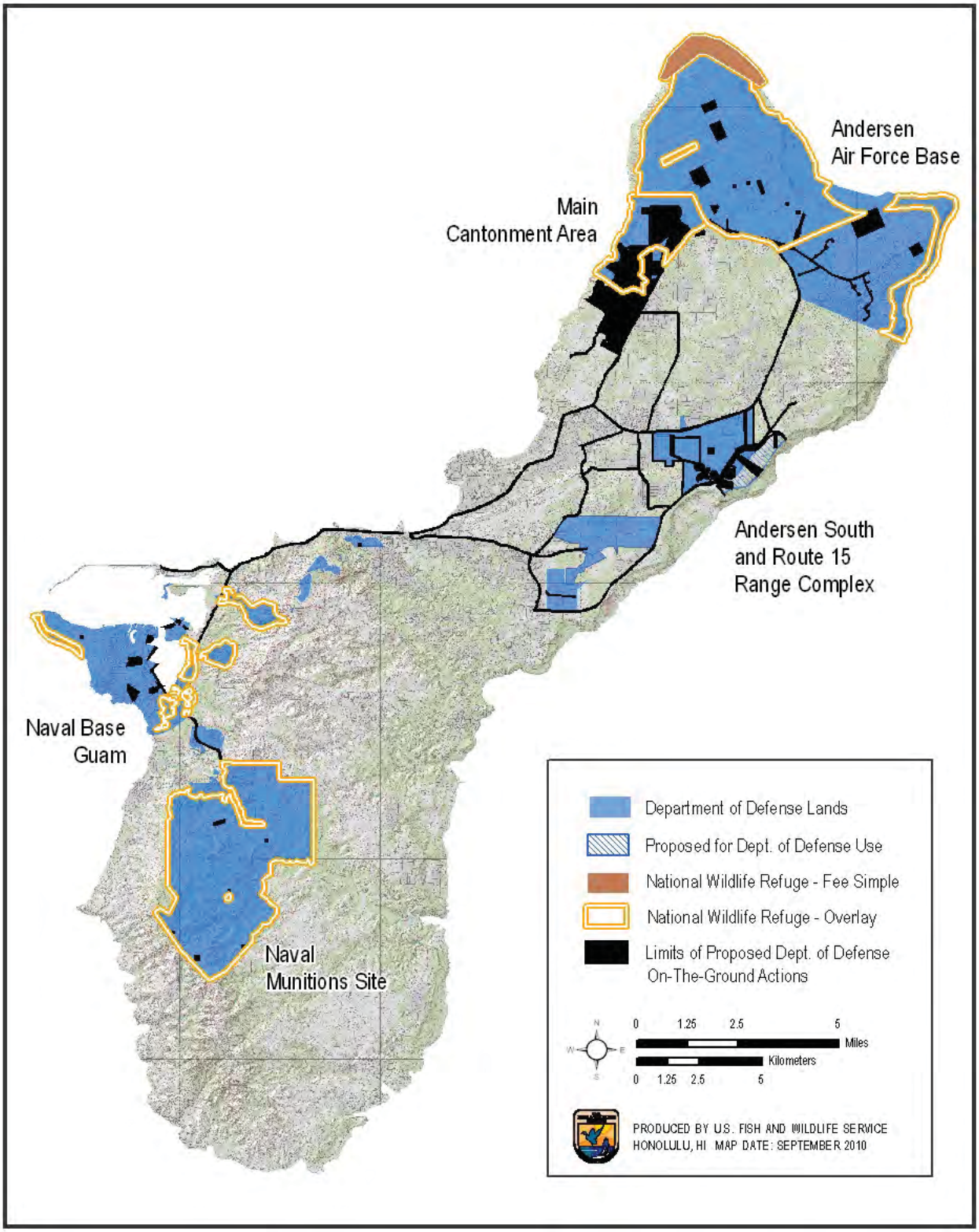

Figure 1. Location of proposed construction and infrastructure improvements on Guam.

Andersen Air Force Base Construction

Air combat element beddown facilities, an air mobility campus air embarkation location, earth-covered magazines, and associated buildings, a new north gate and access road with associated facilities, biosecurity facilities, water lines, and wells will be constructed (Figure 2). The U.S. Forest Service's 2002 vegetation map (U.S. Forest Service 2002) indicates the construction footprint for Andersen Main Base is approximately 7.5 acre (ac) (3.03 hectare (ha)) of primary limestone forest, 92 ac (37.1 ha) of disturbed limestone forest, 23.3 ac (9.41 ha) Scrub/Scrub-Forest, 9.7 ac (3.91 ha) Vitex-Closed Canopy/Sparse Canopy, 0.6 ac (.242 ha) of tangantangan and 254 ac (102.6 ha) of developed land. Of the project footprint within Andersen Main Base 230 ac (93.2 ha) is located within the Guam National Wildlife Refuge Overlay.

At Andersen Northwest Field, three Army missile defense task force weapons emplacement sites and eight earth-covered magazines will be developed. Missile defense task force facilities will be constructed within three fenced areas. The project footprint extends 30 ft (9.1 m) outside the fences because vegetation will be cleared in this area to provide for site security. Development of these sites will include construction of facilities and roads, and development of electromagnetic radiation hazard areas. Existing roads will be used to access the sites and utilities will be connected to the project site along already existing disturbed areas. A total of 129.1 ac (52.1 ha) is within the project footprint of the three weapons emplacement sites. The U.S. Forest Service's 2002 vegetation map (U.S. Forest Service 2002) indicates approximately 2.1 ac (0.8 ha) of limestone forest, 21 ac (8.5 ha) of disturbed limestone forest, 66 ac (27 ha) of scrub or scrub forest, 12 ac (4.8 ha) of *Vitex*-closed canopy or sparse canopy, 2.0 ac (0.8 ha) coconut grove, and 26 ac (11 ha) of developed lands are within the project footprint. One hundred and one ac (41 ha) are within the Guam National Wildlife Refuge Overlay.

One of the proposed weapons emplacement sites overlaps with a location known as "Area 50," which is a patch (42.2 ac, (17.1 ha)) of limestone forest and mixed limestone forest. Area 50 has been used in the past to examine reintroduction of Guam rail, ungulate removal, and brown treesnake suppression. The proposed project will infringe upon Area 50, and will remove approximately (13.2 ac, (5.3 ha)) of the mixed limestone forest. The Service and the DoN considered other alternatives for the locations of the weapons emplacement sites, including the three alternatives presented in the DEIS and a minor modification to the preferred alternative. All alternatives resulted in increased habitat loss and fragmentation over the existing preferred alternative. As a result of project development, only 28.5 ac (11.5 ha) of vegetation will remain undisturbed within Area 50.

A total of 12 earth-covered magazines will be constructed in the existing Andersen Air Force Base Munitions Storage Area 1 at Andersen Air Force Base: six of the new earth-covered magazines will support Marine Corps ground combat training occurring in the northern part of Guam and six will support the Air Combat Element operations at Andersen Air Force Base airfield. The earth-covered magazines will be sited to allow for storage and use of Class/Division 1.1 munitions at a minimum 250,000 lb net explosive weight. The earth-covered magazine will include 2,000-square-foot (ft) (186-square-meter (m)) physical capacity in addition to structural and protective features and earth covering. Each earth-covered magazine

will include two square 150-ft (46-m) wide concrete pads, both with an additional 50- by 100-ft (15- by 30-m) overhang developed areas.

Andersen Air Force Base Operations

The facilities constructed at Andersen Air Force Base north and south ramps will be used by 12 permanently stationed MV-22 helicopters and will accommodate the loading of additional transient aircraft listed in Table 2. These aircraft will conduct training and operational flights (sorties) including the following: field carrier landing practice, familiarization-instrument, Marine air ground task force, tactical air operations center, and routine operations, will occur in association with the air mobility campus and the air combat element. A training event consists of one aircraft performing a take-off, a training evolution, and a landing. These training operations will occur on airfields in current use by similar aircraft (Table 3) such as those addressed in the MIRC Biological Opinion (USFWS 2010, 96 pp.).

Table 2. Proposed aircraft loading (DoN 2010b, vol 2, p. 2-91).

Element	*Number*	*Type*
Permanent stationed: Rotary wing	12	PCS (12) MV-22 (Assault Transport)
Fixed wing	12	F/A-18
Transients: Rotary wing	12	MV-22 Transport (Osprey)
	3	UH-1 Multipurpose Utility (Huey)
	6	AH-1 Attack (Super Cobra)
	4	CH53E
Fixed wing	2	KC-130
	24	F/A-18
	4-6	F-4 (visiting Allied Forces)

Table 3. Anticipated total flight operations at Andersen Air Force Base resulting from previous projects with the addition of the proposed action (Czech and Kester 2008 as cited in DoN 2010b, vol 2, p. 2-91).

Aircraft Type	**Anticipated Total Aircraft Operations per Year Andersen Air Force Base**			
	Previously Addressed	**JGPO Project**	**Total**	**% Increase**
Helicopter	19,029	19,489	38,518	102%
Jet/Propeller	25,697	6,424	32,121	25%

The new air combat element facilities will be used for aircraft operations, maintenance of MV-22 tilt rotor aircraft, and training and support functions. The air combat element facilities will also be used for Marine air control group training. Marine air control group training involves coordination of air command, control, and defense units and the tactical air operations center. Training entails the operation of air traffic control radar and radio frequency emitters and facilities consisting of shelters, a portable tower, and electrical power sources. Tactical air operations center training involves the establishment and dismantling of these facilities within a

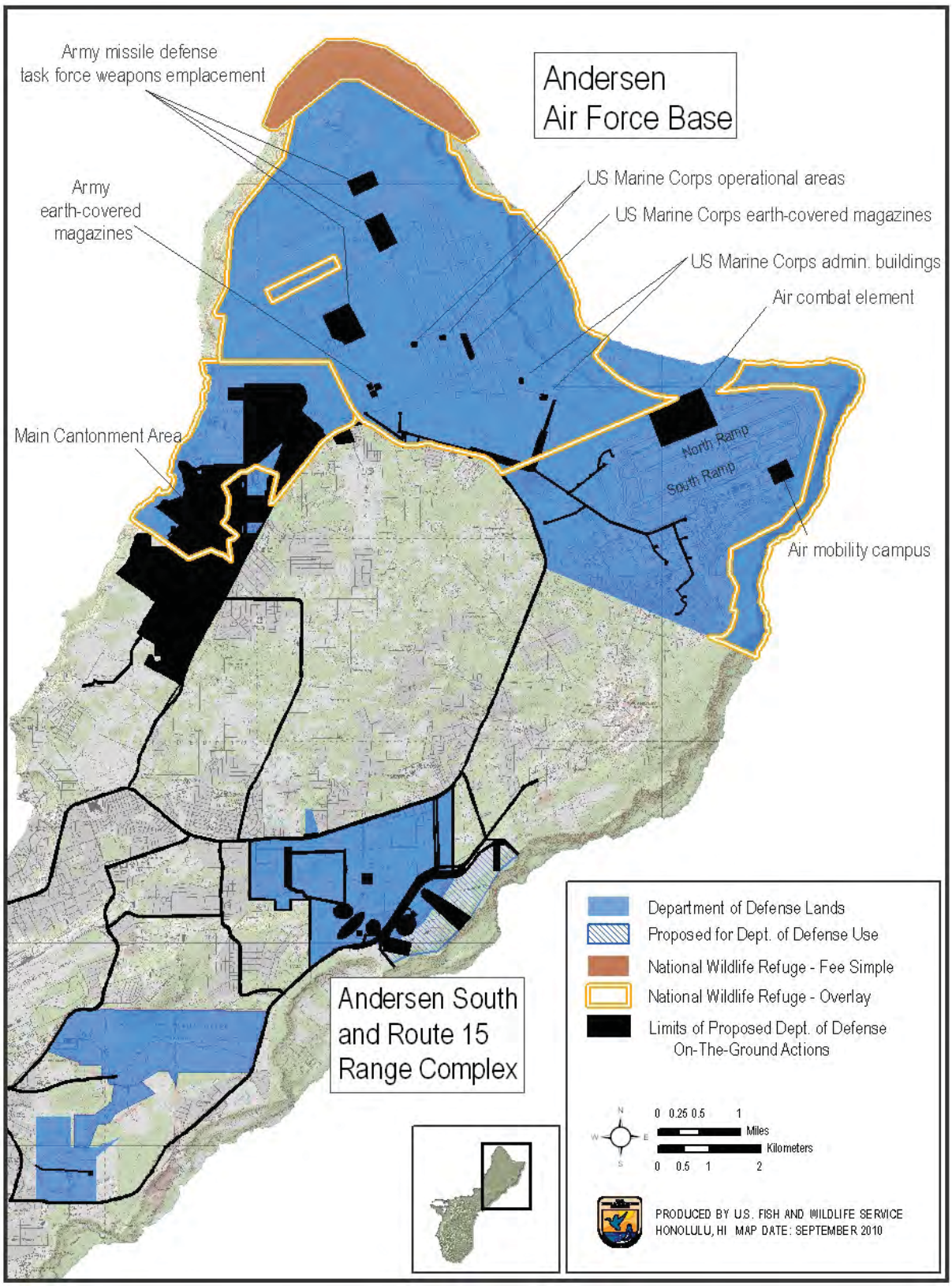

Figure 2. Project footprint at Andersen Air Force Base and other areas of northern Guam within which vegetation clearing will occur.

96-hour period. Training includes use of various emitters and sensors which need to be de-conflicted with other electronic equipment operating in the area. To minimize the constraints it puts on airspace availability, radar equipment, which generates strong electromagnetic radiation fields, will be operated for no more than one hour at a time. The air combat element beddown facilities will operate 24 hours per day and 7 days per week. Staffing levels will be contingent on surge and operational requirements of the air combat element facilities. Traffic will include government-owned vehicles, personal-owned vehicles, and shuttle buses from the proposed Main Cantonment area.

Approximately 1,000 annual field carrier landing practice and 79 familiarization-instrument flight events are proposed for Andersen Main Base. Field carrier landing practice operations entail one or more aircraft flying at a low altitude in almost circular patterns and involves landing on a simulated aircraft carrier during the day and, using night-vision goggles, at night. Familiarization-instrument training, including autorotation and simulated engine-out approaches will occur on the improved airfields with the support of aircraft rescue and fire fighting facilities. Rotary-wing aircraft operations will occur at the Andersen Air Force Base airfields and in various proposed training areas on Guam and Tinian. Fixed-wing aircraft operations will occur only in the immediate airfield environment of Andersen Air Force Base. Aircraft will then leave this area to conduct activities within established training areas of the MIRC or other locations as described under MIRC (USFWS 2010, 96 pp.). Air traffic at the air combat element beddown and North Ramp will include helicopter, vertical lift aircraft, fixed-wing, and unmanned aircraft arrivals and departures.

In addition, a new air embarkation site will be built to serve as the passenger terminal for Andersen Air Force Base and temporary cargo storage. Air embarkation and disembarkation refers to the loading and unloading of passengers or cargo to and from aircraft. The passenger facilities are comparable to those of a small airport: luggage handling, waiting area, and ticket and documentation area. Cargo is staged for loading to aircraft or disbursement to warehouses or individual commands. Currently the Air Force has air embarkation facilities at South Ramp of the airfield. Once the new facility is built, the existing facility will be closed. The site will operate 24 hours per day and 7 days per week.

Actions in the Northwest Field area of Andersen Air Force Base will include new training and Army Missile Defense Task Force activities. New training will occur in Northwest Field on existing runways, drop zones, and non-vegetated areas. Specifically, 125 confined area landing, 95 external load, 114 helicopter insertion- extraction, 1,000 field carrier landing practice, and 79 familiarization-instrument training will occur annually. Training associated with the Army Missile Defense Task Force will occur in Northwest Field. These actions will result in clearing of vegetation within the project footprint area as well as periodic generation of loud noise. The details of the Army Air and Missile Defense Task Force activities, such as frequency of noise generation are classified and therefore they are not presented in this Project Description.

The project will result in noise levels in excess of 60 dB over the Guam landscape. Northern Guam will be periodically exposed to noise levels in excess of 93 dB PK15. Peak sound levels are the calculated peak noise level, without frequency weighting, expected to be exceeded by 15 percent of all events that might occur.

Proposed Main Cantonment Area

The proposed Main Cantonment area will be constructed within the Naval Computer and Telecommunications Station Finegayan, the former Federal Aviation Administration (FAA) site, and the South Finegayan area.

Proposed Main Cantonment Area Construction
Headquarters, administrative support facilities, family housing, bachelor's quarters, temporary lodging, education facilities, quality of life facilities, base operations, maintenance facilities, warehouses, equipment and vehicle storage, hazardous material storage, engineer equipment and decontamination facility, field and classroom training ranges, an indoor small arms range, roads, gates, and utilities will be developed within 2,303 ac (932 ha) in the proposed Main Cantonment area.

A 450-ac (182-ha) outdoor recreation area will be established along the northern edge of the proposed Main Cantonment area, entirely within the Guam National Wildlife Refuge Overlay area. A picnic area will be developed within existing shrub and grassland habitat and a designated nature trail will be established and maintained. Approximately 385 ac (155.5 ha) within the outdoor recreation area are secondary limestone forest and 65 ac (26.3 ha) of shrub and grassland habitat (U.S. Forest Service 2002).

Proposed Main Cantonment Area Operations

Within the proposed Main Cantonment area, training will occur at the following facilities: battle staff training and simulation complex, combined arms staff trainer, Marine air ground task force integrated systems training center, audio-visual simulation training support facility, general purpose auditorium, obstacle and confidence courses, hand-to-hand combat pit, rappelling tower, gas chamber, combat training tank (pool), and the engineer equipment and decontamination station (DoN 2010a, p. 27-90). Training at these locations will occur at facilities constructed as part of the proposed action (see proposed Main Cantonment area construction above). Maneuver area training will occur at designated training areas within the proposed Main Cantonment area and will include crews (groups of two to three individuals), fire teams (smallest unit of infantry, typically four or fewer individuals; not having to do with fire starting or control), and squad drills (a group of 8 to 12 individuals) practicing gun drills (non-firing), formations, and camouflage. Limited training (i.e., compass navigation by fire teams) may occur within the outdoor recreation area.

Indoor Small Arms Range. The indoor small arms range, which is proposed to be located at Naval Computer and Telecommunications Station Finegayan, will be for 5.56 mm and 9 mm firing training. The facility will have no external surface danger zone and is treated for planning as a normal structure. This range will be used for pistol and M4 exercises. The range will also be suitable for scenario and combat shooting training, and for use by military police. Training conducted within the small arms range is indoor and will not result in additional impacts (beyond construction as described above) to listed species or their habitats and will not be analyzed within this Biological Opinion.

Andersen South and Route 15 Range Complex

Andersen South and the Route 15 Range complex are adjacent to each other on the northeastern coast of Guam. Approximately 921 ac (373 ha) of land east of Route 15 will be acquired for the development of the Route 15 ranges. The Guam International Raceway is located on a portion of the land.

Andersen South and Route 15 Range Complex Construction

The proposed project will result in the construction of a military operations in urban terrain training area, a portion of which will be a modular unit and another will be reconstructed from the existing unit; a logistics and administration area; a convoy course; an advanced motor vehicles operators course; an aviation training landing zone; an aviation and maneuver area landing zone; Pioneer Road; other range roads; a perimeter fence; main, secondary, and range road gates; and the realignment of Route 15 at Andersen South. The new firing range complex will be located adjacent to and east of Andersen South and Route 15. The complex will include perimeter security fencing; range access roads; range control towers; range maintenance buildings for administration, maintenance and storage, and automated target storage and maintenance; a breacher house; a shooting house; a known distance range; a pistol range; a square-bay range; an unknown distance range; a machine gun range; a hand grenade range; and a hand grenade house. Parking and utilities will also be within the project footprint of the Route 15 Range complex.

The construction footprint for both Andersen South and the Route 15 Range Complex is a total of 328.1 ac (132.6 ha) and consists of approximately 18.9 ac (7.6 ha) of primary limestone forest, 152.4 ac (61.6 ha) of disturbed limestone forest, 73.2 ac (29.6 ha) of shrub and grassland, 7.7 ac (3.1 ha) of tangantangan and 75.9 ac (30.7 ha) of developed land.

Andersen South and Route 15 Range Complex Operations

Convoy operations, maneuver training for military operations in urban terrain, and general maneuver and air-ground operations will vary, but may occur up to 5 days per week, 45 weeks per year, day and night. The maximum estimate is approximately 250 to 300 Marines will participate in maneuver training at Andersen South each week, for a total annual throughput of 11,250 to 13,500 Marines. Convoy operations will typically consist of 7 to 10 vehicles (e.g., high mobility multipurpose wheeled vehicles) traveling in tandem along an established course.

Military operations in urban terrain includes transporting units to Andersen South by helicopter or vehicle, maneuvering toward the military operations in urban terrain complex on foot or in vehicle, and engaging in integrated training at the military operations in urban terrain complex. Military operations in urban terrain at the reconstructed training area (also referred to as the urban embassy component) will consist of 24 or more, multi-story concrete structures to simulate at least four city blocks. The modular military operations in urban terrain (also referred to as the rural military operations in urban terrain) will consist of movable components that can be stacked and grouped into a number of configurations to present tactical situations to be overcome by training units. This modular military operations in urban terrain will consist of shipping

containers that will be assembled on site to simulate a more rural village or set of suburban buildings located outside the core urban area. Forklifts or cranes will be used to reconfigure the modules of the military operations in urban terrain to add variety and diversity to training. The proposed military operations in urban terrain complex will include live-fire ranges, including a breacher and shooting house that will be used for forced-entry training, and a hand grenade range and house. These will be suitable for units or organizations of up to 800 Marines at a time, and will be used daily by 40 to 750 personnel. The military operations in urban terrain will operate day and night; night operations will comprise an estimated 15% of all operations. The military operations in urban terrain will be used by organizations based on Guam, transients, and visiting regional allied forces. Units using the military operations in urban terrain may bivouac in the vicinity, or arrive and depart daily.

Typically, dry runs and individual skills training will occur prior to the military operations in urban terrain exercise, which will involve fire teams (smallest unit of infantry, typically four or fewer individuals; not having to do with fire starting or control), and squad drills (a group of 8 to 12 individuals). Types of weapons that will be authorized for use at the military operations in urban terrain will include M16, M4, M249, and M240. Blanks, simulators, smoke grenades, diversionary devices (improvised explosive devices and booby traps that release smoke when activated), special effects small arms marking system (similar to paintball), and multiple integrated laser engagement system (small laser receivers scattered over the uniform of an individual soldier, which detect when the soldier has been shined by another soldier's firearm laser) are used instead of ammunition and explosives that would be used in a real combat situation.

Tactical motor vehicle operator training is a continuous requirement for Marine units. The proposed advanced motor vehicle operations course will consist of a route along which a series of obstacles will be placed for driver trainees to negotiate. This will include obstacles simulating terrain features such as narrow bridges, serpentine courses, brake modulation blocks, river crossing, side slope, pot holes, curb and ditch crossing, humps (similar to moguls on a ski slope), and narrow urban driving. The obstacles are connected with unpaved roads. The capacity of the advanced motor vehicle operations course facility will range from 25 to 60 personnel and will be used for individual, section, squad, or platoon training. An estimated 20 drivers per week will train at the advanced motor vehicle operations course, primarily with high mobility multipurpose wheeled vehicles. At two drivers per vehicle, an estimated 10 high mobility multipurpose wheeled vehicles will use the course during training events. Training activities will result in increased noise and wildfire threat.

Convoy training consists of simulated threats and tactical scenarios to train in various defensive techniques. This area of Andersen South is currently used by the Air Force for expeditionary airfield and military operations in urban terrain training which has similarities to the proposed maneuver area training. The convoy training course is 2.5 mi (4 km) and will use existing and new roadways (see Andersen South construction above) within areas identified for the maneuver training space. All existing roads will be open to motor vehicle use associated with maneuver area training; this will primarily be wheeled vehicles, but occasionally a tracked vehicle may be used in maneuver area training at Andersen South. The area will continue to support Air Force training, while also accommodating Marine Corps training requirements. Access to the site will

be by vehicle or air lift. Air lifts will typically involve two to four CH-53 helicopters dropping off and picking up personnel twice a week.

Andersen South will support landing zones for aviation training and include helicopter support team training for ground units. Personnel train in rappelling from the helicopter and procedures that will be used in inserting and extracting troops via helicopter at combat locations. The air operation events associated with this air-ground training will typically consist of a pass for orientation, followed by a downwind approach, hovering at 30 ft (9 m) above ground level for approximately one minute at a designated landing zone and a departure. Since the maneuver area aviation training operations will be a component of training to meet the aviation training requirements, they are also described below under aviation training. Helicopter-insertion extraction activities include fast rope, rappelling, helocasting, and parachute operations. Helicopter insertion-extraction training operations will involve one pass for landing zone orientation, followed by an approach of the landing zone, hovering at approximately 30 ft (9 m) above ground level for approximately one minute, and then departing the landing zone. During each training event, approximately three helicopter insertion-extraction operations will be conducted at one or more closely located landing zones. Approximately 114 helicopter insertion- extraction events will occur at Andersen South per year. Confined area landing, external loads, and maneuver lift (see descriptions above) training will also occur on Andersen South at a frequency of 125, 63, and 720 events per year, respectively.

On Guam, east of Route 15, training will be conducted at six new ranges and additional facilities constructed for the proposed project (see Route 15 Range Complex Construction above): pistol range, square-bay range, unknown distance range, known distance range, machine gun range, hand grenade range, hand grenade house, breacher house, and a shooting house. The six ranges and additional facilities comprise one training range complex at Route 15. The Route 15 training range complex will operate 7 days per week, 24 hours per day, approximately 45 weeks per year with the highest use generally being between 6 a.m. and 10 p.m. Tracers and illumination rounds may be used at Andersen South training ranges during periods of low fire danger. An estimated 15% of the operations at the pistol, square-bay, unknown distance, and machine gun ranges will occur at night. Tables 4 and 5 list the daily and annual proposed munitions use at these ranges based on maximum implementation of existing training requirements. The number of personnel training on the range complex could vary between 70 and 250 individuals. The majority of personnel will arrive in buses, while some will arrive in personal vehicles. Up to company size units will use the range at one time (approximately 150 people, requiring 4 buses, and 10 cars). Range management, including maintenance, accounts for up to 4 weeks per year that the range complex may not be available for use.

Route 15 Range Complex range maintenance will be periodically conducted, in accordance with all applicable regulations, by sifting the expended rounds from the soil on site, placing the soil immediately back on the berm, containing and transporting the expended rounds to a local recycling contractor or smelter. Soils will be monitored to ensure a neutral pH level (6 to 8) is maintained.

Known Distance Rifle Range. The 5.56 mm rifle known distance range is proposed to be used to train personnel on the skills necessary to identify, engage, and hit stationary targets in a static array from a known distance.

Table 4. Daily and annual use of proposed demolition and explosive ranges.

Range	*Explosive or Munition*	*Typical Use Estimate*			*Ammunition Expenditure Estimates*		
		Crews or Personnel	*Hours*	*Days Per Yr*	*Busy Day*		*Annual*
					Day	*Night*	
Demolition	TNT (<20 pound)	80	0800-1600	48	10 lb	0	500 lb
	C-4	20	0800-1600	48	20 lb	0	682 lb
	Other (20 pound TNT equiv.)	20	0800-1600	48	40 lb	0	1,920 lb
Breacher and Shooting House	TNT (0.25 pound)	40	0800-1200 1900-2200	36	5	1	300
Hand Grenade	M67 Fragmentation Grenade	54	0800-1600	70	54	0	3,780
Hand Grenade House	M67 Fragmentation Grenade	26	0800-1600	70	26	0	1,820

Pistol Range. The proposed 9 mm pistol range will provide for 25 firing points and a 50-yard (yd) (46-m) square-bay range for multi-purpose use and conversion to use for M4. A known distance firing range is where Marines shoot (typically rifles) at targets located at designated distances.

Square-Bay Range. The square-bay range is proposed to be used for 9 mm pistol and 5.56 mm rifle training and is a known distance firing range.

Unknown Distance Range. The 5.56 mm rifle unknown distance range is proposed to be used as a firing range where the distance between firing points and targets varies.

Machine Gun Range. Typical operations at the machine gun range is proposed to involve the firing of .50-cal., 7.62 mm, and MK19 40 mm training practice munitions. Guns will be mounted on vehicles, tripods, and bipods.

Hand Grenade Range. The M67 fragmentation hand grenade range is proposed to operate as an open practice throwing field with various targets and throwing positions.

Hand Grenade House. The hand grenade house is proposed as an open structure made of ballistic concrete or other bullet absorbing material where training occurs with fragmentation grenades to simulate grenade use in an urban environment.

Table 5. Daily and annual use of proposed small arms outdoor qualification ranges (DoN 2010b, vol 2, p.2-57).

Range	Weapon	Ammunition Type	Typical Use Estimate			Ammunition Expenditure Estimates		
			Crews or Personnel	Hours	Days Per Yr[(a)]	Busy Day[(b)] Day	Busy Day[(b)] Night[(c)]	Annual[(d)]
KD	Rifle	5.56mm	250	0800-1200 1900-2200	200	10,000	2,250	2,450,000
Pistol	Pistol (M9)	9mm	100	0800-1200 1900-2200	225	7,000	3,000	2,250,000
Nonstandard Small Arms Range	Rifle	5.56mm	125	0800-1600 1900-2200	225	4,523	2,227	1,518,750
	Pistol	9mm	25	0800-1600 1900-2200	225	4,500	750	1,181,250
MRF Range	Rifle	5.56mm	64	0800-1600 1900-2200	225	5,440	750	1,392,750
Machine Gun	MMG	7.62mm	32	0800-1600	225	4,000	2,400	920,000
	HMG	.50 cal	32	0800-1600	225	4,000	2,400	340,000
	HMG	40mm TP	32	0800-1600	225	1,120	480	82,000
							Total	**10,134,750**

Legend: cal = caliber, mm = millimeters, HMG = heavy machine gun, MMG = medium machine gun.
Notes:

(a) The figures for number of days of use are determined from estimated down time for maintenance and weather. Typical use is estimated at 5 days/week, 45 weeks/year for most ranges and 5 days/week, with the exception of the KD range that is adjusted to account for weather (i.e., if 1 or 2 days of training at the KD range is lost due to weather, the whole week is rescheduled; scheduling of the other ranges is more flexible). Range use would occur periodically throughout the year, with no predictably busy or non-use periods.

(b) The estimates for the KD, Pistol, Nonstandard, and MRF ranges are based on the maximum number of shooters per day who could make use of each proposed range (calculated by multiplying the number of firing points or lanes by the number of firing relays), firing the number of rounds prescribed for a standard string of fire. This estimate is consistent with the munitions allocation for the relocated AIP units. For the machine gun range, the AIP munitions allocation is considerably less than the range capacity.

(c) Night refers to non-daylight hours that are generally 1900-0600 on Guam. Range use is not expected to extend beyond 2200 (2200-0700 is considered nighttime for community noise analysis)

(d) The annual numbers of rounds expended are consistent with the AIP munitions allocation.

Breacher House Training. The breacher house operations, is proposed to be located in Andersen South will be integrated into the military operations in urban terrain. The shooting house is a standard two-story enclosed structure used for various types of training in forced entry, including in the use of small explosive charges (less than 0.25 pounds of trinitrotoluene, commonly known as TNT).

Shooting House Training. Shooting house operations, which are proposed to be located in Andersen South, are conducted in an enclosed structure and provide training in close-quarter skills, like room clearing and hallway navigation. No explosives are used; however, live-fire training operations with the 5.56 mm rifle will be authorized at the facility.

Naval Base Guam

Naval Base Guam is located along the southern side of Apra Harbor on the western coast of Guam. The civilian Port of Guam flanks the northern side of the Harbor (Figure 3).

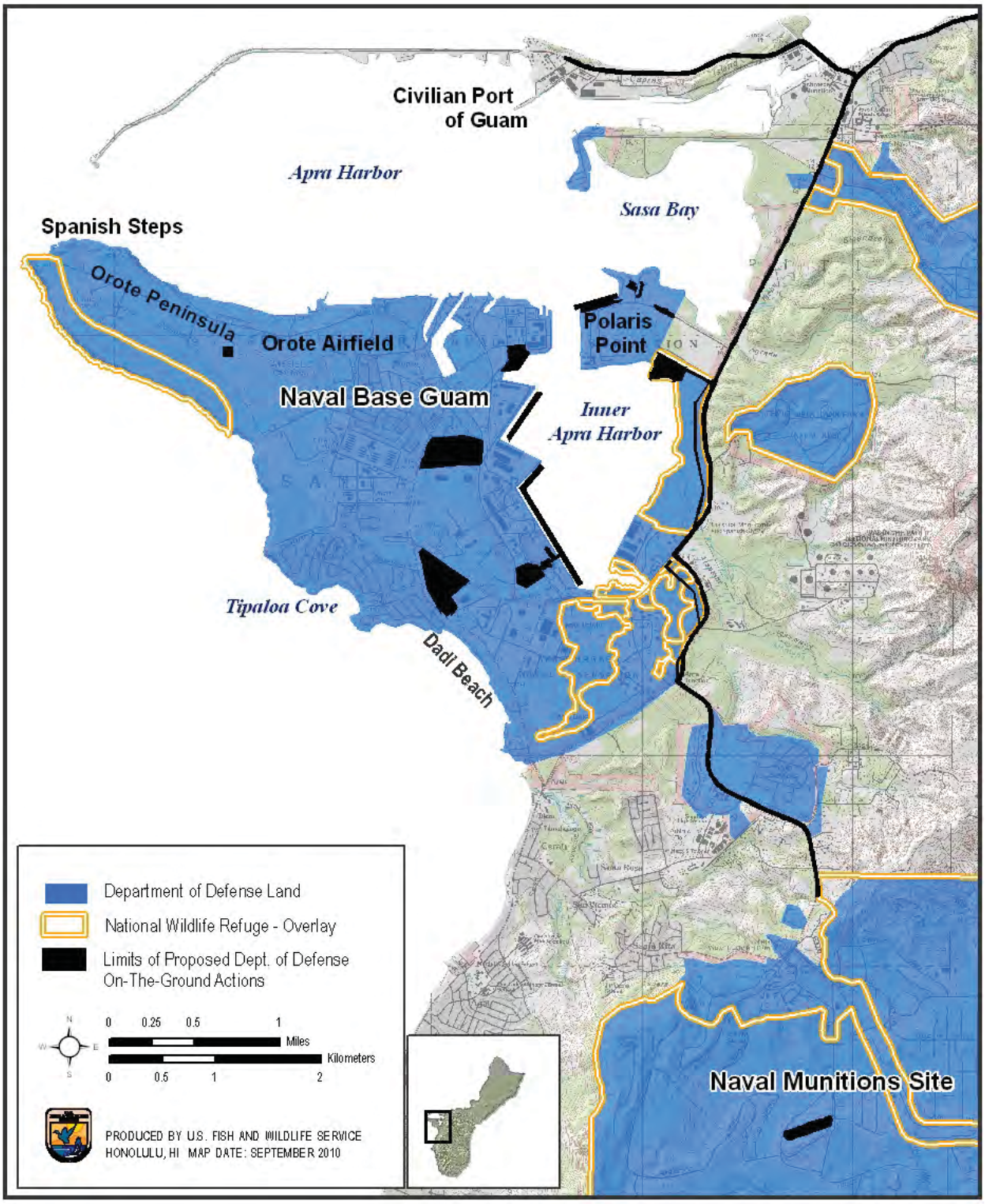

Figure 3. Location of proposed infrastructure and facilities development in the Apra Harbor area.

Naval Base Guam Construction Projects

In-water ship berthing and embarkation areas, staging areas, an amphibious craft laydown area, a military working dog kennel relocation, a medical and dental clinic, washdown facilities, brown treesnake barriers, and quarantine areas will be developed at Naval Base Guam. In addition, a United States Coast Guard berthing and crew support building will be relocated to an area that is not currently forested. The military working dog kennel will be relocated from its existing site to a new site on Naval Base Guam. The proposed project location is in an existing laydown area for base maintenance with existing access roads and utility tie-ins. Associated with the aircraft carrier berthing at Naval Base Guam are the shore-side facilities (recreation, gathering, laundry, waiting for transportation, and food and beverage sales), staging areas, new buildings, and parking. The Apra Branch Medical and Dental Clinic will be built on a previously disturbed area that is currently vacant. The Morale, Welfare, and Recreation area will be developed to provide food and beverage booths, seating for 500 people, 40 phone bank seats, 100 stalls for visitor and rental car parking, portable restrooms, laundry facilities, temporary lighting, and trash dumpsters.

All facilities will have security lights mounted on buildings or steel poles. Lighting along the wharves will consist of 1,000-watt high pressure sodium floodlights mounted on new or existing poles. Lighting will be shielded and aimed such that the majority of the illumination will be directed towards the wharf deck, extending over water approximately 100 ft (30.5 m). All actions related to development and improvement of waterfront facilities will occur in currently paved or landscaped areas. All utility distribution lines and ductwork will be located underground, generally within existing utility corridors.

The DoN will develop permanent and temporary washdown, quarantine, and inspection areas at arrival areas on Guam at Apra Harbor (ship and amphibious vehicle loading and unloading) and Andersen Air Force Base (DoN 2010a, p. 70) as follows.

1. A washdown, quarantine, and inspection facility will be built at Apra Harbor within 600 ft (183 m) of Victor Wharf to reduce the risk of exposure to invasive species after leaving the clean, biosecure area. During construction, invasive species and debris will be removed from the site. Prior to operation, the biosecure area will be inspected and will only begin operations when the area is invasive species-free. These facilities will provide vehicle cargo quarantine, inspection, and storage areas. These areas will be constructed with a brown treesnake barrier and active trapping for brown treesnakes will occur. These facilities will provide a pre-wash down area, vacuum equipment, wash racks (raised platforms with ramps at either end that facilitate cleaning and inspection of undercarriages), an inspection building, and fenced area that will meet the requirements for the use of inspection dogs and a cargo loading and inspection area. Specifically, these facilities will be built in a designated paved area with a wash down area and sufficient space for segregating “clean” from “dirty” equipment, cargo, and vehicles. The areas will be surrounded by brown treesnake barriers following specifications received from the Service: The barriers will be 4.5 ft (1.4m) tall; made from pre-cast concrete with an outward projecting lip to deter snakes; the barriers will have only two gates providing one-way flow of traffic through the site; each gate made from sliding chain-link with fabric barriers to prevent snake ingress and egress.

2. When in Apra Harbor, the vehicles and equipment unloaded or loaded onto a ship will be inspected and receive a wash down on arrival and departure to prevent introduction of any pest or invasive species that may present a potential threat to agriculture, public health, or the natural resources of Guam or other Pacific Islands. All wash downs will be conducted and supervised by trained personnel in accordance with Armed Forces Technical Guide 31. U.S. Department of Agriculture (USDA) personnel may participate in inspections and brown treesnake inspections will be conducted with involvement of USDA Animal and Plant Health Inspection Service (APHIS) personnel. Vehicles will be inspected (internally and externally) prior to passing into the biosecure area. The water used to wash vehicles will be captured and circulated through filters to prevent pests from spreading. All waste on board ships will continue to be steam sterilized prior to disposal in regulated landfills in accordance with base operating procedures.

3. Supplies for the Coast Guard Cutters are delivered to the wharves from existing DoN supply warehouses where all supplies and material have undergone required USDA inspections upon arrival and before being transferred out of the warehouse and onto a U.S. Coast Guard ship. The U.S. Coast Guard ships will not be offloading supplies onto Guam from other locations (DoN 2010a, p. 79).

4. Truck traffic at the wharf will be required to re-supply ships (DoN 2010a, p. 85). Trucks may be from DoN Supply or direct from commercial vendors. Equipment to move cargo will be brought to the wharf as needed. When an aircraft carrier is not berthed, the Port Operations building will be used for storage. All equipment and cargo will go through inspection procedures prior to being brought into "clean" areas or being loaded on to ships, regardless of vendor.

5. A washdown, quarantine, and inspection facility will also be built at the amphibious vehicle laydown area in Apra Harbor to reduce the risk of exposure to invasive species after leaving the clean, biosecure area. This facility will be adjacent to the shore so that amphibious craft can drive into the washdown, quarantine, and inspection facility. This facility will be built to the specifications described above for Victor Wharf with modifications to accommodate amphibious vehicles, specifically: the laydown area will have dedicated ramps for landing craft air cushion and amphibious assault vehicles in the quarantine area.

6. Typically, the Amphibious Task Force will arrive fully supplied to meet all training requirements or will be replenished as needed prior to training in the CNMI. If cargo is loaded or unloaded, inspection is required as described above for Victor Wharf. Cargo will be loaded and unloaded in the laydown area which will be of sufficient size to segregate "clean" from "dirty" cargos. If there is a training mission on Guam, the trucks drive off the ships' stern ramps. Other cargo may be offloaded by mobile crane. After inspection, cargo may be temporarily stored in a "clean" material handling equipment at the waterfront.

7. There are several projects in Apra Harbor. For all facilities, the DoN will attempt to include USDA APHIS at the earliest possible time to plan for brown treesnake

inspections. Planning for cargo storage will include considerations of the length of time for storage, risk of brown treesnake or other invasive species, and origin and destination of cargo. These considerations need to be vetted through the Biological Monitor (detailed in subsequent sections of the Project Description) and this staff person will coordinate with other partners. Permanent barriers and moveable brown treesnake barriers will be used as the situation dictates.

8. The DoN will develop permanent and temporary quarantine and inspection areas at a new Air Embarkation and Disembarkation area at Andersen Main Base to load and unload passengers and cargo from aircraft (DoN 2010a, p. 62-63). USDA APHIS will be included in the design of this facility as early as possible to assist with planning. This facility will be surrounded by a brown treesnake barrier built to the specifications described above and will have inspection and quarantine areas to separate "clean" from "dirty" areas such that all aircraft, baggage, equipment, and cargo are 100% inspected upon arrival and 100% inspected upon departure. The aircraft carrier berthing will bring up to 59 aircraft to Guam that may beddown at Andersen Air Force Base. All transient aircraft will follow all existing invasive species inspection protocols, including brown treesnake protocols (DoN 2010a, p. 83).

The total terrestrial project footprint at Naval Base Guam is 288 ac (116.9 ha). Approximately 12 ac (4.9 ha) of scrub forest, 51 ac (21 ha) of shrub and grassland, 34 ac (14 ha) of tangantangan forest, and 191 ac (77 ha) of developed land will be used for the construction of these features. Of the 288-ac (116.9-ha) project footprint, 12 ac (4.8 ha) is located with the Guam National Wildlife Refuge Overlay.

Naval Base Guam Operations

All amphibious training operations and conservation measures are assessed under the MIRC Biological Opinion (USFWS 2010, 96 pp.). Though new facilities will be constructed due to the proposed project, no additional amphibious training will occur in undisturbed areas, either new or increased frequency or tempo is proposed under the proposed project. Therefore, amphibious training will not be analyzed within this Biological Opinion.

New aviation training, called external load, will occur at Orote Airfield on Naval Base Guam. The training requires access to pre-positioned cargo for practice, and ground access is needed for ground support team personnel. External loads cannot be carried across public roads or populated areas. External load training operations will involve one pass for landing zone orientation, followed by an approach of the landing zone, hovering approximately 30 ft (9 m) above ground level for approximately one minute while the ground support team attaches a load (e.g., concrete block, items in a cargo net, or a vehicle), departure of the landing zone vicinity with the load in tow, flying with the load in an arc, then returning to the landing zone with the load, and hovering for approximately 30 seconds while the ground support team retrieves the equipment, and then departing the landing zone vicinity. During each event, these operations will typically involve five repeated attachments and detachments of external loads at the same landing zone where the ground support team is positioned. Ground support teams will include up to 40 personnel at one time and will support landing zone operations. Approximately 10 to 12

wheeled vehicles (e.g., high mobility multipurpose wheeled vehicles) will be used by these teams.

There are no listed species or recovery habitat near Orote Airfield that will be affected by external load training. External load training will involve pick up and return from the same location on Guam, thereby reducing the risk of transporting invasive species. Therefore, external load training at Orote Airfield will not be analyzed within this Biological Opinion. No other new training is proposed for the Naval Base Guam.

Naval Munitions Site

The Naval Munitions Site is an 8,789 ac (3,557 ha) area in southern Guam dominated by limestone forest, ravine forest, and savanna vegetation. The Fena Valley Reservoir is located along the eastern side of the Naval Munitions Site. A system of existing roads and munitions storage facilities occupy approximately one-third of the Naval Munitions Site. Unimproved roads provide limited access to the mountainous southern half of the site.

Naval Munitions Site Construction

Eleven munitions storage magazines, four aviation training landing zones, one aviation and maneuver landing zone and an access road from Route 2 to the southern portion of the Naval Munitions Site will be developed (Figure 4). Unimproved, unpaved, helicopter landing zones will be developed and maintained in the Naval Munitions Site. Vegetation within the landing zones will be kept clear with the use of portable equipment. Heavy equipment and other ground-based vehicles will not be used outside existing and proposed developed areas in the southern Naval Munitions Site.

The construction footprint is a total of 43.6 ac (17.6 ha) and consists of approximately 17.1 ac (6.9 ha) of ravine forest, 24.0 ac (9.7 ha) of shrub or grassland savanna, and 2.5 ac (1.0 ha) of developed land. Of the 43.6 ac (17.6 ha) of land needed for construction at the Naval Munitions Site, 39 ac (15.8 ha) is located within the Guam National Wildlife Refuge Overlay.

Naval Munitions Site Operations

Company-level patrolling, jungle training, land navigation, and air-ground operations will occur on 5 to 7 consecutive days, 12 weeks per year, day and night, for a total annual throughput at the Naval Munitions Site of 1,440 Marines. Sixteen events are authorized under the MIRC Biological Opinion (USFWS 2010, 96 pp.), the number of days and weeks described above represent an increase of training events per year due to the proposed project (revised total of 28 events per year). This site is rural and rugged and is currently designated as the Southern Land Navigation Area, supporting foot land navigation training primarily for special forces personnel (USFWS 2010, 96 pp.). Access to the Naval Munitions Site for training will occur via helicopter transport operations at proposed landing zones. Approximately eight CH-53 (heavy-lift transport helicopters) lifts will be required for a company-level training event. Personnel, hand-carried supplies, and equipment will typically be airlifted to the site on a Monday and lifted out on Friday of the same week. No other roads will be established and no vehicles will be used within

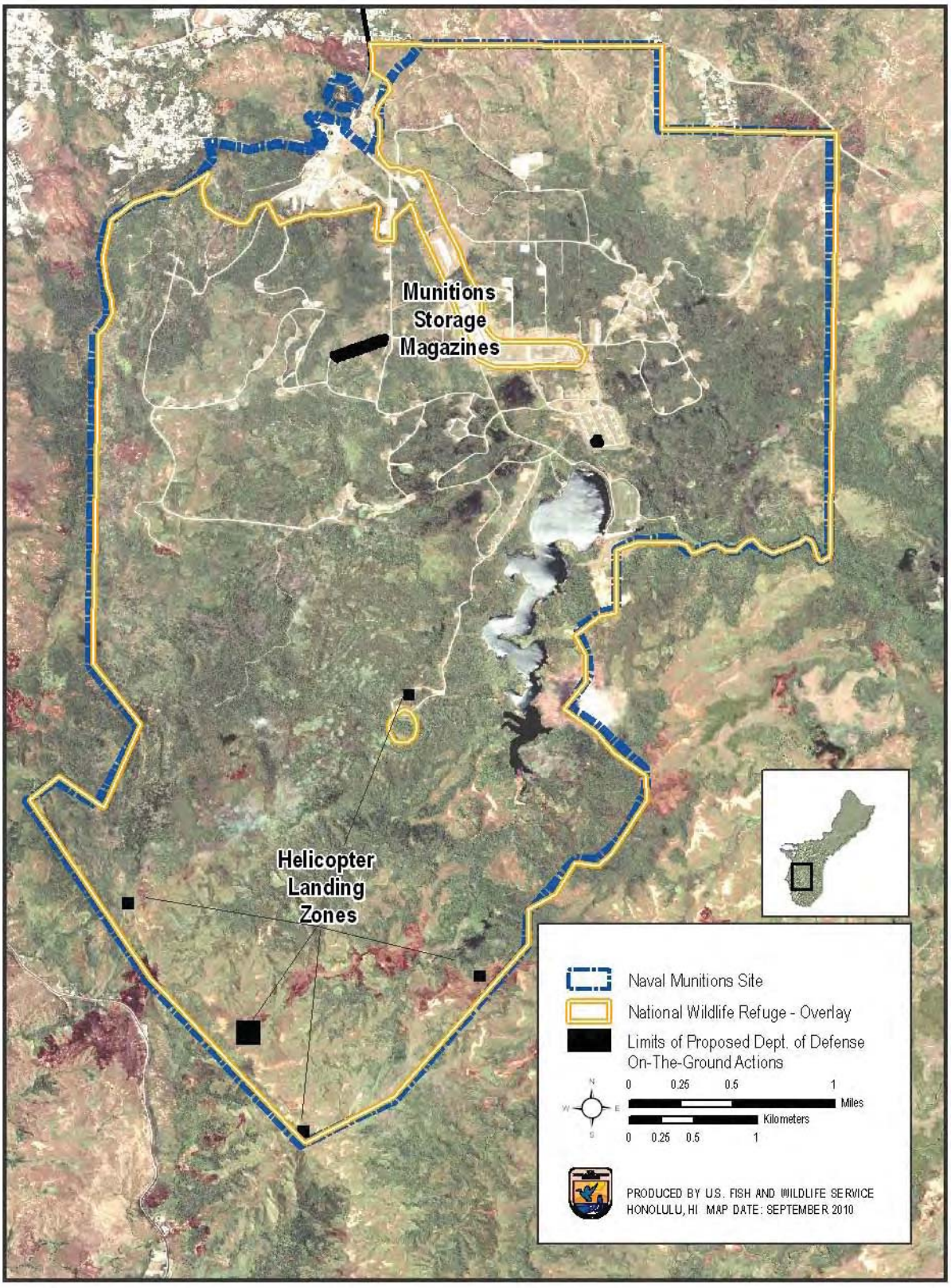

Figure 4. Project footprint for the proposed access road, helicopter landing zones and munitions storage facility at the Naval Munitions Site.

the training site. The access road will have an associated parking area that will be periodically mowed to allow for parking and to reduce fuel loading and potential for fires. Foot trails will be established within the southern portion of the Naval Munitions Site due to repeated use during maneuver training.

Terrain flight, ground threat reaction, defensive maneuvering, confined area landing, and external load training will occur at the Naval Munitions Site. No other training at the Naval Munitions Site is included in the proposed project. Terrain flights require a route with varying terrain for night flight with night-vision goggles, at 50 to 200 ft (15 to 61 m) above ground level. Training for terrain flights will occur only within the southern portion of the Naval Munitions Site, south of the southern extent of Fena Reservoir. Aircraft will leave Andersen Air Force Base and transit to southern Guam using standard military flight procedures (i.e., greater than 1,000 ft [305 m] above ground level). Aircraft may fly over land or over water on their way to the Naval Munitions Site. A typical training event may involve an aircraft leaving Andersen Air Force Base, moving to the east over the ocean, traveling along the coast at an altitude greater than 1,000 ft (305 m) until approximately the Talofofo River, and then flying up the river to the Naval Munitions Site still at an altitude equal to or greater than 1,000 ft (305 m). Flights may go up the Ugum River at altitudes of 1,000 ft (305 m) or greater above ground level until they reach 9,843 ft (3,000 m) from the mouth of the river at Highway 4 and then flights may conduct low-level terrain flights. Once the aircraft crosses into the Naval Munitions Site below Fena Reservoir (training restriction line), pilots will then be authorized to conduct low-level (50 to 200 ft (15 to 61 m) above ground level) terrain flights within the southern Naval Munitions Site. Low-level flights will not occur over the munitions bunkers, the main Naval Munitions Site, the area to the east of the munitions bunkers, over Fena Reservoir, or over the Almagosa Springs.

Ground threat reaction training requires a tactical flight maneuver area or route (similar to terrain flight routes) where ground-based electromagnetic radiation threat simulators may be placed. Defensive maneuvers are also conducted along a route over land or water. Differing helicopter types (AH-1, CH-53E, UH-1) and the MV-22 tilt rotor aircraft, will be used to conduct terrain flights, ground threat reaction, and defensive maneuvers training; however, terrain flights training operations are low altitude tactics and the ground threat reaction and defensive maneuvers training is conducted more in a tactical navigation area than along a route. Ground threat reaction is also low-altitude training like terrain flights, while defensive maneuver training is higher in altitude (equal to or greater than 1,000 ft [305 m] above ground level). Approximately 100 terrain flights, 94 ground threat reaction, 94 defensive maneuvers, and 1,104 maneuver lift flights per year will occur in the Naval Munitions Site.

Confined area landing training operations will also occur at the Naval Munitions Site. Confined area landing training consists of one pass of the landing zone for orientation, a downwind approach, followed by the landing, and takeoff. To meet qualification requirements, confined area landing training events typically will have five associated operations. Typically, a number of different, closely located landing zones, will be used during the training event. There will be approximately 125 confined area landing training operations per year at the Naval Munitions Site. Approximately 63 external load training operations will also occur at the Naval Munitions Site and are described under “Naval Base Guam Operations”.

Figure 5 delineates areas on Guam that will be impacted by project-related training and aircraft noise greater than 60 dB.

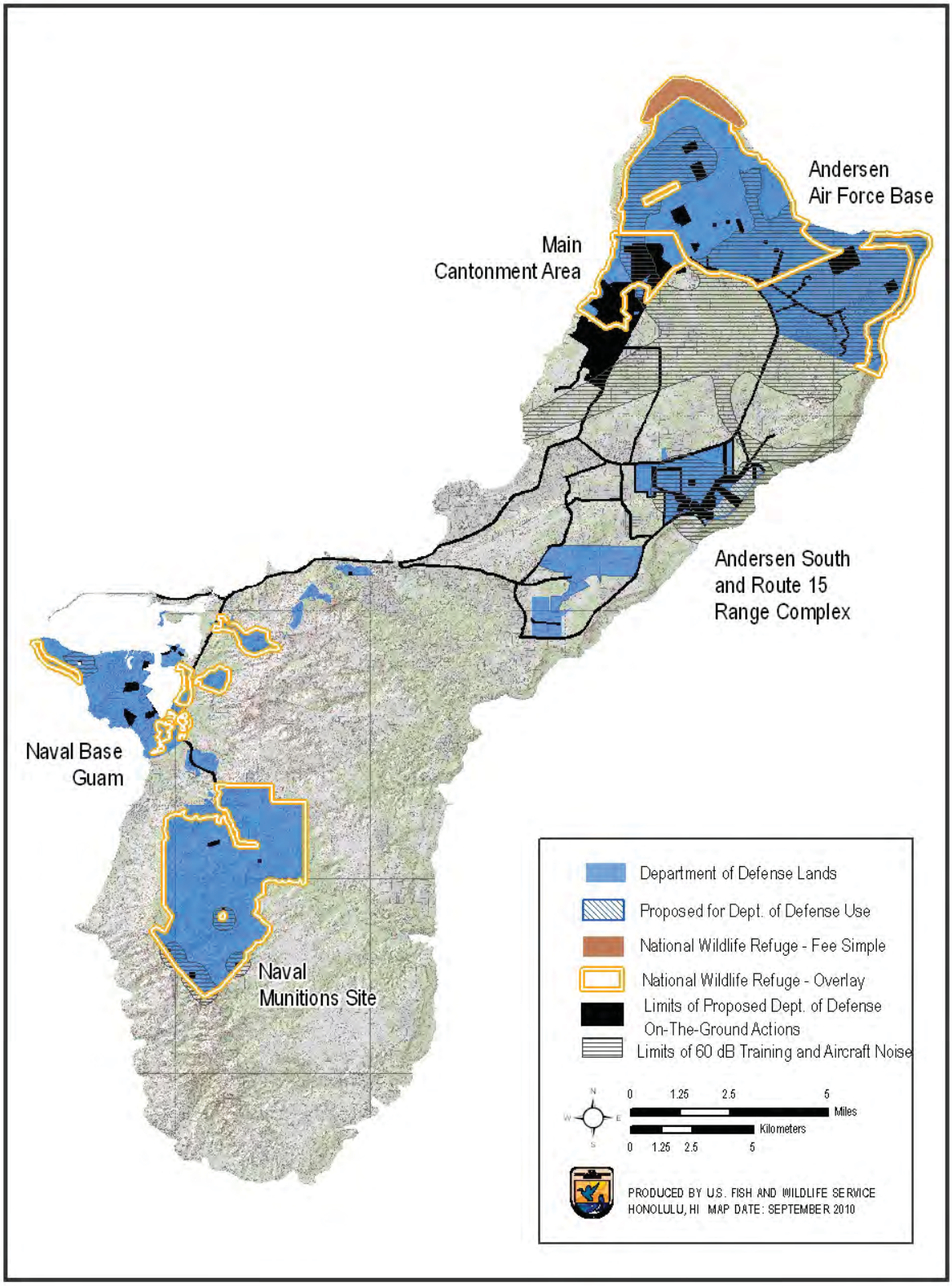

Figure 5. Anticipated project training and aircraft noise footprint (greater than 60 dB) on Guam.

Power Grid

To support the estimated power demands associated with implementation of the proposed action, up to five existing permitted Guam Power Authority turbines (Yigo, Dededo No. 1, Dededo No. 2, Marbo, and Macheche) will be upgraded and maintained by the Guam Power Authority to increase system capacity and support interim-load demands for DoD and civilian population requirements. In addition, there will be upgrades to existing transmission and distribution lines and the potential addition of new lines on existing structures. All ground-disturbing activities will occur in previously developed areas within existing power corridors and at existing power stations.

Wastewater

The proposed action may entail refurbishing and upgrading Guam's Northern District Wastewater Treatment Plant primary treatment capacity. The Guam Waterworks Authority or a private entity will accept the additional military buildup and civilian related flows and loads in the short term, with phased implementation of a long-term solution to construct a final wastewater facility with more advanced secondary treatment (as deemed necessary by the U.S. Environmental Protection Agency Region IX). Currently there are no plans to construct the wastewater treatment plant on DoD-controlled land. Therefore, it is anticipated that should the wastewater treatment plant require construction, the plant would be located on Government of Guam lands or private lands secured by the Government of Guam. In either instance Guam officials will control the underlying land use and permit decisions associated with the siting of such facility.

Although no direct military buildup will occur in central Guam under the proposed action, there is a requirement in a Stipulated Order issued to Guam Water Authority to refurbish the effluent pump station at the Hagatna wastewater treatment plant to address sewage overflows and non-compliance. This project has been delayed due to lack of funding, so DoD is negotiating with the Government of Japan to determine if they can finance the needed refurbishment to ensure the increase in wastewater flows from the construction workforce and the military buildup–induced population residing in the area can be accommodated. Buildup-induced population is the population growth that will occur from immigration to Guam because of new jobs that will support commercial and industrial activities on Guam (not including military, DoD civilians, their dependants or construction workers) (DoN 2010a, p. 16). In addition, there will be upgrades to existing wastewater collection lines on DoD property and the addition of new lines along existing corridors or within areas proposed for construction (e.g., proposed Main Cantonment) both on DoD property and off-base along existing Guam Water Authority utility easements that are addressed under those DoD proposed actions.

All other ground-disturbing activities will occur in previously disturbed areas within existing utility corridors. No other construction will occur in recovery habitat and none will be removed to upgrade or add transmission and distribution lines or the upgrade system capacity. Therefore, except as it pertains to conservation measures, we will not consider the wastewater upgrades further within this Biological Opinion.

Roadways

The proposed road projects on Guam will enable and improve roadway connectivity, capacity, and pavement strength for military construction and deployment in support of the proposed project. Some of these road projects will be funded by DoD pursuant to the Defense Access Roads program. The projects that are not funded will be the responsibility of the Government of Guam Department of Public Works or the Federal Highways Administration. Logistical routes for construction-related transport will connect the Port of Guam with Naval Base Guam, Andersen Air Force Base, the proposed Main Cantonment, the Naval Munitions Site, and existing concrete batch plants, rock quarries, and precast concrete panel fabrication sites associated with the military buildup on the island.

In addition to improvements to the construction routes, increased traffic associated with the presence of the military personnel and their dependents will require roadway modifications. As a result of the recent transportation and traffic studies on the island of Guam, 50 individual road projects have been proposed. These consist of 42 off-base projects and eight intersection improvement projects at military gates. The 42 off-base projects are comprised of five types of roadway projects: intersection improvements, bridge replacement, pavement strengthening (combined with roadway widening at some locations), roadway widening, and new road construction.

Thirty-five of these projects will either occur within previously developed areas of Guam such as residential and commercial areas, or they will not entail impacts to woody vegetation or other natural resources potentially utilized by listed species (for instance, pavement strengthening will not require any additional disturbance to areas outside of the existing roadbed). Because of their proximity to the proposed Main Cantonment area, the improvements to Naval Computer and Telecommunications Station Finegayan to Route 9, and a new commercial gate at Naval Computer and Telecommunications Station Finegayan, are considered to be within the proposed Main Cantonment area below. Roadway relocation and realignment for Route 15 is evaluated described in the Andersen South section of this Project Description. A new road will be constructed in the proposed Main Cantonment area and these impacts are included in the Main Cantonment section. Route 3 to Andersen Air Force Base North gate and Andersen Air Force Base North gate to Route 1 (Main Gate) are described under Andersen Main Base. The remaining two projects, Agana Bridge 1 Replacement and Four Bridge Replacements (Atantano, Laguas, Sasa, and Fonte), occur along Route 1 and have the potential to impact wetland habitat. None of these are within the Guam National Wildlife Refuge Overlay. The Atantano wetlands are secondary habitat as identified in the recovery plan for the Mariana common moorhen (USFWS 1992, p. 5-10). Conservation measures have been included to ensure wetland habitat function and value are not altered.

2.1.2 CONSTRUCTION AND OPERATIONS ON TINIAN

Tinian Construction

The construction of four new ranges (platoon battle course, automated combat pistol and multipurpose firearms qualification course, rifle known distance range, and field firing range)

and associated infrastructure (e.g., assembly and briefing areas, parking, portable sanitary facilities) will occur on Tinian (Figure 6). No construction is needed to accommodate the controlled access points, range flags, or surface danger zone observation points.

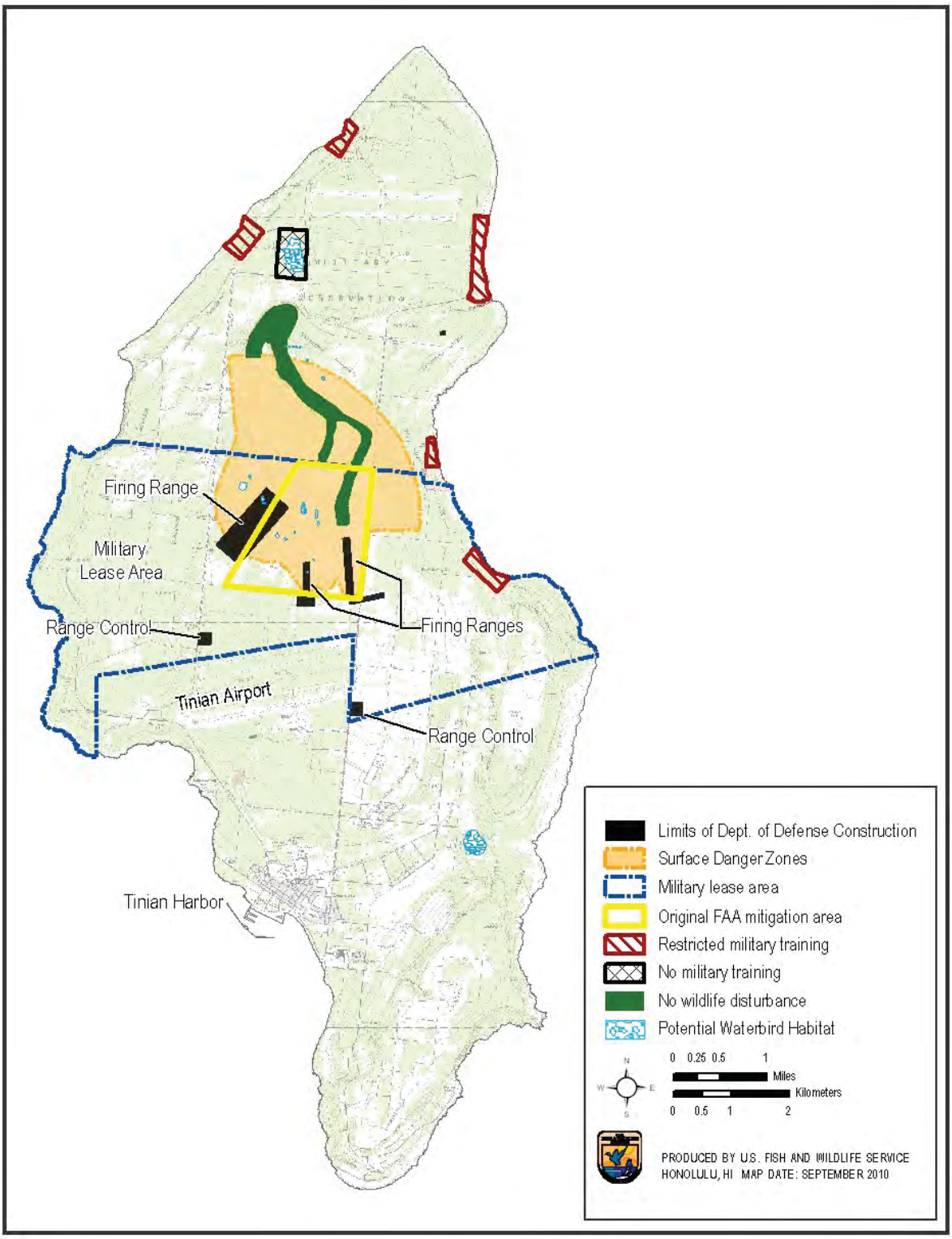

Figure 6. New training ranges and range control facilities proposed on Tinian.

Approximately 241 ac (98 ha) of vegetation will be cleared to accommodate the new training ranges. Currently, 176 ac (71 ha) of mixed introduced forest, 62 ac (25 ha) of other shrub and grass, 2 ac (1 ha) of tangantangan, 1 ac (0.4 ha) of urban/built-up, and 0.3 ac (0.1 ha) of native limestone forest occur within the project clearing footprint.

The biological assessment (DoN 2010a) identified 0.3 ac (0.1 ha) of potential wetland habitat within the footprint of the platoon battle course. After additional investigation, the depressions were determined to be sinks rather than seasonal wetlands and no wetland vegetation or soils were present. However, the DoN will work with planners to avoid sighting the footprint of the platoon battle course within the area of potential wetlands.

Construction will typically occur between 6 a.m. and 5 p.m. Heavy equipment will be used on all project sites to clear and grade to prepare sites for building construction.

Construction of the proposed Tinian ranges, including a 328-ft (100-m) buffer around each range footprint, will result in the disturbance to 241 ac (98 ha) of vegetation within a mitigation area established by the FAA, leaving 675 ac (273 ha) of this FAA mitigation area remaining.

Training Ranges - Tinian

The proposed action includes live-fire weapons training in the Tinian Military Lease Back Area. Training will occur at the platoon battle course, and automated combat pistol and multipurpose firearms qualification course, a rifle known distance range, and a field firing range. All training will be considered "expeditionary," in that the Marines will bring all necessary equipment to the ranges (including supplies and ammunition), bivouac onsite, and remove all equipment following completion of the training activities. Tracers or fire igniting devices may be used on Tinian ranges. The transport of 200 to 400 Marines to Tinian from Guam for the proposed one week per month company-level training exercises will be via aircraft between Andersen Air Force Base and Tinian International Airport.

The following procedures will be in place prior to personnel arrival on Tinian:

a) Training activity will be scheduled and notice provided in newspapers or otherwise posted at least one week prior to training event. The focus of the public notice efforts will be on Tinian and Saipan.

b) Biosecurity training will be completed through informal coordination with Service, USDA, Guam Division of Aquatic and Wildlife Resources and CNMI Division of Fish and Wildlife, through the regional training authority one week prior to the training event. All materials, equipment (including personell and vehicles), and supplies will be inspected less than 48 hours prior to departure and loaded onto the aircraft. If necessary, inspected equipment may be stored in a "clean" area up to 48 hours, prior to departure. An area is considered "clean" of brown treesnakes if the area is enclosed by a permanent or temporary snake barrier and successful snake suppression is in place.

c) Environmental and cultural resources briefings will be completed and aircraft and ships cargo will be inspected prior to departure from Guam following existing standard operating procedures.

d) Aircraft and ships cargo will be inspected prior to departure from Guam following existing standard operating procedures.

The following procedures will be in place after arrival on Tinian and prior to any movement or training begins:

a) Vehicles and equipment will be subject to brown treesnake inspection protocols on the airfield apron upon arrival.

b) All military related cargoes (construction and training equipment, vehicles, materials, and supplies) will be inspected by USDA APHIS and determined to be clean prior to leaving the quarantine and inspection areas for training on Tinian.

Construction Implementation at all Sites on Tinian

Rifle Known Distance Range. The 5.56 mm rifle known distance range will be used to train personnel on the skills necessary to identify, engage, and hit stationary targets in a static array from a known distance.

Automated Combat Pistol/Multipurpose Firearms Qualification Course. This range will be designed to meet training and qualification requirements with 9 mm and .45 caliber weapons (combat pistols and revolvers) and used to train and test personnel on the skills necessary to identify, engage, and hit stationary infantry targets.

Platoon Battle Course. The platoon battle course will be used to train and test platoons, either mounted or dismounted, on the skills necessary to conduct tactical movement techniques, detect, identify, engage, and defeat stationary and moving armor and infantry targets in a tactical array. Targets will not be fully automated and will not have the capability to execute computer driven or scored training scenarios. This course will provide the capacity for small units up to approximately 40 personnel to train in tactical scenarios, engaging targets at varying distances and angles while moving. Weapons that will be used on this range are those found at the platoon level, which are 5.56 mm carbines and rifles and squad automatic weapons (i.e., M249 light machine gun).

Field Firing Range. This range will be designed to support training target engagement techniques with the rifle, including identifying, engaging, and hitting stationary infantry targets. This will be a scored range with automated targets for use with the 5.56 mm rifle, but also will be suitable for the M4 carbine and squad automatic weapons (i.e., M249 light machine gun).

Activities within the Range Footprint. All firing of weapons occurs within the range footprint as defined. Within this space, ground disturbing activities may take place to maintain line of sight between firing points (i.e., location where weapons are discharged) and targets, and to place

target mechanisms below ground level for protection. Bullet backstops, usually of earth, are located behind the targets. Access ways are maintained to the targets for small vehicles for installation and retrieval of target mechanisms after use. Grading may be required during initial construction, to provide lines of sight, depending on the terrain. To properly maintain the range berms, which capture expended munitions, the Marine Corps will periodically shut down the range, to clear it of expended munitions.

Grass cutting and landscape maintenance is required to keep range lines of sight and access intact, but does not usually require the entire site be cleared. A perimeter road may be built to also serve as a fire break. Other range maintenance will be periodically conducted, in accordance with all applicable regulations, by sifting the expended rounds from the soil on site, placing the soil immediately back on the berm, containing and transporting the expended rounds to a local recycling contractor or smelter. Soils will be monitored to ensure a neutral pH level (6 to 8) is maintained.

Table 6 provides an estimate of the annual range utilization under a typical range use scenario for each of the ranges proposed at Tinian based on maximum implementation of existing training requirements.

Table 6. Proposed daily and annual use of small arms qualification ranges on Tinian (DoN 2010b, vol. 3, p. 11-23).

Range	*Weapon*	*Ammunition Type*	*Typical Use Estimate*			*Ammunition Expenditure Estimates*		
			Crews or Personnel	*Hours*	*Days Per Yr*[a]	*Busy Day*[b]		*Annual*[d]
						Day	*Night*[c]	
Known Distance	Rifle	5.56 mm	100	8:00 -12:00 7:00- 9:00	80	12,000	0	960,000
Automated Combat Pistol/ Military Police Firearms Qualification	Pistol (M9)	9 mm	100	8:00-10:00 7:00- 9:00	60	3,750	1,250	300,000
	45	.45caliber	50	8:00-10:00 7:00- 9:00	20	3,750	1,250	100,000
Platoon Battle Course	Rifle	5.56 mm	120	8:00-4:00 7:00- 1:00	80	6,750	2,250	720,000
	SAW	5.56 mm	40	8:00-4:00 7:00- 1:00	80	2,250	750	240,000
Field Firing Range	Rifle	5.56 mm	120	8:00-4:00 7:00- 1:00	80	9,000	3,000	960,000
							Total	**3,280,000**

Legend: mm = millimeters; SAW = Squad Assault Weapon.

Notes:

[a] The figures for number of days of use are determined based on an estimated use of the ranges up to 16 weeks per year (1 week per month plus 1 additional week per quarter), 5 days per week. Range use would occur periodically throughout the year, with no predictably busy or non-use periods.

[b] Estimates based on the maximum number of shooters per day who could make use of each proposed range (calculated by multiplying the number of firing points or lanes by the number of firing relays), firing the number of rounds prescribed for a standard string of fire. This estimate is consistent with the ammunition allocation for the relocated Agreed Implementation Plan units.

[c] Night refers to non-daylight hours that are generally 7:00 p.m. – 6:00 a.m. on Tinian.

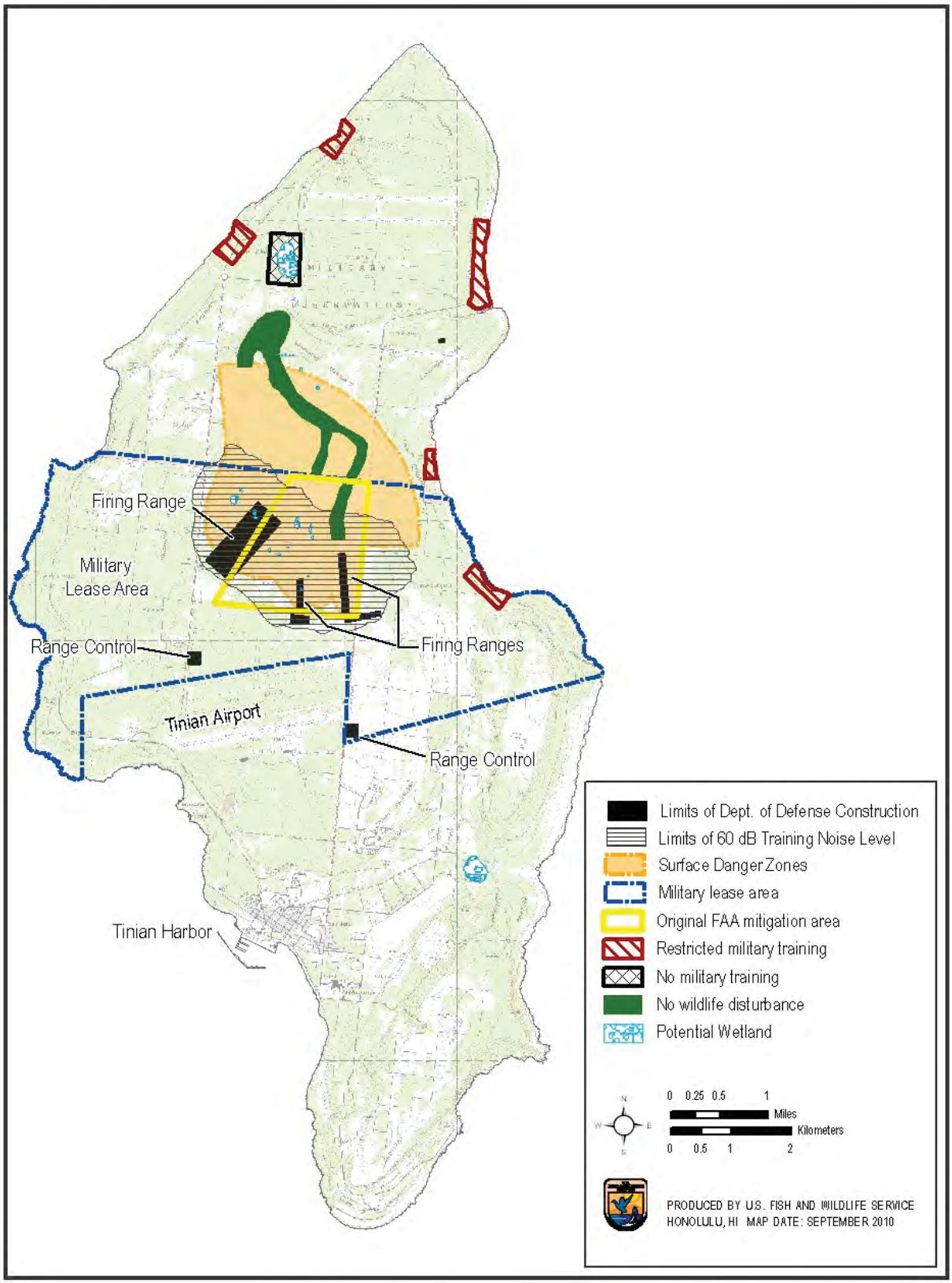

Figure 7. Noise footprint for proposed live-fire training exercises on Tinian.

The ranges as proposed will be used by up to 400 military personnel at a time. Ranges will primarily be used during daylight hours; however, some training is required during nighttime hours, typically between the hours of 7 p.m. and 6 a.m. Figure 7 delineates the approximate areas that will be impacted by noise resulting from weapons use at the training ranges.

Activities outside the Range Footprint on Tinian. Outside the range footprint, activities will include those required for assembling the personnel undergoing training, parking vehicles, issuing ammunition, and passing orders and instruction. A typical one-week long training exercise on Tinian will entail 200 to 400 personnel flying to Tinian, transporting any larger items via barge, setting up a billeting area within the Military Lease Area, and traveling each day by foot or bus to the firing ranges. Sanitary facilities will be provided through portable means. Range targets will be operated on batteries, but a portable range generator or solar-battery system may be utilized to operate the tower. For safety reasons, the public will be excluded from areas within the surface danger zones while training is being conducted.

The range training area will need to be secured and cleared of non-participating personnel during live-firing to avoid the potential for injury from ricochet or misdirected shots. Therefore, range flag poles (on which red flags will be flown during range operations), and controlled access points will be established to allow closure of land access to all or portions of the range training area and associated surface danger zones, depending on the firing conditions. Guards will be stationed on perimeter roads to form controlled access points and range control personnel will survey the area for unauthorized people. No facilities or ground-disturbing activities are required for establishment of the range flags, controlled access points, or range observation points.

The transport of 200 to 400 Marines to Tinian from Guam for the proposed one week per month company-level training exercises will be via aircraft between Andersen Air Force Base and Tinian International Airport. If equipment is moved by barge, a single barge will be able to carry the equipment necessary to support the training evolution. The DoN will utilize the existing single individual and canine conducting all brown treesnake interdiction activities on Tinian. The current brown treesnake interdiction quarantine facility is surrounded by a typhoon proof snake barrier. This facility is adequate for the current import rate of cargo proposed for movement onto Tinian. All military related cargoes (construction and training equipment, vehicles, materials, and supplies) from the proposed project will be inspected by USDA APHIS and determined to be clean prior to leaving the quarantine and inspection areas for work or training on Tinian and for shipment off Tinian.

2.1.3 INTERRELATED AND INTERDEPENDENT CIVILIAN ACTIONS

Housing, infrastructure, and facilities for that are indirectly related to the proposed action are addressed in this section. The acquisition of the Route 15 range area, resulting in the relocation of the Guam International Raceway, as well as the relocation of cattle leases in areas slated for development of firing ranges on Tinian are also interrelated to the proposed action.

Temporary Workforce Housing

The Guam Land Use Commission recently issued a new resolution which specifically addresses zoning for temporary workforce housing and requires all temporary workforce housing to be placed in areas designated at "light industrial" (Guam Land Use Commission 2009, 12 pp.). Housing capacity for 2,000 to 18,000 temporary construction workers was approved in April 2010 for a 250-ac (101-ha) parcel in North Tumon, near Two Lovers Point. Although the parcel was previously disturbed, intact limestone forest occurs on the sites adjacent to the planned housing area. Existing housing and housing which could be retrofitted on and off installations in northern and southern Guam are also likely to be used (Table 7).

Table 7. Anticipated locations for temporary construction worker housing (DoN 2010b, vol. 2, p. 16-89).

	Guam Land Use Commission Case #	*Applicant*	*Legal Lot Description*	*Municipal District*	*Location*	*Current Zone*	*Status*	*Capacity (people)*
1*	2009-56	Younex Enterprises, LLC	L10184 & L5039	Dededo / Tamuning	North	"M-1" (Light Industrial)	Approved by GLUC 10/29/2009	18,000
2	2010-22B	Pacific Int. Guam Inc.	L7024-R5	Yigo	North	"A" Rural	Currently being processed	1,176
3	2009-093B	DDT Konstract	L5224-6-2	Barrigada	Central	"A" Rural	Approved by GLUC 4/8/2010	390
4	2009-78	Black Construction Corp.	L5161-1-1 & -1-R15	Tamuning	Central	"M" (Light Industrial)	Approved by GLUC 2/25/2010	1,200
5	2009-94	S.K. Construction Inc.	L5106-5-NEW	Tamuning	Central	"M" (Light Industrial)	Currently being processed	350
6	2010-18	Chugach World Services Inc.	L5148-REM-EAST-1	Tamuning	Central	"M" (Light Industrial)	Currently being processed	696
7	2010-19	Core Tech International	L2103-1A-1	Tamuning	Central	"M" (Light Industrial)	Currently being processed	856
8	2008-53	Bob Salas	L3462 &3474	Mangilao	Central	"A" Rural	Currently being processed	64
9	2008-72	Bascon Corp.	L3278-2	Ordot	Central	"R-1" (Single-Family Dwelling)	Currently being processed	30
								22,762

Development of Housing, and Facilities: Non-Construction Worker Civilians

During the construction period, an anticipated estimated 16,988 off-island workers will move to Guam to fill non-Federal, non-construction jobs, such as teachers and food service workers in areas adjacent to development of construction worker housing. The DoN refers to this population increase as "indirect" or "induced" growth (Table 8).

In addition to the construction worker and indirect or induced jobs associated with the construction period, approximately 22,968 Federal jobs will be created on Guam, of which 1,836

will be filled by civilian Federal employees (DoN Briefing, March 8, 2010). After construction is completed, the service industry and other support jobs will shrink to a level of approximately 4,482 individuals. The 1,836 civilian Federal employees (and their dependents) and the 4,482 non-Federal employees (and their dependents) will live in areas outside the installations for the duration of project implementation.

Table 8. Anticipated human population increase on Guam resulting from the proposed project (DoN 2010b, vol. 1, page ES – 8).

	2010	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*	*2020*
Direct DoD Population[1]											
Active Duty Marine Corps	510	1,570	1,570	1,570	10,552	10,552	10,552	10,552	10,552	10,552	10,552
Marine Corps Dependents	537	1,231	1,231	1,231	9,000	9,000	9,000	9,000	9,000	9,000	9,000
Active Duty Navy[2]	0	0	0	0	0	0	0	0	0	0	0
Navy Dependents	0	0	0	0	0	0	0	0	0	0	0
Active Duty Army	0	50	50	50	50	630	630	630	630	630	630
Army Dependents	0	0	0	0	0	950	950	950	950	950	950
Civilian Military Workers	102	244	244	244	1,720	1,836	1,836	1,836	1,836	1,836	1,836
Civilian Military Worker Dependents	97	232	232	232	1,634	1,745	1,745	1,745	1,745	1,745	1,745
Off-Island Construction Workers (DoD Projects)[3]	3,238	8,202	14,217	17,834	18,374	12,140	3,785	0	0	0	0
Dependents of Off-Island Construction Workers (DoD Projects)	1,162	2,583	3,800	3,964	4,721	2,832	1,047	0	0	0	0
Direct DoD Subtotal	**5,646**	**14,112**	**21,344**	**25,125**	**46,052**	**39,685**	**29,545**	**24,713**	**24,713**	**24,713**	**24,713**
Indirect and Induced Population											
Off-Island Workers for Indirect/Induced Jobs[3]	2,766	7,038	11,773	14,077	16,988	12,940	6,346	4,346	4,346	4,482	4,482
Dependents of Off-Island Workers for Indirect/Induced Jobs	2,627	6,685	11,184	13,373	16,138	12,293	6,028	4,372	4,372	4,413	4,413
Indirect/Induced Subtotal	**5,393**	**13,723**	**22,957**	**27,450**	**33,126**	**25,233**	**12,374**	**8,718**	**8,718**	**8,895**	**8,895**
Total Population	**11,038**	**27,835**	**44,301**	**52,575**	**79,178**	**64,918**	**41,919**	**33,431**	**33,431**	**33,608**	**33,608**

Notes: [1] DoD population includes military personnel, DoD civilian workers and dependents from off-island.
[2] The Navy rows do not include increases from the transient presence of aircraft carrier crew with its CSG.
[3] Population figures do not include Guam residents who obtain employment as a result of the proposed actions.

Civilian employees and the longer-term induced jobs will be situated in a manner more closely related to the current civilians whose move to Guam was military-related (U.S. Census Bureau, 2000). The geographic distribution of the anticipated indirect/induced population increase resulting from the project is shown in Figure 8.

Additional jobs will be created as an indirect result of the construction period staffing buildup. They include public service workers such as teachers as well as restaurant and other service industry positions. As the DoD facilities are constructed, jobs for permanent DoD civilian employees will be filled (refer to Table 8).

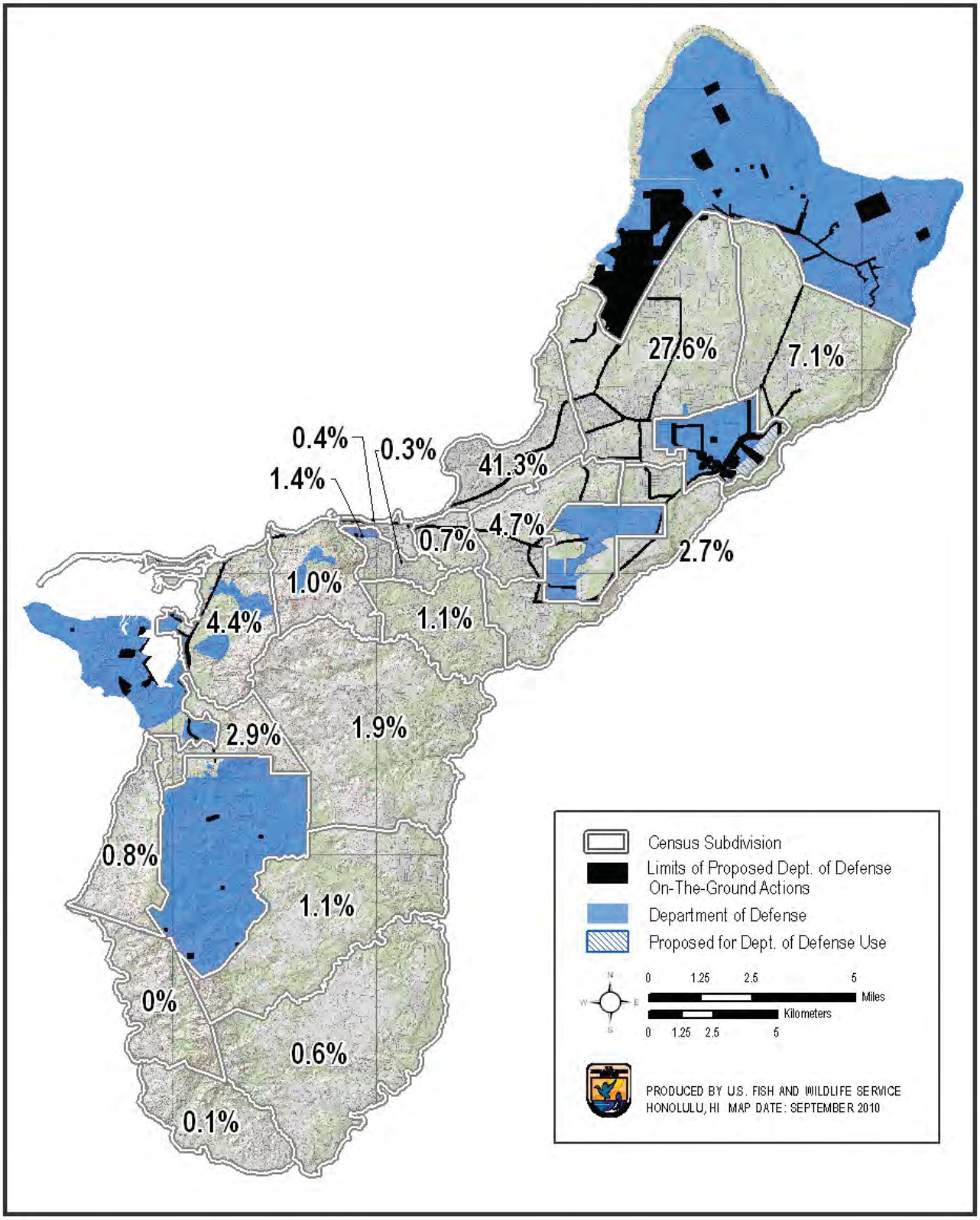

Figure 8. Estimated geographic distribution of the indirect/induced human population increase resulting from the project, derived from information in Table 8 and U.S. Census Bureau (2010) data.

Relocation of the Guam International Raceway

Acquisition of private and Chamorro Land Trust and the Ancestral Lands Commission lands will be necessary for DoD's development of the Route 15 Range Complex. A non-profit organization operates the Guam International Raceway on the northernmost portion of the proposed training range complex. In the event DoD acquires or leases the land, the Guam International Raceway would have to decide whether to continue operation in another location. If it continues operations it may be eligible for relocation assistance from DoD pursuant to the Uniform Assistance and Real Property Acquisition Polices Act of 1970. If eligible, DoD would provide relocation assistance in the form of advisory services, and some specific financial assistance related to a move, but would not fund the physical relocation of the operations of the Guam International Raceway. Selection of any new raceway location would be subject to land use decisions by the Government of Guam. Should the Guam International Raceway decide to continue operations at an alternate location and be eligible for relocation assistance from DoD, DoN will work with Government of Guam land use and natural resource officials to ensure that project impacts to recovery habitat are minimized in any relocation effort.

Solid Waste

Under the proposed action, the currently unimproved DoN Landfill at Naval Base Guam will be used until the new Layon Landfill is completed by Government of Guam in 2011. The proposed project will use the Layon Landfill and the DoN landfill for disposal of all DoD solid waste. The existing DoN Landfill has the potential for providing 10 years of capacity based on the computed demand, assuming a landfill height of 54 ft (16 m) and completion of minor operational improvements such as reducing the daily cover and using larger compaction equipment to achieve greater densities.

In northern Guam, new facilities will be constructed and existing facilities will receive increased use at Andersen Air Force Base, including the Northwest Field Naval Munitions Site, the proposed Main Cantonment area at Naval Computer and Telecommunications Station Finegayan, Naval Base Guam, Andersen South and the proposed Route 15 Range Complex. Construction and operational uses on each installation are described below, followed by information applicable to construction on all Guam installations and to the construction of infrastructure and utilities on and adjacent to the installations.

Relocation of the Tinian Cattle Leases

The DoN formerly proposed to terminate all subleases in the leaseback area to accommodate the new training ranges. To minimize impacts from terminating all subleases, the DoN has revised its Project Description and will only terminate subleases in the leaseback area that are within the footprint of the proposed ranges. The relocation of these leases will be under the control of the CNMI government as they are responsible for non-Federal land use decisions on Tinian.

2.1.5 CONSERVATION MEASURES TO MINIMIZE AND OFFSET PROJECT IMPACTS

The project's conservation measures are designed to avoid or minimize project impacts to listed species and their habitats or to contribute to the recovery of a listed species. The conservation measures include those that were proposed in the biological assessment and the Final EIS (including the best management practices (DoN 2010b vol. 7, pp 2-4 to 2-23) (duplicated in Appendix A of this Biological Opinion)). Highlights of these conservation measures, in addition to updated descriptions of conservation measures that were modified during the formal consultation period are described below. Conservation measures are considered part of the proposed action and they will be implemented in full. Any changes to, modifications of, or failure to implement these conservation measures may result in a need to reinitiate this consultation. Modifications to aspects of the conservation measures described, that provide protection equal to or greater than the protection afforded by the measure as it is proposed in this Project Description may be substituted for those provided in this Biological Opinion with the Service's written concurrence. The conservation measures will be implemented prior to or concurrent with construction unless otherwise stated.

General Conservation Measures to Contribute to the Recovery of Listed Species

1. The DoN conservation measures are intended to support re-introduction of native endangered or threatened species on DoD lands on Guam consistent with species recovery plans. In further support of such recovery efforts, the DoN intends to actively participate in recovery committees for endangered or threatened species on Guam. When the DoN and Service mutually agree the constraints to reintroduction of native threatened or endangered species on DoD lands on Guam have been minimized to a point that a feasible and successful re-introduction of the affected species is more probable than not, the DoN will work with the Service to develop a re-introduction plan and supporting programmatic biological opinion that ensures such re-introduction efforts are consistent with the species recovery plans and the military mission on Guam.

2. The DoN will fund the development and implementation (if determined feasible) of Guam Micronesian kingfisher introduction plan(s) on islands other than Guam. The DoN will work with the species experts, regulatory agencies and local governments to determine appropriate islands for a managed introduction with the goal of full release. In order for DoN to be able to fund the project, the island(s) shall be either U.S. territories or U.S. protectorates. The plan(s) will include selection of a minimum of one island for introduction with the goal of implementing actions on three suitable islands, identifying and controlling threats to endangered birds on each of these islands prior to introduction; habitat management, and specific introduction targets to ensure source populations are not harmed by removing birds while introducing birds in high enough numbers to contribute to self-sustaining populations. The management of introduced populations will be conducted by DoN-funded biologists. The introduction of a wild kingfisher population outside of Guam might be more viable than one reintroduced directly from captivity to Guam because it could be established in habitat that has not been compromised by brown treesnakes. The overall goal of the action is to develop three

self-sustaining populations that will complement captive populations and buffer captive and existing populations against stochastic events in the interim and long-term to allow for "wild" individuals to be reintroduced to Guam if and when native ecosystems on Guam are restored to support a viable population. Funds for planning and implementation will be released within 24 months of initiation of clearing affected recovery habitat within the proposed Main Cantonment. If this conservation measure is not feasible, DoN will work with the Service to develop a comparable conservation measure to benefit the Guam Micronesian kingfisher.

3. The DoN will hire two additional DoN biologists to implement conservation and recovery actions on Guam National Wildlife Refuge Overlay lands and ensure conformance with requirements within this Biological Opinion (DoN 2010a, p. 130). The DoN will meet with the Service (Ecological Services and Refuges) at the beginning of the fourth quarter of each fiscal year to review progress and mutually identify priorities and specific actions for the coming fiscal year. Actions should be targeted to on-the-ground conservation actions (or steps needed to prepare for on-the-ground actions) identified in Integrated Natural Resources Management Plans, recovery plans, five-year status reviews, Comprehensive Wildlife Conservation Strategy, or other actions identified as priorities for natural resources management. The job announcements for the DoN Overlay Refuge biologists will be provided to the Office of Personnel Management within six months of the start of construction actions within Guam National Wildlife Refuge Overlay. The two biologists are proposed because of the increased workload due to the new projects. Goals for the biologists include ungulate removal, forest enhancement, establishing fire management plans, etc.

4. DoN will ensure funding for two biologists on Rota for a 12-year period, beginning in FY11 to conserve the Mariana crow and the Mariana fruit bat. Initially the two biologists will be DoN contractors and as soon as possible DoN will work with Office of Management and Budget to ensure a budget-based transfer is completed to enable the Service to fund two Senior Fish and Wildlife Biologists (e.g., Service Fish and Wildlife Biologists with experience implementing complex projects; experience in the CNMI/Guam and familiarity with threatened and endangered species in the Pacific Islands) for the remainder of the 12-year period.

5. The DoN will hire two DoN Conservation Law Enforcement Officers to increase security on DoN lands and prevent poaching. The DoN will sign a Memorandum of Agreement such that these law enforcement officers can assist Service law enforcement officers (on Guam and all islands within the CNMI) with violations under the Act, Lacey Act, Migratory Bird Treaty Act, and Convention on International Trade in Endangered Species (CITES). The DoN will hire the two law enforcement officers within the first two years after the initiation of construction within recovery habitat in the proposed Main Cantonment area or Andersen Air Force Base as this is when large fluxes in population will begin to occur (DoN 2010a, p. 16). Ongoing objectives will include elimination of poaching on DoD land.

6. To assist in understanding long-term trends in habitat and vegetation on Guam and Tinian, the DoN will re-evaluate and re-structure the existing vegetation monitoring and anchor points that have been established on Guam and Tinian to provide information necessary for long-term habitat monitoring associated with DoD natural resources management efforts (DoN 2010a, p. 135). The purpose of the vegetation monitoring is to track the effects of ungulate removal, identify potential invasive plants and document the effects of training on the vegetation. This has been an ongoing project. The monitoring locations will change as a result of the project and subsequently through adaptive management. Construction areas and trails used during training will be monitored. If incipient populations of invasive species are detected, an eradication strategy will be developed and implemented.

7. The Ungulate Management Plan will be finalized by the DoN for DoD lands on Guam to include specific management and control of ungulates. The objective of the Ungulate Management Plan (in progress) is to improve habitat quality for special status species, reduce erosion, and reduce habitat degradation on DoD lands. Implementation of the plan will begin within one year of plan finalization (DoN 2010a, p. 129). The Service will be provided a 30-day period, from the date of receipt of the draft Ungulate Management Plan, to provide comments and recommendations for the DoN's consideration. The initial phase of management will entail significant effort; sustained maintenance and control will require less ongoing effort.

8. To develop a better understanding of baseline populations and long-term ecological processes of sea turtles in the waters of Guam, Saipan, Tinian and Rota, the DoN in conjunction with relevant Federal resource agencies will develop and implement a joint investigation on sea turtle population abundance estimates, demographic information, near-shore habitat use, baseline populations, and long-term population parameters (DoN 2010a, p. 134). The DoN funded study is proposed to include a long-term foraging habitat and mark-recapture program combined with laparoscope examinations to acquire necessary abundance estimates as well as growth, reproductive status, and sex ratio information essential for adequate population demographic modeling. A long-term, in-water study will provide valuable information regarding near-shore foraging habitat use, and combined with applied research techniques including sonic (or acoustic) tags, satellite telemetry, and genetic analysis will provide greater insight into foraging ecology, migratory movements and connectivity of sea turtles within the greater Western Pacific region. This measure will begin within the first two years of construction activities (DoN 2010a, p. 16).

Site-Specific Conservation Projects: Outdoor Recreation Area, Ecological Reserve Areas, and Habitat Restoration

DoN will implement the following conservation projects on Guam:

1. The DoN will establish an outdoor recreation area at the proposed Main Cantonment area to protect native vegetation and will limit recreation to designated trails, picnic tables, interpretive panels, benches, and barbeque pits. The area will also serve to direct recreation away from sensitive habitats near and within the Haputo Ecological Reserve Area (i.e., beaches, cliffline forests). Designated trails will be in place and off-trail training or recreation may not be allowed. Recreation is intended to be passive and not alter the habitat such that it would become unsuitable for supporting listed species. Development of the outdoor recreation area will begin within one year of initiation of construction on the proposed Main Cantonment area or Andersen Air Force Base. The outdoor recreation area will be implemented prior to new training within the Proposed Main Cantonment.

2. Four proposed Ecological Reserve Areas, a Route 15 Range Conservation Area, and proposed wetland and forest restoration project areas, shown in Figure 9, are summarized by installation, below.

<u>Andersen Air Force Base</u>

1. The DoN will submit a proposal to create the Ritidian Point Ecological Reserve Area to protect native limestone forest habitats in northern Guam that are recovery habitats for the Mariana crow, Guam Micronesian kingfisher, Mariana fruit bat, and *Serianthes nelsonii*. The Ritidian Point Ecological Reserve Area is proposed to be contiguous with and incorporate the areas protected under the ISR Strike Biological Opinion (USFWS 2006a, 73 pp.) and Northwest Field (USFWS 2006b, 7 pp.) consultations. Long-term management of the Ecological Reserve Area will be added to the Integrated Natural Resources Management Plan. By incorporating the previous mitigation areas into the Ritidian Point Ecological Reserve Area, this measure will ensure compliance with the prior consultations as the mitigation areas have not been formally designated as protected. The entire Ritidian Point Ecological Reserve Area will be approximately 781 ac (316 ha) of habitat for listed species, of which 601 ac (243 ha) were required by the ISR Strike Biological Opinion and Northwest Field consultations. This proposal to designate an area as an Ecological Reserve Area will be initiated no later than six months from start of construction associated with the proposed action. If the submitted proposal is not approved, DoN will work with the Service to develop an alternate conservation measure (or measures) to provide equal or greater conservation benefit.

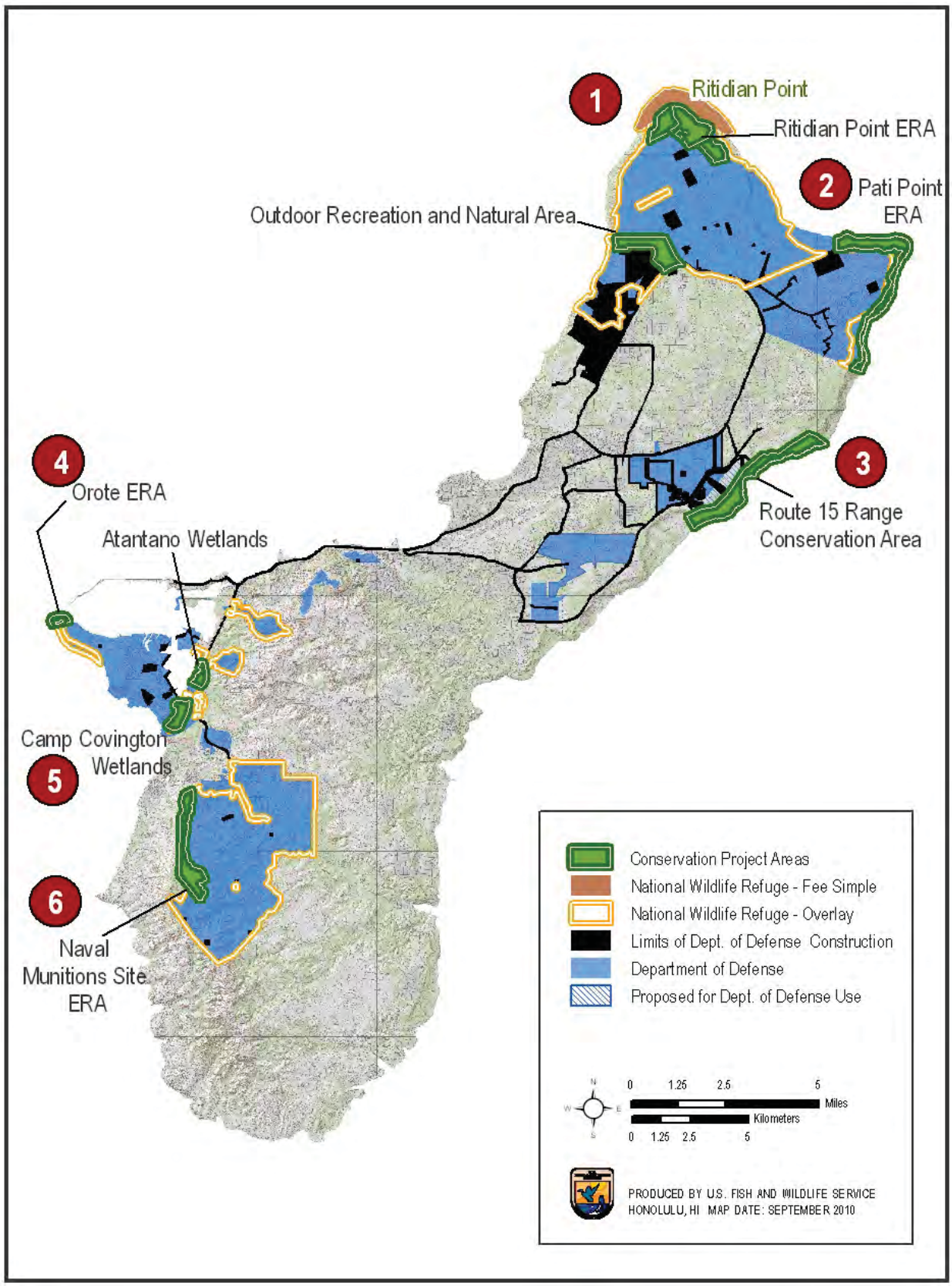

Figure 9. Proposed Ecological Reserve Areas and wetland restoration project sites.

2. The DoN will submit a proposal to Chief of Naval Operations N45 to create the Pati Point Ecological Reserve Area to protect native limestone forest habitats in northern Guam which are recovery habitats for the Mariana crow, Guam Micronesian kingfisher, *Serianthes nelsonii,* and Mariana fruit bat. The new Ecological Reserve Area is proposed to include approximately 713 ac (289 ha) of habitat for listed species and will be situated in an area previously designated as the Pati Point Natural Area and it lies within the Guam National Wildlife Refuge overlay. This measure will be implemented prior to any clearing or construction related to the potable water system, air mobility campus, air embarkation area, or the air combat element, or when flight operations under the proposed action increase (anticipated 2014, DoN 2010a, p. 62), whichever comes first. If the submitted proposal is not approved, DoN will work with the Service to develop an alternate conservation measure (or measures) to provide equal or greater conservation benefit.

3. The DoN will fund research on the Mariana fruit bat. The long-term goal is to develop guidelines to be used in recovery and sustainable management of fruit bats on different islands. Research will include, but is not limited to, demographic information used in population viability analysis (age of sexual maturity, timing and frequency of births, survivorship, longevity, adult and juvenile dispersal and frequency of inter-island movements); carrying capacity (quantification of habitat quality, density by habitat type, and habitat availability); island-wide population surveys throughout the range; estimates of predation by brown treesnakes and hunters; identification of any other population-limiting factors (DoN 2010a, p. 135). This project will be funded within one year of clearing or construction related to the potable water system, air mobility campus, air embarkation area, or the air combat element, or when flight operations under the proposed action increase (anticipated 2014, DoN 2010a, p. 62), whichever comes first.

Andersen South and Route 15 Range Complex

To the maximum extent practical, the DoN will coordinate with the Government of Guam to conserve the limestone forest habitat on Government of Guam lands spanning from the area east of the proposed ranges on Route 15, north, to the Government of Guam's existing Anao Conservation Area. The area is zoned as "Park/Open Space" in the North and Central Guam Land Use Plan (Government of Guam, 2009 pp. 2-14). These lands are recovery habitat for the Mariana crow, Guam Micronesian kingfisher, *Serianthes nelsonii*, and Mariana fruit bat. The intention is to develop a continuous band of protected area from the Andersen Air Force Base at the Pati Point Ecological Reserve Area through Government of Guam's Anao Conservation Area south to the proposed Route 15 Range Complex. This will involve working with Government of Guam to designate the Anao Conservation Area as protected in perpetuity and then developing a Cooperative Agreement or Memorandum of Understanding on joint natural resources management to benefit listed species and their habitats in the entire area. The proposed conservation area will be approximately 850 ac (344 ha) of habitat for listed species in addition to the Anao Conservation Area. Coordination will be initiated prior to any proposed construction on Andersen South or Route 15. If the submitted proposal is not approved, DoN

will work with the Service to develop an alternate conservation measure (or measures) to provide equal or greater conservation benefit.

Naval Base Guam

1. The DoN will submit a proposal to Chief of Naval Operations N45 to expand the existing Orote Ecological Reserve Area to encompass Orote Island (seabird nesting habitat), Adotgan Point, and the Spanish Steps area that supports sea turtle nesting (DoN 2010a, p. 125) on Naval Base Guam. The expansion will add approximately 32 ac (13 ha) of terrestrial habitat to the Orote Ecological Reserve Area. The proposal for the expansion of the Ecological Reserve Area will be initiated within the first year of construction activities at Naval Base Guam. If the submitted proposal is not approved, DoN will work with the Service to develop an alternate conservation measure (or measures) to provide equal or greater conservation benefit.

2. No proposed project related construction or training actions will occur at the Camp Covington wetlands (DoN 2010a, p. 130). A restoration plan will be developed for the Camp Covington wetlands in an effort to increase suitable habitat for the Mariana common moorhen. If Camp Covington is deemed unsuitable for wetland enhancement or restoration, the Atantano wetlands will be evaluated for restoration potential. The wetland enhancement will begin concurrently with the new aviation training (i.e., Terrain Flights) over the Talafofo River basin and the Naval Munitions Site. This measure will also be implemented prior to highway improvements to bridges along Route 1 or training in the southern Naval magazine from the proposed project, whichever occurs first. If neither wetland is deemed suitable for restoration, the DoN will work with the Service to develop an alternate conservation measure (or measures) to provide equal or greater conservation benefit.

Naval Munitions Site

1. The DoN will submit a proposal to Chief of Naval Operations N45 to create the Naval Munitions Site Ecological Reserve Area to conserve native limestone forest habitats in southern Guam which are recovery habitats for the Mariana crow, Guam Micronesian kingfisher, and Mariana fruit bat (DoN 2010a, p. 125). The new Ecological Reserve Area will be added to the Integrated Natural Resources Management Plan. The proposed Ecological Reserve Area will encompass approximately 553 ac (234 ha) of habitat for listed species. This measure will be initiated prior to initiation of project related construction or training in the southern Naval magazine, whichever occurs first. If the submitted proposal is not approved, DoN will work with the Service to develop an alternate conservation measure (or measures) to provide equal or greater conservation benefit.

2. The DoN will implement forest enhancement and restoration in the Naval Munitions Site. A minimum of 8.9 ac (3.6 ha) will be restored. Enhancement and restoration will occur in areas contiguous with existing recovery habitats to increase the overall amount of recovery habitat within southern Guam. A forest restoration and

enhancement plan will be prepared by a qualified forester/plant ecologist who has knowledge of Guam's forest ecosystems. The goal of the forest enhancement is to increase the habitat suitability for native wildlife species. Forest enhancement and restoration will begin prior to implementation of any construction or training activities in the Naval Munitions Site and will follow the guidelines below.

In savanna areas, forest restoration and enhancement will include non-native species eradication or control and:

a) establish greenbelts of *Acacia* spp. to fix soil nitrogen, build soil quality, and limit the spread of wildland fires;

b) extend greenbelts to become contiguous forest areas with recovery habitats;

c) underplant *Acacia* spp. with native species; and

d) reduce *Acacia* spp. after native species are established.

3. On Overlay Refuge lands and adjacent DoD lands the objective would be to achieve and maintain low numbers of non-native feral mammals (cats, (*Felis catus*), dogs (*Canus lupus*), and ungulates).

4. The DoN will work with the Government of Guam to investigate the feasibility of restoring habitat within the Bolanos Conservation Area. If habitat restoration is determined to be feasible, the DoN may choose to restore habitat such that over the long-term it is restored into recovery habitat.

5. If the DoN decides that additional restoration is feasible, the DoN will work with the Service to develop a recovery crediting program (or similar assurances) for these sites, if applicable.

Site-Specific Conservation Measures to Minimize Impacts of Construction and Training on Guam and Tinian

1. Due to environmental, biological, cultural, or safety factors, there must be flexibility to where each individual facility is physically located within the project footprint. Within a project area footprint as described above in the Project Description, construction will occur within the limits of construction shown in the Project Description's figures. As site specific plans for construction projects are developed, to the maximum extent practical, the DoN will minimize overall habitat loss, within these limits of construction, by incorporating language and a map into the site plans that identifies environmentally sensitive areas. DoN will further encourage contractors to avoid or minimize their impacts. Under no circumstances shall equipment or personnel move outside the designated construction zone (including staging areas) and into native vegetation. Contractors working on the proposed

project will be responsible for all materials and labor for the repair of all unauthorized vegetation damage and will be required to replace any damaged vegetation onsite and provide maintenance and monitoring in accordance with the landscape requirements.

2. The DoN will hire two full-time biological monitors during the construction phase. The Biological Monitors shall be responsible for oversight of avoidance, minimization, mitigation, and conservation measure implementation by the construction contractors for projects associated with the proposed action. Additionally, the Biological Monitors will provide training, review, and guidance on Hazard Analysis Critical Control Point (HACCP) plan development, implementation, and revision during the construction phase of the buildup on Guam. The Biological Monitor shall ensure that construction remains within the limits of construction and that sensitive resources are avoided, unless otherwise specified in this Project Description. These positions will be filled and implemented prior to initiation of construction within recovery habitat on the proposed Main Cantonment area or Andersen Air Force Base.

3. The Biological Monitors will also:

   a) assist with the implementation, review and compliance at project sites, conduct site visits and provide expert knowledge to contractors and workers. They will be familiar with goods that need to be certified, inspection techniques, and reporting requirements for HACCP and sanitation procedures.

   b) assist with the preparation of site plans and specifications for each construction package.

   c) assist with the review of construction specifications and provide assistance with incorporating environmental laws, best management practices, and standardized procedures into the construction project specifications supporting this action.

   d) review practices and provide revisions to contract specifications to ensure they are in compliance with legally enforceable environmental policies with particular attention being paid to the prevention, control, and minimization of moving of non-native invasive species inter- and intra-island.

   e) one week prior to any clearing of vegetation, the Biological Monitor will survey the delineated limits of construction to determine if any listed species are present. The Biological Monitor will have experience in the identification of listed species by sight, sound, and nesting behaviors.

      i. If Mariana crows are nesting within 984 ft (300 m) of the project site, the work must be postponed until conclusion of the nesting event (65 days to build the nest, incubate eggs, and fledge the juveniles, Morton et al. 1999, pp.12-17).

ii. If a Mariana fruit bat is present within 492 ft (150 m) of the project site, the work must be postponed until the bat has left the area.

iii. If nesting Mariana common moorhen are present, clearing and construction will be postponed until the chicks have fledged. If work stops for more than one week, pre-construction surveys should be repeated to ensure that no birds have begun nesting.

iv. If Micronesian megapodes are present within 492 ft (150 m) of the project site, the work must be postponed until the megapode has left the area. If megapodes are nesting within 984 ft (300 m) of the project site, on Tinian, the work must be postponed and the Service contacted immediately as no nesting is known to occur there.

v. The presence of a listed species will be reported to the Service and Guam Division of Aquatic and Wildlife Resources or CNMI Division of Fish and Wildlife within 48 hours, but the location of species will not be revealed to any other outside party.

f) will ensure that the construction contractor has clearly staked the project limits and the boundary remains in place throughout construction. The Biological Monitor will accurately map and prepare monitoring reports documenting actual impacts of proposed project construction.

g) such advice and technical expertise provided by the Biological Monitor shall not relieve contractors of their liabilities for compliance with relevant resource protection laws and regulations, including the Act.

4. Prior to the initiation of construction, a contractor education program will be implemented by the DoN to ensure that contractors and construction personnel are informed of the biological resources associated with this project. This program will focus on resource protection; construction contractor identification of sensitive resource areas in the field (e.g., areas delineated on maps and by flags or fencing), environmentally responsible construction practices and protection measures, protocol to resolve conflicts that may arise at any time during the construction process, and ramifications of non-compliance.

5. For any clearing of vegetation that is adjacent to or contiguous with recovery habitat, the perimeter and 98.4 ft (30 m) into the habitat will be surveyed to identify vegetation community composition. This survey will be repeated six months and at one year after vegetation removal to ensure effectiveness of HACCP implementation (clean equipment, supplies, and materials) during construction activities. If new non-native, invasive species are detected, the DoN will notify the Service and the DoN will develop and implement an eradication plan or control effort to prevent infestation.

6. For the minimization of potential impacts to sea turtles and fruit bats, lighting will be designed to meet minimum safety, anti-terrorism, and force protection requirements. To the maximum extent practical, hooded lights will be used at all new roads and facilities proposed for construction and use within sea turtle land-based habitat and Mariana fruit bat habitat.

   Lighting associated with the Andersen South and Route 15 Range Complex ranges will be installed at parking and administrative facilities (DoN 2010a, p. 44). The actual ranges will not have lights. "Night-adapted" lights will be installed in the briefing and bleacher areas. Night-adapted lighting uses bulbs in red or other spectrums that allow a person's eyes to remain adapted to low light or night conditions while still providing enough light for work and safety. Illumination of forest, coastline, or beach will be consistent with range safety and security requirements and kept to an absolute minimum including the shielding of lights and directing lighting away from the forest or other wildlife habitat.

7. Appropriate, native and non-invasive species will be planted in all new landscapes upon completion of proposed construction activities. Plants to be used will be selected from a list of recommended plants identified in the consolidated landscape plan (Naval Facilities Engineering Command, Pacific, in prep.) that incorporates the information in the Architectural Compatibility and Base Design Standards, Andersen Air Force Base, Guam (June 2006), Marianas Region Architectural and Construction Standards, Commander U.S. Naval Forces, Marianas and the Installation Appearance Plan, Commander U.S. Naval Forces Marianas (September 2007) into one plan. Recommendations from the plan include, but are not limited to:

   a) use of at least 50% native species for all landscaping projects.

   b) at least 50% of the plants used should be native species when existing landscape plants need to be replaced.

   c) use of a clumping strategy of several individual plants together whenever possible to increase survival of plants during typhoons.

   d) planting during the wet season between June and September to allow plants to become established before the dry season in January and May.

8. The monitoring and reporting of project implementation will be addressed by Naval Facilities Engineering Command Pacific and Naval Facilities Engineering Command Marianas as part of their natural resources management programs.

Site-Specific Conservation Measures to Minimize Impacts of Construction on Guam

Proposed Main Cantonment Area

At the proposed Main Cantonment Area, the engineer equipment and decontamination training area includes the construction of a water runoff control pond. A wash-down pad and oil-water separator will be installed to ensure hazardous materials are not washed into the pond (DoN 2010a, pp. 38-39). The pond will be a small, rock-lined pit with a drainage sump and constructed such that it does not serve as an attractant for the endangered Mariana common moorhen or other shore or sea birds. Though the soils are porous limestone, the pond will have steep sloping sides and vegetation will be mowed or removed so that foraging and nesting habitat is not created. A Biological Monitor will survey the water runoff control pond to ensure that the completed project does not serve as an attractant for the endangered Mariana common moorhen. The Biological Monitor shall survey the area for one year post-construction after all rainfall events sufficient to allow ponding in the area, to determine if it is an attractant.

Naval Base Guam

1. At Naval Base Guam, dredged material will be used as "Beneficial Reuse" like backfill for the proposed action construction projects (DoN 2010a, p.73).

Site-Specific Conservation Measures to Minimize Impacts of Training on Guam

1. A Fire Management Plan will be prepared to address the potential for fires on proposed new ranges at Route 15 and other proposed new training areas. The Fire Management Plan will address the training, and the new live-fire ranges in one comprehensive Fire Management Plan. The Fire Management Plan will include protocols for monitoring fire conditions and adjusting training as needed (e.g., firing may be disallowed under certain fire conditions), location and management of fuels reductions (DoN 2010a, p. 36), fire breaks, fire fighting roads, fire fighting water systems, burn hazard assessment response, on-call helicopter fire suppression, protocols for using units to be briefed by range control on requirements suitable to the conditions of the day, and protocols that will be implemented should a fire occur (e.g., specifying how the range will shut down and fire suppression actions will be taken). In particular, the Fire Management Plan will provide guidance and direction to ensure fires do not encroach into vegetated areas that can be used by the bat, kingfisher, crow, rail, or moorhen. The Service will be provided a 30-day review period, from the date of receipt of the draft Fire Management Plan, to provide comments and recommendations for the DoN's consideration. The Fire Management Plan will be completed and fully operational (implemented) whenever training occurs at the new firing ranges on Guam.

2. The outdoor recreation area on the proposed Main Cantonment area may be used for compass navigation. No other training will occur within the outdoor recreation area.

3. Other than the new access road, no new roads will be established in the Southern Land Navigation Area and no vehicles will be used within the training site (DoN 2010a, p. 32). Foot trails will be established within the southern portion of the Naval Munitions Site due to repeated use during of the area for maneuver training; however, no large woody vegetation (greater than 4 in or 10 cm) will be removed during training. Prior to training exercises, personnel will inspect themselves and their equipment.

4. Overflights at low levels may result in Bird Aircraft Strike Hazard impacts. To avoid bird strike and noise impacts to Mariana common moorhen and Mariana swiftlet, all aviation training will be conducted so that flights will approach the southern portion of the Naval Munitions Site over the Talafofo River watershed and Fena Reservoir at heights of 1,000 ft (305 m) or greater above ground level. Flights may go up the Ugum River at altitudes of 1,000 ft (305 m) or greater above ground level until they reach 9,843 ft (3,000 m) from the mouth of the river at Highway 4 and then flights may conduct low-level terrain flights. Low-level training flights (DoN 2010a, p. 54) will be restricted to the southernmost portion of the Naval Munitions Site (DoN 2010a, p. 35) where swiftlets and moorhen are not commonly present. As addressed in Chapter 6, Volume 2 of the DEIS, noise will not be above ambient levels.

5. Route 15 Range Complex range berms will contain non-invasive herbaceous vegetation, and other engineering controls to manage stormwater runoff and control erosion.

6. New aviation training at Northwest Field will follow all previous flight restrictions identified in the MIRC (USFWS 2010a, 96 pp.) and ISR Strike (USFWS 2006a, 73 pp.). There will be no operations when Mariana crows are nesting (November through April) and no flights below 1,000 ft (305 m) above ground level, with the exception of landing zones (DoN 2010a, p. 52).

7. After a training event on Guam is complete, vehicles and equipment will return to the wharf or airfield, be inspected and washed prior to being loaded on to the ships or flying off-island (DoN 2010a, p. 75).

8. Consistent with the MIRC BO, the DoD will maintain 328-ft (100-m) no training buffers around the known Mariana swiftlet nesting caves (e.g., Mahlac Cave, Fachi Cave, Maemong Cave) in the Naval Munitions Site and will continue to trap brown treesnake within areas surrounding the swiftlet caves.

<u>Site-Specific Conservation Measures to Minimize Impacts of Construction on Tinian</u>

1. The proposed placement of ranges will decrease the amount of land for conservation set out in the "Dedication of Tinian Military Retention Area Land for Wildlife Conservation". This agreement was a conservation measure within the biological opinion for improvements to the Tinian International Airport (USFWS 1998a, 17 pp.) and was integral to the delisting of the Tinian monarch (USFWS 2004a, 7 pp.). The agreement established a 936-ac (379-ha) mitigation area for the protection of "endangered and threatened wildlife, particularly the Tinian monarch" with the provision that it is the right of the U.S. military to "use the

premises for low-impact military training and for other purposes that do not disrupt the habitat and living conditions of the Tinian monarch." The agreement further states "In the event of a national emergency or other condition requiring the use of this land for military purposes, the United States shall retain the right to unilaterally withdraw all, or any portion of, the respective leasehold lands that are designated the Conservation Area, for national defense purposes." The DoN has elected to not withdraw all the lands from the mitigation area and instead withdraw only a portion for the new firing ranges.

The DoN in coordination with the FAA and the Service would revise the existing FAA Mitigation Area to encompass the central escarpment associated with Mt. Laso to protect some of the largest remaining areas of intact native limestone forest on Tinian (Figure 10).

Proposed ranges would result in the loss of 261 ac (106 ha) of the original 937-ac (379-ha) FAA Mitigation Area leaving 675 ac (273 ha) of the original FAA Mitigation Area remaining. The new revised area would encompass a total of 1,214 ac (491 ha), or an addition of 539 ac (218 ha), a greater than 2:1 replacement of the area lost due to the proposed ranges (DoN 2010a, p. 131). This revised and larger area would serve as important habitat for listed species (e.g., Micronesian megapode, Mariana fruit bat) and the delisted Tinian monarch, in particular increasing the acreage of native limestone forest, mixed introduced forest, and tangantangan within the proposed expanded FAA Mitigation Area. This measure will be implemented prior to construction of new ranges on Tinian.

The DoN will further minimize impacts to listed and other native species on Tinian by developing and implementing a Native Forest Enhancement Plan within the "FAA Mitigation Area" (DoN 2010a, p. 133). The Native Forest Enhancement Plan will focus on improving the quality of native forest habitat and result in the conversion of non-native habitats into native forest types for the benefit of listed species and will be completed at least one year prior to the proposed onset of construction on Tinian. Implementation of the plan will begin prior to constructing new ranges on Tinian.

2. The platoon battle course is being sited in areas not known to be use for breeding by the Mariana common moorhen and all construction will begin during the dry season, if possible, so that noise impacts to Mariana common moorhen are minimized.

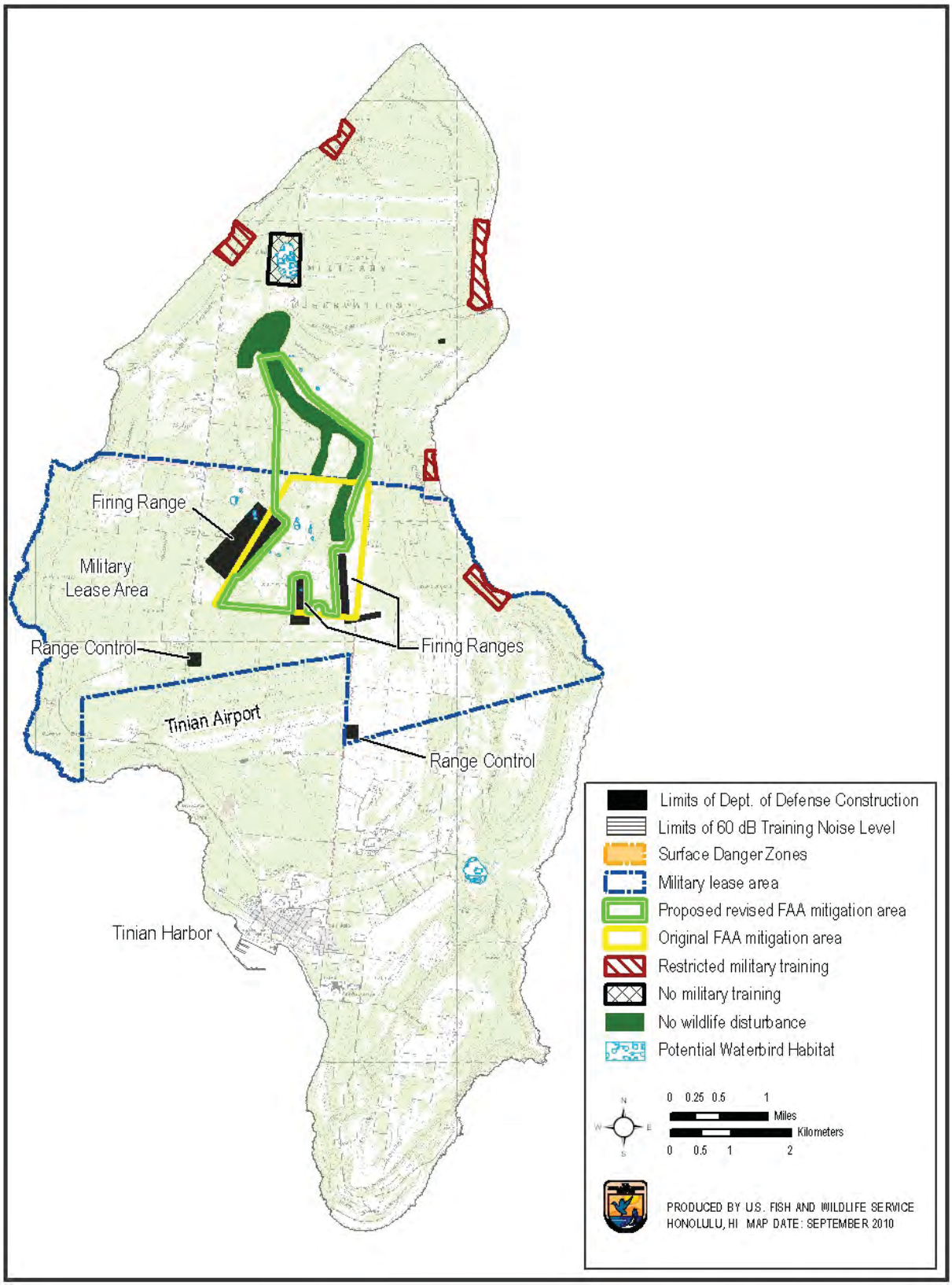

Figure 10. Revised FAA mitigation area on Tinian.

Site-Specific Conservation Measures to Minimize Impacts of Training on Tinian

1. A Fire Management Plan will be prepared to address the potential for fires on Tinian as the result of live-fire training activities on the proposed ranges (DoN 2010a, p. 129). The Fire Management Plan will address the training, and the new live-fire ranges in one comprehensive Fire Management Plan. The Fire Management Plan will include protocols for monitoring fire conditions and adjusting training as needed (e.g., firing may be disallowed under certain fire conditions), location and management of fuel reductions (DoN 2010a, p. 36), fire breaks, fire fighting roads, fire fighting water systems, burn hazard assessment response, on-call helicopter fire suppression, protocols for using units to be briefed by range control on requirements suitable to the conditions of the day, and protocols that will be implemented should a fire occur (e.g., specifying how the range will shut down and fire suppression actions will be taken). In particular, the Fire Management Plan will provide guidance and direction to ensure fires do not encroach into vegetated areas that can be used by the bat, megapode, or moorhen. The Service will be provided a 30-day period, from the date of receipt of the draft Fire Management Plan, to provide comments and recommendations for the DoN's consideration. The Fire Management Plan will be completed and fully operational (implemented) whenever training occurs at the new firing ranges on Tinian (DoN 2010a, pp. 133-134).

2. The berms on the ranges will contain non-invasive herbaceous vegetation, and other engineering controls to manage stormwater runoff and control erosion.

Conservation Measures to Minimize Impacts of Infrastructure and Indirect/Induced Civilian Development

1. To minimize the impacts from increased recreational beach use due to the increase in population anticipated from the proposed project (DoN 2010a, p. 16), the DoN, in cooperation with Service and Guam Division of Aquatic and Wildlife Resources, will undertake an educational program to inform military and civilian personnel about sea turtle nesting and the potential impacts to the species from nest disturbance and direct harassment of sea turtles (in the marine and terrestrial environment), beach disturbance, etc. (DoN 2010a, p. 134). In addition to signage near beaches on DoD property describing the legal requirements regarding sea turtles, the DoN will provide and distribute brochures and other educational materials at DoD facilities, including Morale, Welfare and Recreation facilities, beach picnic areas, trail heads, dive shops, and other DoD locations where potential recreational beach users may frequent to remind them of land-based impacts to sea turtles. Education and outreach will begin within the first two years of construction activities and continue throughout the construction phase until two years after completion of major construction activities (i.e., worker population has left Guam) (DoN 2010a, p. 16).

2. On Tinian, there is not expected to be an increase in recreational beach use by civilians and military personnel. However, the DoN, in cooperation with Service and the CNMI sea turtle program, will undertake an educational program to inform military and civilian personnel about sea turtle nesting and the potential impacts to the species from nest

disturbance and direct harassment of sea turtles (in the marine and terrestrial environment), beach disturbance, etc. The DoN will prepare and distribute brochures describing the legal requirements regarding sea turtles to potential recreational beach users to remind them of land-based impacts to sea turtles. In addition, information on sea turtles will be included as part of the environmental briefings associated with the range training on Tinian (DoN 2010a, p. 116). Education and outreach will begin within the first two years of construction activities on Tinian and continue as long as DoN training occurs on Tinian.

3. *Security Fencing and Other Habitat Loss Minimization*. Prior to any on-the-ground clearing for security fence construction, DoN will review each construction action to determine if the issuance of a waiver to reduce stand-off distances for security fencing is possible (consistent with security requirements) allowing a reduction in the amount of recovery habitat lost due to the proposed construction. Waiver requests must first be processed through the Commander Naval Installations Command and DoD for approval. If a waiver will reduce the amount of recovery habitat lost, consistent with underlying security requirements, the DoN will follow the approved processes and request the waiver reductions in standoff distances for fencing, if approved.

Roadways.

1. DoN will work with the U.S. Department of Transportation and Guam Public Works Department to ensure road and bridge work will be designed, to the maximum extent practical, that wetland impacts are minimized up and downstream of the site such that habitat for listed species is not negatively impacted (i.e., permanently altering habitat such that the moorhens will no longer use it) due to the improvements.

2. Pre-construction surveys will be completed one week prior to the onset of work by a biologist experienced in the identification of the Mariana common moorhen by sight and vocalizations and experienced with implementation of Service protocol survey methodology to ensure that no nesting moorhens are present. If nesting moorhens are present, clearing and construction will be postponed until the chicks have fledged. If work stops for more than one week, pre-construction surveys will be repeated to ensure that no moorhens have begun nesting (Takara 2010).

3. Bridge and road construction and improvements at the Atantano and other wetland areas adjacent to Route 1 on Guam will occur when moorhen are not nesting at or near (within 984 ft (300 m)) the project site to avoid effects to moorhen (Takara 2010).

4. Wetland habitat enhancement or restoration to benefit the moorhen may occur at Camp Covington. If Camp Covington is deemed unsuitable for wetland enhancement or restoration, the Atantano wetlands will be evaluated for restoration potential.

Conservation Measures to Minimize the Impacts of Invasive Species

Micronesia Biosecurity Plan

1. To address pathways and encourage a more holistic approach to managing invasive species, as part of the proposed action, the DoN has funded and is a participating agency in the development of the Micronesia Biosecurity Plan. Individual activities for various species will continue, but the DoN and others agree it is more efficient to manage pathways and prescribe corrective measures for a suite of species which will be monitored at discrete control points through time. The Micronesia Biosecurity Plan is much greater and is applicable to all agencies in Micronesia and will provide a platform for coordination and integration of inter-agency invasive species management efforts such as control, interdiction, eradication, and research.

2. DoN has contracted with the National Invasive Species Council to develop and coordinate risk assessments and prepare the Micronesia Biosecurity Plan in cooperation with USDA Wildlife Services, USDA APHIS Plant and Protection and Quarantine, USDA APHIS Veterinary Services; U.S. Geological Survey (USGS) Biological Resources Discipline; Naval Facilities Engineering Command, Pacific; Smithsonian Environmental Research Center.

3. The approach for the Micronesia Biosecurity Plan will involve risk assessments to provide decision support and corrective actions that integrate techniques involving exclusion, detection, eradication, and control of non-native and invasive organisms that can be readily implemented into standard operating procedures, training instructions, and applied best management practices related to supporting and completing construction projects and infrastructure repairs. Many of these techniques already exist and are being implemented. The risk assessments will identify and prioritize hazards and risks for species, pathways, and vectors which could include, but are not limited to, non-native species, construction equipment, training materials, personal protective equipment, foot traffic, vehicles and vessels, and shipping/packing material. The outcomes from the risk assessments will be corrective measures, monitoring techniques, and best management practices to avoid and minimize the introduction of non-native invasive species to Guam, the CNMI, and other Pacific Islands.

4. The Micronesia Biosecurity Plan is a long-term strategy that incorporates two components: a risk analysis of various pathways, vectors, and species associated with the importation to and exportation from Guam to other areas of Micronesia, and a multi-tiered implementation plan which prescribes corrective actions and identifies invasive species, pathways, and vectors which were identified as posing a risk. Risk assessments will result in information that could be incorporated into a multi-tiered protection system including pre-departure inspection or certification of goods and transport, inspection at the port of entry, post-admittance monitoring, rapid response eradication of incipient invasive species incursions, and control of invasive species. An outline for the risk analysis has been completed and a final risk analysis is anticipated in March 2011. The implementation plan will be drafted and finalized in April 2011.

5. Until the Micronesia Biosecurity Plan is finalized, pathway analysis may be used as a tool to improve programmatic efficiency. Methods such as HACCP or similar procedures will be used to conduct pathway analysis as applied to aspects of interdiction for brown treesnake and other potential invasive species. The USDA and Service have experience in conducting pathway analysis and have offered to assist the DoN in the development of these actions.

6. The DoN will implement biosecurity measures as described below, to ensure that risk from transporting invasive species to or from Guam and the CNMI is controlled.

General Biosecurity Measures

Existing levels of federally funded brown treesnake interdiction efforts will be increased, as necessary, to address increases in outbound civilian cargo exports to U.S. states and territories resulting from the proposed action. In order to guide the level of brown treesnake interdiction efforts, an iterative process employing adaptive management techniques will be used. The DoN commits to convening a working group to identify a system of reporting, monitoring and threshold metrics that can be used to guide the appropriate level of brown treesnake interdiction associated with the Marine Corps relocation effort. The prospective working group members will include representatives from DoI-Office of Insular Affairs, USDA APHIS Wildlife Services, Hawaii Department of Agriculture, Government of Guam, CNMI, the Service, and USGS Biological Resources Discipline. The DoN will initiate discussions with prospective working group members within 90 days of the Record of Decision. The working group will serve as a subgroup to the Civil Military Coordination Council (Council). The Council implements Adaptive Program Management for the proposed action as described in the "Environmental Impact Statement/Overseas Environmental Impact Statement for Guam and CNMI Military Relocation: Relocating Marines from Okinawa, Visiting Aircraft Carrier Berthing, and Army Air and Missile Defense Task Force."

1. The working group will serve in an advisory capacity to facilitate efficient and effective brown treesnake interdiction efforts. The working group will meet, at a minimum, on a biannual basis. If an issue arises that warrants immediate attention, the working group will convene via electronic mail or telephone. If timing does not allow for engaging the working group, the DoN and Service will coordinate to develop an agreed-upon response.

2. The DoN will provide the Service and the working group with annual reports detailing brown treesnake interdiction measures on Guam and the CNMI and anticipated levels of future DoD construction activity associated with the Marine Corps realignment efforts. The working group will advise the Council on brown treesnake interdiction efforts relative to the construction tempo and sequencing associated with the Marine Corps realignment construction effort. Following completion of the construction phase of the project, the Brown Treesnake Working Group will function as a mechanism to monitor the brown treesnake interdiction program.

3. The DoN will develop a biosecurity program to be employed throughout the construction phase of the military buildup. The program will have terrestrial and aquatic resources response

capabilities. The DoN's Biosecurity program will address non-native, invasive species issues on DoD property within Guam and the CNMI. DoN will work with partners to develop newspaper, radio, and television public service messages and website and education materials for the public and DoN describing non-native invasive species, their impacts to native species, what can be done for their prevention and control, and training. The Biosecurity program will work to control and eradicate existing non-native plants and animals. DoD will support opportunities to work collaboratively through Memorandums of Understanding or Memorandums of Agreement with the local government, which will afford improved biosecurity for both DoD and the community as a whole. The Biosecurity progam will include cross training for non-native invasive plant and animal species where inspection and rapid response techniques have been developed. The Biosecurity program will be initiated prior to initiation of construction within recovery habitat on the proposed Main Cantonment area or Andersen Air Force Base.

In addition, biosecurity program efforts will:

a) establish a process for the DoN to determine rapid response situations identifying when and how, to transfer long-term control efforts to when applicable. This will be part of the Biosecurity Response Team Operations Manual (to be developed as part of this action), which will be modeled after the National Park Service Exotic Plant Management Teams Operations Manual (2002). The Biosecurity Team Operations Manual will be developed within one year of filling the Biosecurity Team.

b) Biosecurity Team members will participate in regional and local invasive species work groups (i.e., Regional Invasive Species Council, Guam Invasive Species Committee, Coconut Rhinoceros Beetle Incident Command, Brown Tree Snake Working Group, and other invasive species specific groups) throughout Micronesia. These groups provide opportunities for cross-training, technology transfer, and sharing of current issues with a specific species or region. These venues also provide for the Teams to report on activities to partners.

c) assist existing federally-funded brown treesnake rapid response teams to enable coverage of each brown treesnake detection incident in CNMI and Hawaii. The DoN will support USGS Biological Resources Discipline to develop procedures and protocols that will support rapid response team actions for a brown treesnake detection incident. DoN personnel will be trained on rapid response procedures or the DoN may retain agreements with trained, local pest control contractors or cooperating partner agencies that would assist in the response actions. DoN support for rapid response actions would be subject to a Memorandum of Understanding that will be initiated within 180 days of the Record of Decision. Implementation of brown treesnake rapid response is currently provided for pursuant to the MIRC Biological Opinion. If the action is not funded pursuant to the MIRC Biological Opinion in the future, alternate sources of funding would be secured to ensure implementation of this rapid response conservation measure.

4. There will be two Biological Monitors that will provide training, review, and guidance on HACCP plan development, implementation, and revision during the construction phase of the buildup on Guam.

5. The DoN's contracts will include requirements for the contractor to perform certain tasks to prevent the inadvertent movement of non-native, invasive species from the project site to other locations. Cleaning of vehicles and equipment will take place off-site to the greatest extent possible. If washing must occur on site, designated bermed wash areas must be used to prevent wash water contact with storm water, creeks, rivers, and other water bodies.

6. The contractor shall provide documentation that supports prevention, worker awareness, and control of non-native invasive and pest species in the project area and efforts to prevent the movement of non-native invasive species to areas outside the project area, whether in a purposeful or inadvertent manner. The contractor is responsible for ensuring that their employees receive applicable environmental and occupational health and safety training, and keep up to date on regulatory required specific training for the type of work to be conducted onsite. This may include, but is not limited to HACCP planning, species- (e.g., brown treesnake and coconut rhinoceros beetle) specific information, regulated pest list, threatened and endangered species information, and proper washdown and inspection techniques for equipment. Vehicle hygiene, that is vehicle washdown and inspection for soil and other material, is required to prevent the inadvertent movement of non-native invasive species from the project site to other locations. The Contractor is required to establish appropriate facilities that comply with all environmental laws and regulations, provide training for proper vehicle hygiene, and promptly take corrective and preventative actions for noncompliance. All large dumpsters without lids shall be inspected by the Biological Monitor for non-native invasive species prior to movement of the dumpster off the project site.

7. The DoN will work with partners to develop, prioritize, and implement eradication and control projects that target non-native invasive lizard species. As an example, eradication or suppression of non-native invasive lizard species to reduce prey for brown treesnake could be implemented in the Ecological Reserve Areas. These types of management actions will be implemented within one year of establishing the Ecological Reserve Area.

8. The DoN will work with partners to develop, prioritize, and implement non-native rodent control (suppression) on Guam for conservation and human health and safety concerns. As an example, suppression of rodents to reduce prey for brown treesnakes or prevent rodent explosions after control of brown treesnakes could be implemented in the Ecological Reserve Areas.

9. The DoN will work with partners to develop, prioritize, and implement eradication and control projects that target non-native insect and invertebrate species for conservation and human health and safety concerns. As an example, eradication or suppression of non-native flatworms could be implemented in the Ecological Reserve Areas to reduce predation of snails.

10. To prevent the spread of coconut rhinoceros beetle, the DoN will include specifications in contracts for inspections and proper re-use or disposal of vegetation within coconut rhinoceros

beetle quarantine area. The biosecurity measures would ensure that yard waste and vegetation debris is not harboring coconut rhinoceros beetle or the waste is treated prior to re-use or movement off construction site.

11. To fully support the National Defense Reauthorization Act of 2009, the DoN will establish a DoD (i.e., representatives from the Navy, Marine Corps, Army, and Air Force) Brown Tree Snake Working Group to establish and implement a comprehensive program to control and, to the extent practicable, eradicate brown treesnake from military facilities in Guam. Implementation of this activity is ongoing and long-term. The DoN will assist with coordination of funding, planning, and streamlining implementation of DoN brown treesnake projects on Guam. Additional actions include, but are not limited to:

a) committing to implement inspections and quarantine procedures at new facilities;

b) actively participating in the Brown Tree Snake Working Group and work with partners to develop, prioritize, and implement projects that target landscape-level brown treesnake suppression, interdiction and control for human health and safety and provide areas with low snake densities. The DoN will support implementation and monitoring of efficacy for current techniques that address Integrated Pest Management and landscape-level brown treesnake control in Ecological Reserve Areas and other DoN priority areas;

c) expanding the existing environmental education program for new personnel arrivals (personnel undergoing Permanent Change of Station). The current program includes on-line testing and a brown treesnake factsheet;

d) funding the development of methods to eradicate or significantly suppress brown treesnake island-wide. As part of the proposed action, the DoN will provide funding for brown treesnake research and suppression throughout the construction phase.

<u>Biosecurity Measures Specific to Training Actions</u>

The following measures pertain to training and training cargo movement:

1. 100% inspection of all outgoing cargo on vessels and aircraft from Guam with trained quarantine officers and dog detection teams, which could be supplemented by other pest control expertise with appropriate USDA APHIS brown treesnake detection training and oversight to meet 100% inspection goals for large scale training activities;

2. in the event military units, vehicles, and equipment accidentally leave Guam without inspection the DoN will as soon as possible notify their inspection contractor and the point of destination port or airport authorities and work with the destination port to resolve the issue. Urgency of notification is a priority so that rapid response or other actions can be implemented to reduce risk;

3. the DoN will route inbound personnel and cargo for tactical approach exercises that require an uninterrupted flow of events directly to CNMI training locations to avoid

Guam seaports and airfields. If Guam cannot be avoided, the DoN in cooperation with USDA shall identify and the DoN will implement appropriate interdiction methods that may include repeated inspections or other interdiction methods as agreed to by USDA and the DoN. Additionally, tactical approach exercises will involve only cargo equipment that has not originated from areas containing a brown treesnake population or will be 100% inspected by certified brown treesnake canine programs. If the USDA develops performance standards for this activity, the DoN will adopt those standards, provided they are compatible with military mission;

4. the DoN is committed to implementing repeated inspections. Repeated inspections include inspections on Guam and at the receiving jurisdiction for administrative and logistical movements that do not require a tactical approach to complete the training requirements. It is anticipated that repeated inspections will utilize existing quarantine and inspection protocols at receiving ports;

5. the DoN will also establish snake-free quarantine areas for cargo traveling from Guam to the CNMI and other locations. These brown treesnake sterile areas will be subject to: multiple day and night searches with appropriately trained interdiction canine teams; snake trapping, and visual inspection for snakes. Temporary (i.e., movable) barriers may be preferable to permanent exclosures because of the variable sizes needed for various training activities. The DoN will use OPNAVINST 5090.10A for standard operating procedures for temporary barrier construction and use. Standard operating procedures will ensure that temporary barriers are constructed and maintained in a manner that assures the efficacy of the barrier tool and that staff maintaining and constructing the temporary barriers will receive training related to this activity prior to construction. Review of standard operating procedures will be conducted in cooperation with the USGS Biological Resources Discipline, and the USDA APHIS. The DoN and other appropriate parties will meet, if necessary, to resolve concerns such that the protocols ensure risk is adequately minimized;

6. working in collaboration with the USDA APHIS, DoN will decide how best to implement the Brown Treesnake Control Plan (BTS TWG 2009, 37 pp.) relevant to DoD actions;

7. adherence to DoN Instruction 5090.7, which calls for individual troops to be responsible for conducting self inspections to avoid potential introductions of invasive species to Guam and the CNMI. Troops will inspect all gear and clothing (e.g., boots, bags, weapons, pants) for soil accumulations, seeds, invertebrates, and vertebrates. The intent of this measure is to minimize the potential risks and subsequent effects associated with transport of troops and personnel to Guam and to CNMI from areas that contain species that are not native to Guam and Tinian terrestrial habitats;

8. each action will undergo a pathway risk analysis as a tool to improve programmatic efficiency while preventing the spread or introduction of invasive species. Actions at risk of transporting invasive species will have prevention tasks identified and implemented to reduce risk. Methods such as HACCP planning (see http://www.haccp-nrm.org) may be utilized to conduct pathway analysis;

9. the DoN will invite the Service to participate in the development of regional standard operating procedures and exercise planning to better meet invasive species management needs associated with proposed training. Current procedures can be found in 5090.10A "Brown Tree Snake Control and Interdiction Plan" (DoN 2005, 28 pp.);

10. the DoN representative will assure that "Area Training" coordinates meetings for brown treesnake interdiction on all training activities for the training execution phase and an after action review phase. If a snake is found during training, the DoN policy is to kill the snake and report it to DoN Environmental staff;

Biosecurity Measures Specific to Civilian Sector Transportation

DoN agrees that it will fund the increase of current federally funded brown treesnake interdiction measures (in Guam, CNMI, and Hawaii) where the increase is related to direct, indirect and induced-growth caused by the Marine Corps relocation to Guam. The objectives include the following:

i. maintain inspection levels consistent with current inspection regimes of all outgoing cargo, containers, aircraft, and vessels from Guam bound for the U.S. or U.S. territories with trained quarantine officers and dog detection teams, which could be supplemented by other pest control expertise with appropriate USDA APHIS brown treesnake detection training and oversight;

ii. maintain brown treesnake suppression on Guam at all commercial cargo staging, packing, handling and trans-shipment facilities handling outbound cargo for the U.S. or U.S territories;

iii. maintain brown treesnake suppression around commercial port and airport facilities on Guam;

iv. maintain current reporting systems that track outbound cargo and vessels bound for the U.S. or U.S. territories;

v. maintain current levels of brown treesnake inspection and quarantine for arriving cargo, containers, aircraft, and vessels at recipient sites with established federally funded interdiction programs;

vi. maintain current brown treesnake detection and monitoring at recipient sites with established federally funded interdiction programs.

Procedures for brown treesnake interdiction efforts are described in the USDA APHIS WS Containment Plan for Guam (pages 1 - 18), USDA APHIS WS Canine Standard Operating Procedures (pages 22 - 30), draft BTS Control Plan (December 2009), and the 2009 USDA APHIS WS canine interdiction report. One of the goals of the current interagency Brown Treesnake Working Group is 100% interdiction to prevent the brown treesnake from dispersing to other locations. The 2009 USDA APHIS WS canine interdiction report, CNMI DoI Office of Insular Affairs Grant Project Narrative Status Report ((July thru December 2009), and Semi-

Annual BTS Hawaii Department of Agriculture (July thru December 2009) are outlines of current interdiction effort on Guam, CNMI and Hawaii.

The FY10 level of funding for the Federal interagency brown treesnake interdiction effort on Guam, CNMI, and Hawaii and 2010 transportation levels associated with outbound cargo from Guam for the U.S. or U.S. territories will be used as the baseline. For 2011, the Service and DoN will jointly evaluate existing programs and determine the appropriate level of effort based on the FY10 Federal funding levels. Future adjustments in brown treesnake interdiction efforts will be determined based upon forecasts of the tempo and sequencing associated with the Marine Corps realignment construction effort, provided from the Council and other available sources, and the ability of current and previous years' efforts to maintain objectives related to the proposed action.

Biosecurity Measures Specific to Non-Training Actions

For non-training actions (i.e., routine operations, construction, etc.) the DoN implements actions identified in DoN instructional manuals and participates in work groups and collaborative efforts that focus on the prevention, control, and eradication of non-native invasive species on Guam and in the Pacific. The DoN implements recommended management actions for non-native invasive species of plants and animals. Non-native invasive species management includes but is not limited to snakes, deer, pigs, rats, lizards, goats, and plants with 100% inspection rate as the goal for brown treesnake. Examples of DoN invasive species management include, but are not limited to:

1. participation in the design, siting, installation, and operational use of brown treesnake barriers and gates for quarantine purposes on DoN lands;

2. incorporation of language in to new contracts for quarantine, inspection, and invasive species prevention measures. Examples include specific language for HACCP plan development and review, landscaping practices for native species, prohibition of feeding feral animals;

3. dedicated support for large-scale, long-term efforts to refine methods for brown treesnake control that will reduce snake populations on a landscape level more cost-effectively and to increase the efficacy of capturing snakes in low-density situations;

4. participation in coconut rhinoceros beetle control efforts by maintaining sentinel buckets and incorporation of biosecurity measures into DoN projects that generate yard waste and vegetation debris;

5. coordination with experts and implementation of actions to protect cycads from the scale insects and incorporation of biosecurity measures into projects or training events that will be moving into and out of areas infected by the invasive scale insect;

6. enforcement of the Chief of Naval Operations policy letter of January 10, 2002, on preventing feral cat and dog populations on DoN property;

7. mapping of non-native invasive plants and incorporating biosecurity measures into projects or training events that move into and out of areas within invasive weeds that are not prevalent elsewhere.

2.2 ACTION AREA

The action area encompasses the areas within which the action is likely to produce stressors that have direct or indirect adverse consequence to listed resources. The action entails DoD construction and training on Guam and Tinian (Figure 11). Interrelated and interdependent civilian actions on Guam and Tinian including development and modifications to the locations of existing civilian activities will indirectly result from the action. These actions will result in stressors including habitat loss and noise on Guam and Tinian.



Figure 11. The action area encompasses the Mariana Archipelago Islands of Guam and Tinian.

2.3 NOT LIKELY TO ADVERSELY AFFECT REVIEW

Your January 4, 2010, letter, as updated by your staff (Cobb, pers. comm. 2010a, Cobb, pers. comm. 2010b), requested our concurrence with your determination that the subject action is not likely to adversely affect the Mariana swiftlet, Micronesian megapode, and the green sea turtle or hawksbill sea turtle (collectively referred to as sea turtles) pursuant to section 7 of the Act. The following sections summarize our review of anticipated project effects to these species.

Mariana Swiftlet

Mariana Swiftlet Biology and Occurrence in the Action Area
The following section summarizes Mariana swiftlet population status and biology based on the information available to the Service. The Mariana swiftlet is endemic to Guam and the four southern islands of CNMI (Cruz et al. 2008, p. 233). A population also became established on Oahu, Hawaii, between 1962 and 1965 (Wiles and Woodside 1999, p. 57). Most historical information on the species comes from Guam, where it was reported as being common and the third most abundant species seen during roadside counts, but declined to approximately its current levels by the late 1970s (USFWS 1991b, p. 7). The total number of Mariana swiftlets occurring within its historical range is approximately 6,800 individuals and it currently occurs on Guam (in three known caves within the Naval Munitions Site), Aguiguan (in nine known caves), and Saipan (ten known caves), and is considered extirpated from Tinian and Rota (Cruz et al. 2008, pp. 235–236; Grimm 2008, p. 1; Service 1991b, pp. 8, 13–14; Engbring et al. 1986, pp. 58–59).

The current estimate of the Mariana swiftlet population on Guam is 1,150 birds (Grimm 2008, p. 1). Monthly swiftlet counts at Mahlac cave fluctuated between 150 and 500 between 1984 and 1999, but have since increased to approximately 950 in 2008 (Grimm 2008, p. 1) (Figure 12). Similarly, the number of swiftlets observed at Maemong cave increased from 4 to 100 between 2004 and 2008 (Grimm 2008, p. 1) (Figure 13). The number of swiftlets observed at Fachi cave has fluctuated widely, but the count has never exceeded 100 (Grimm 2008, p. 1) (Figure 14).



Figure 12. Monthly Mariana swiftlet counts at Mahlac Cave, Guam, 1984–2008 (Grimm 2008, p. 5).

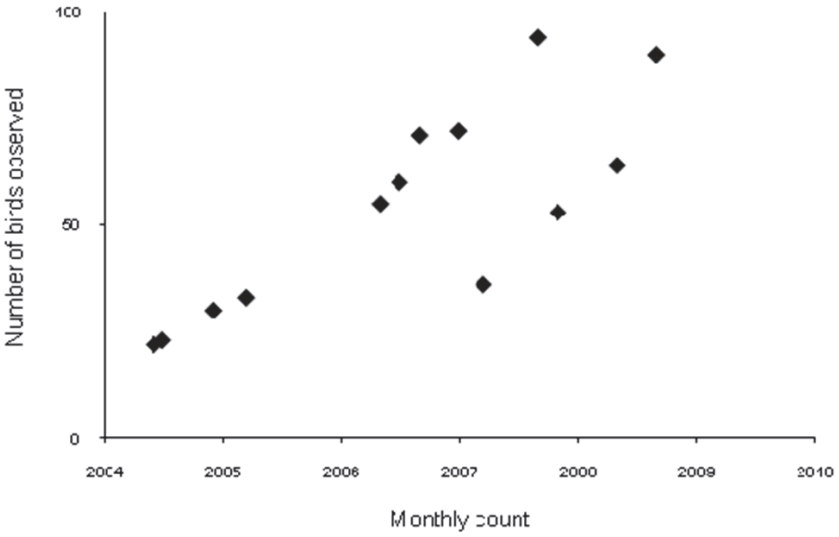

Figure 13. Monthly Mariana swiftlet counts at Maemong Cave, Guam, 2004–2008 (Grimm 2008, p. 6).

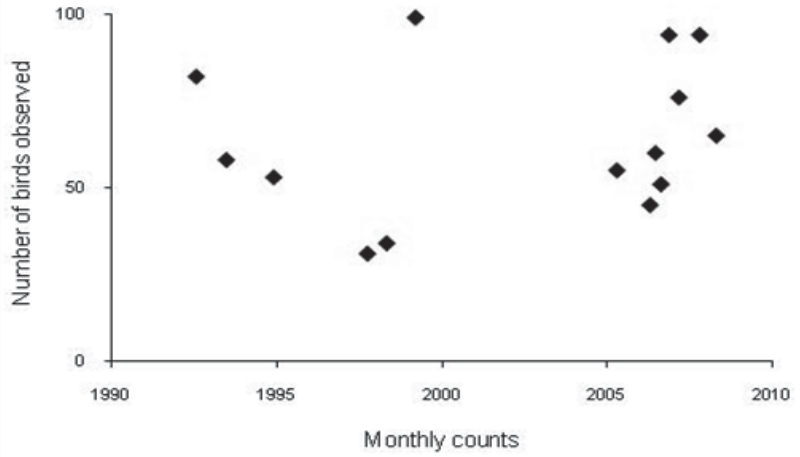

Figure 14. Monthly Mariana swiftlet counts at Fachi Cave, Guam, 1992–2008 (Grimm 2008, p. 5).

The species nests and roosts in limestone caves with the following characteristics: entrances typically a minimum of 2 m (6.2 ft) high; chambers with dark zones; and fresh air (USFWS 1991b, p. 2). Mariana swiftlets capture prey while flying, and foraging has been observed to occur over a wide variety of habitat types but they appear to favor ridge crests and open grassy savanna areas (USFWS 1991b, p. 6). Most birds leave their cave at dawn and return at sunset, but often return from foraging to roost in caves during the day. An analysis of swiftlet guano collected from occupied caves on Saipan found that the remains of flying ants (*Formicidae*) were common, as were the remains of beetles (*Coleoptera*) (Kershner et al. 2007). Kershner et al. (2007) speculated that Mariana swiftlets use a foraging strategy of seeking out pulses in insects and that such dense concentrations of prey could be important resources to swiftlets. Eggs are

laid in cup-shaped nests made of moss and saliva attached to cave walls or ceilings. A single egg is laid, usually between January and July. Swiftlets navigate through the darkest portions of caves using echolocation (Vogt and Williams 2004).

Threats to the Mariana Swiflet

The restricted distribution of Mariana swiftlets, along with its small population size and dependence on caves, makes the species vulnerable to threats. The causes for the decline of Mariana swiftlets are mostly unknown, but human disturbance, predation, pesticides, and disease have all been hypothesized as having a role. Swiftlets have been documented to flush or fail to enter their caves when humans are near or within their caves (Wiles and Woodside 1999, pp. 57, 61). Their sensitivity to human presence has resulted in injuries to chicks and adults and could result in damage to eggs (Wiles and Woodside 1999, p. 61). Sources of human disturbance have included Japanese soldiers during World War II, guano mining, hunters, hikers, and vandalism. While the introduction of brown treesnake is known to have caused the extirpation of many bird species in Guam and CNMI, it is not known whether it has significantly affected swiftlets. Brown treesnake predation on Mariana swiftlets is considered to be a regular event and only those birds able to find nest or roost sites on high, smooth walls and ceilings are able to avoid snake predation. The use of pesticides such as DDT has been suspected of causing the decline of swiftlet populations on Guam (Diamond 1984, p. 452), but the concentrations of pesticide residues found in swiftlet guano have not supported this hypothesis (Grue 1985, p. 301). On Saipan, non-native cockroaches are known to destroy swiftlet nests by consuming the saliva that holds the nests to the walls or ceilings (Cruz et al. 2008, p. 242). Savidge (1986, p. 9) investigated the role of disease in the decline of birds on Guam and found that there is no evidence that it has played a significant role. The typhoons that frequently occur in the area may cause periodic declines in swiftlet populations, but are not expected to threaten the species as a whole since the species has survived numerous such events during its evolutionary history (USFWS 1991b, p. 22).

Effects of the Action – Mariana Swiftlet

The current estimate of the Mariana swiftlet population on Guam is 1,150 birds (Grimm 2008, p. 1). On Guam, all three of the caves currently occupied by Mariana swiftlets are located within the Naval Munitions Site, and none of the proposed project stressors will occur near those caves. However, new aviation training flight paths are proposed over the Talafofo River watershed, the primary foraging area for swiftlets on Guam, and over the Naval Munitions area (refer to Figure 17 in the General Effects section). Flights may also occur over the Ugum River watershed that supports swiftlet foraging near the mouth of the river. Foraging by most members of the swift family (Apodidae) is likely limited to 328 ft (100 m) above the tree canopy because of the reduction in insect prey above that level (Chantler 1999, p. 402). Tree canopy height plus 328 ft (100 m) is expected to be well below 1,000 ft (305 m) above ground level, thereby reducing risk of bird/wildlife aircraft strike hazard but noise generated by the aircraft may still affect swiftlet foraging behavior, as has been documented in other species (refer to general effects, noise section). To avoid noise impacts and bird/wildlife aircraft strike hazard risks, all aviation training will be conducted such that flights approach the southern portion of the Naval Munitions Site over the Talafofo River watershed and Fena Reservoir at heights of 1,000 ft (305 m) or greater above ground level. Flights may go up the Ugum River at altitudes of 1,000 ft (305 m) or greater above ground level until they reach 9,843 ft (3,000 m) from the mouth of the river at

Highway 4 and then low-level terrain flights may begin. Otherwise, low-level training flights (DoN 2010a, p. 54) will be restricted to the southernmost portion of the Naval Munitions Site (DoN 2010a, p. 35) where swiftlets are not commonly present.

Because the proposed project will avoid Mariana swiftlet cave habitat, and because the proposed approach of aircraft will be higher than foraging Mariana swiftlets, we concur with your determination that the proposed action is not likely to adversely affect the Mariana swiftlet.

Micronesian Megapode

Micronesian Megapode Biology and Occurrence in the Action Area
The following section summarizes the population status and biology of the Micronesian megapode in the action area. Although the Micronesian megapode is endemic to Guam, CNMI, and Palau, currently megapodes from Micronesia and Palau are considered different races of the same species, *M. l. laperouse* and *M. l. senex*, respectively (USFWS 1998b, p. 4–5). Populations on Guam and Rota are considered extirpated (USFWS 1998b, p. 3; Stinson 1992, p. 220; Amidon 2009, pers. comm.). The population on Anatahan also appears to have been extirpated due to recent and ongoing volcanic activity (Kessler 2006, p. 3; Kessler 2009, pers. comm.). Based upon surveys conducted during the past decade, we have estimated the total population of the Micronesian megapode to be a minimum of 1,585 individuals (USFWS 2009a, p.124; Vogt 2009, p. 3).

Although Micronesian megapodes were not detected on Tinian during 2008 (USFWS 2009a, p. 124), proposed training areas on Tinian support foraging and roosting habitat for the Micronesian megapode (DoN 2009, pp. 3.11–26, 3.11–44). Incidental reports and regular sightings (1995 to 2005) of the Micronesian megapode on Tinian indicates that either a small but persisting population of Micronesian megapodes exists on Tinian or that Micronesian megapodes routinely use habitats on Tinian when flying between Aguiguan and Tinian or Tinian and Saipan (USFWS 1998b, pp. 10, 18; DoN 2009, p. 3.11–44). Due to the presence of suitable habitat and the occasional but routine observations of Micronesian megapodes on Tinian, we have determined that the Micronesian megapode is at least transient and reasonably certain to occur within the Military Lease Area on Tinian.

Micronesian megapodes can use a variety of habitat types. Typically, native and secondary forest are considered the primary habitats for foraging while nesting may occur in forests, open fields, cinder and ash fields, and coastal strand edges with sand substrates. The Micronesian megapode is omnivorous and forages under ferns, branches, and leaf litter on the forest floor and in trees within bird's nest ferns (*Asplenium nidus*) (Glass and Aldan 1988, p. 142). Diet includes seeds and other plant matter, beetles, ants, ant larvae, and other insects and crabs (Glass and Aldan 1988, p. 142; Pratt et al. 1980, p. 121; Stinson 1992, p. 230). Territory size was estimated between 2.47 ac (one ha) and approximately 9.4 ac (3.8 ha) depending on habitat type (Glass and Aldan 1988, pp. 141–142; Service 2009a, p. 124 and 126). Dispersal between islands of the CNMI is not well documented.

The reproductive cycle of the Micronesian megapode is not well understood. Megapodes, including the Micronesian megapode, do not incubate their nests with their own body heat.

Instead, megapodes will construct burrows or mounds on beaches and cinder fields, or at geothermal sites. Breeding has been observed (eggs, chicks, and juveniles) on Anatahan, Sarigan, Guguan, Pagan, Agrihan, and Maug during all months except October, November, and December (USFWS 1998b, pp. 6–7 and references within; Amidon 2009, pers. comm.). The absence of breeding activity in October, November, and December is more likely a reflection of the lack of surveys during these months, and difficulty in finding megapodes during traditional avian surveys (Amidon 2009, pers. comm.).

Threats to the Micronesian Megapode

The initial (20th century) declines in the Micronesian megapode populations in the southern islands of the archipelago (Guam, Rota, Aguiguan, Tinian, and Saipan) resulted from a combination of hunting, habitat loss and destruction, and the introduction of alien species (e.g., alien plant species and ungulates) that degraded native habitat (Vogt and Williams 2004, p. 22; Service 1998b, pp. 35–39). Current threats to the Micronesian megapode's habitat include military activities, urbanization, agriculture, and other forms of development manifesting themselves as habitat loss, fragmentation, or degradation of forest habitat; and direct disturbance of megapodes by noise, increased traffic, and/or physical intrusion on foraging and nest sites.

Effects of the Action - Micronesian Megapode

The Micronesian megapode is distributed from the more populated, southern Mariana Islands of Tinian and Saipan with the largest portion of its population of approximately 1,600 individuals occurring on several human uninhabited, Northern Mariana Islands (see Figure 17 in the General Effects section). While no megapodes are expected to be within the project footprint, the DoN has agreed to complete pre-construction surveys to ensure megapodes will be avoided during construction. Megapodes are expected to avoid the ranges after construction; however, they could use the surrounding forest areas. We anticipate no harm to megapodes from the operation and maintenance of the ranges as megapodes are known to tolerate other loud noises associated with military training (USFWS 2010). The DoN has proposed to minimize habitat impacts to Micronesian megapode on Tinian from the construction of firing ranges in the "FAA Mitigation Area" by adding some additional lands to the north. The additional land is comprised of native limestone forest and areas of tangantangan where megapodes were typically sighted between 1995 and 2005. The mitigation area will also receive management (native forest restoration in areas of non-native habitat) to benefit the Micronesian megapode as well as other native species. Megapodes are not expected to be breeding on Tinian; therefore clearing the forest habitat for ranges is not expected to affect megapode reproduction. The DoN will also terminate cattle grazing leases within the footprint of the new range complex. The DoN has proposed conservation measures to work with the government of CNMI to make sure the new cattle leases are not granted within habitat for listed species.

The Micronesian megapode no longer occurs on Guam, and its population on Tinian is considered to be transient or very small. Because of the population status of this species in the action area, and because of the minimization and offsetting measures implemented by the DoN described above, we concur with your determination that the proposed project is not likely to adversely affect the Micronesian megapode.

Sea Turtles

In addition to increases in human population, the project will result in development and installation of lights in the vicinity of the shoreline. Conservation measures to conserve sea turtles, including those summarized below will be implemented to minimize the action's potential effects on sea turtles:

1. To minimize recreational impacts to sea turtle adults, nests, and hatchlings and to prevent impacts to their nesting habitats from increased recreational beach use resulting from project-related population increases (DoN 2010a, p. 16), the DoN, in cooperation with USFWS and Guam Division of Aquatic and Wildlife Resources, will develop and implement sea turtle educational programs. These programs will inform military and civilian personnel about sea turtle nesting and the potential impacts to the species such as nest disturbance, harassment, and beach disturbance (DoN 2010a, p. 134). In addition to establishing signage near beaches describing the legal requirements regarding sea turtles, the DoN will develop and distribute sea turtle conservation brochures and other educational materials at military Morale, Welfare and Recreation facilities, beach picnic areas, trail heads, dive shops, and other locations where potential recreational beach users may frequent. Education and outreach will begin within the first two years of construction activities and continue throughout the construction phase until two years after completion of major construction activities (DoN 2010a, p. 16).

2. Reduce outdoor recreational impacts to sensitive beach areas at Haputo Ecological Reserve Area by establishing an outdoor recreation area in upland areas adjacent to the Main Cantonment Area on the Naval Computer and Telecommunications Station Finegayan.

3. On Tinian, the DoN, in cooperation with Service and the CNMI sea turtle program, will undertake an educational program to inform military and civilian personnel about sea turtle nesting and the potential impacts to the species such as nest disturbance, harassment, and beach disturbance. The DoN will prepare and distribute brochures describing the legal requirements regarding sea turtles to potential recreational beach users. In addition, information on sea turtles will be included as part of the environmental briefings associated with training on Tinian (DoN 2010a, p. 116). Education and outreach will begin within the first two years of construction activities on Tinian and continue for as long as DoN training occurs on Tinian.

4. The DoN will submit a proposal to Chief of Naval Operations N45 to expand the existing Orote Ecological Reserve Area to encompass Orote Island, Adotgan Point, and the Spanish Steps areas that support sea turtle nesting on Naval Base Guam (DoN 2010a, p. 125).

5. To develop a better understanding of baseline populations and long-term ecological processes of marine turtles in the waters of Guam, Saipan, Tinian and Rota, the DoN, in conjunction with relevant federal resource agencies will develop and implement a joint investigation of sea turtle population abundance estimates, demography, near-shore habitat use, baseline population size, and long-term changes in population parameters

(DoN 2010a, p. 134). The project will include a long-term study of foraging habitat use and growth rate, a mark-recapture program to estimate sea turtle abundance, laparoscopic examinations to determine reproductive status and gender, and completion of demographic modeling. A long-term, in-water study will provide valuable information regarding near-shore foraging habitat use, and combined with applied research techniques including sonic (or acoustic) tags, satellite telemetry, and genetic analysis will provide greater insight into foraging ecology, migratory movements and connectivity of sea turtles within the greater Western Pacific region. This measure will begin within the first two years of construction activities (DoN 2010a, p. 16). Once details of this action are finalized, the DoN will coordinate with the Service to secure any permits necessary to address handling of the sea turtles.

6. The DoN has proposed a number of conservation measures to reduce the risk of introduction, spread, and establishment of non-native invasive species due to the proposed project actions (described in the Project Description section of this Biological Opinion).

The Service and the National Marine Fisheries Service (NMFS) share Federal coordination responsibilities for sea turtles pursuant to section 7 of the Act. The Service addresses all issues involving sea turtles using terrestrial habitats; NMFS addresses sea turtles and their habitats in the marine environment. Therefore, we only reviewed the proposed action for its potential impacts on eggs, hatchlings, nesting, and basking sea turtles, addressing sea turtles on land and their shoreline habitat.

Sea Turtle Biology and Occurrence on Guam and Tinian

The following section summarizes sea turtle biology based on the information in recovery plans and five-year status reviews developed by the NMFS and Service (NMFS and USFWS 1998a, 95 pp.; 1998b, 95 pp.; 2007a, 105 pp.; 2007b, 93 pp). Sea turtles are highly migratory, globally distributed, and generally found in tropical and subtropical waters along continental coasts and islands between 30° north and 30° south latitude and, to a lesser extent, in subtropical waters with temperatures above 20° C. The geographic range of sea turtles includes the Caribbean Sea, Atlantic, Pacific, and Indian Oceans and associated bodies of water.

Sea turtles bury their eggs in the sand in upper areas of oceanic beaches. Reproductive maturity occurs at ages ranging from 20 to 50 years and varies by species. Female sea turtles have high site fidelity to their hatching (natal) beaches, returning close to their own hatching site to lay their nests. Females may nest multiple times over a given nesting season. Nesting seasons typically occur at semi-regular intervals, with inter-nesting intervals ranging between two to more than five years depending on the species. Hatchlings emerge 45 to 90 days after a nest is laid. Emerging hatchlings navigate toward the water using visual cues; they move toward the brighter horizon and away from darker silhouettes formed by dune line, tree lines, or cliff walls (Tuxbury and Salmon 2005, p. 312). In addition to nesting, green turtles may also use beaches to haul out and bask, although this behavior has never been documented in Guam or the CNMI (Kelly, 2009, pers. comm.; Wusstig 2009, pers. comm.).

Green turtle

Numbers of breeding green turtle populations in Hawaii, Australia, and Japan are increasing (Chaloupka et al. 2008, p. 299; NMFS and Service 2007a, p. 13) and numbers of turtles nesting on Guam have been stable (NMFS and Service 2007a, p. 13). Green sea turtles are regularly recorded in the waters in Guam and the Commonwealth of the Northern Mariana Islands (CNMI) (Kolinski et al. 2004, p. 110; Kolinski et al. 2001, p. 55; Kolinski et al. 2006, p. 509). Individuals have been detected around most of the northern islands within the CNMI (Ilo and Manglona 2002, p. 4), although in lesser abundance than in the southern islands (Kolinski et al. 2005, p. 290). Approximately 1,000 to 2,000 green turtles inhabit island reef areas in Guam and the southern CNMI (Kolinski et al. 2004, pp. 98, 111). In 1995 and 2001 (Tinian), 1999 (Saipan), and 2003 (Rota), the majority of individuals observed in the surrounding waters were juveniles or sub adults (Kolinski et al. 2001, pp. 59, 66; Kolinski et al. 2004, p. 107; Kolinski et al. 2006, pp. 514, 517; Pultz et al. 1999, p. 92).

Green turtles are known to nest on the following Guam beaches: Adotgan Dangkolo, Adotgan Dikiki, Waterfront Annex of Naval Base Guam, Kilo Wharf area, Spanish Steps, Cocos Island, Asiga Bay, Nomnia area, Deley Beach, Turtle Cove to Togcha Beach, Tagachan Beach, Andersen Air Force Base (Tarague Beach, Sirena Beach, Pati Point), Jinapsan Beach, Cetti Bay, Sella Bay, Inarajan Beach, Acho Bay, Guam National Wildlife Refuge, Haputo area, Urano area, Tumon Bay, and Cabras area (Sea Plane Beach) (Wusstig 2009, pers. comm.; Grimm and Farley 2008, p. 1). Nesting activity on Guam occurs throughout the entire year with a peak in nesting between April and July (Grimm and Farley 2008, p. 1). Nesting has been known to occur from January through mid-July on Tinian (Pultz et al. 1999, p. 86). Sea turtles nest infrequently on Guam and Tinian (Kolinski et al. 2001, p. 59; Pultz et al. 1999, pp. 84, 87; Kolinski et al. 2004, p. 113; Grimm and Farley 2008, p. 3). Hatching success of these nests was 84% and approximately 93% of the hatchlings emerged successfully (Wusstig 2009, pers. comm.). Incubation periods on Guam are known to be approximately 50 and 90 days (Grimm and Farley 2008, p. 1).

Green turtles are likely to nest on all Tinian beaches (Pultz et al. 1999, p. 85). On Tinian, mean clutch size of 91 eggs, an incubation period of 62 days, and hatching success for successful nests of 89% has been recorded (Pultz et al. 1999, p. 85).

Hawksbill turtle

The status of breeding hawksbill turtles is generally decreasing globally; however, there has been a recent increase in reproductive effort within the Atlantic Ocean basin and at one location (Hawaii) in the Pacific Ocean basin (NMFS and Service 2007b, pp. 19-20 and references within).

Hawksbill turtles are frequently sighted in the near-shore waters surrounding Guam (Grimm and Farley 2008, p. 1). On Guam, the population is thought to be declining, and fewer than ten females are expected to nest per season (NMFS and Service 2007b, p. 19). Hawksbill turtles were reported nesting in June and July at Tarague Beach, Guam; however, this is based on only one year of data (Wusstig 2009, pers. comm.). Between 1991 and 1994, hawksbill turtles nested in Sumay Marina, Guam, during varying months including October, December, February, and March (Wusstig 2009, pers. comm.). An average of 55 days (51 to 58 days; 4 nests) was

documented from the time of nest discovery to nest hatch. Clutch sizes ranged from 81 to 121 eggs. Hatchling data is incomplete; however, one clutch of 121 eggs produced 70 hatchlings. In 2008, four incomplete nesting attempts at Adotgan Dikiki, Guam, were attributed to the hawksbill turtle (Grimm and Farley 2008, p. 3). The most recent documented hawksbill turtle nest was in 2009, when four nests, believed to be from the same female, were found (Wusstig 2009, pers comm.).

Although anecdotal information suggests that hawksbill nesting occurred historically within the CNMI, no nesting activity has been documented there in recent years (Kelly 2009, pers. comm.). This species was not observed on Tinian during marine and terrestrial surveys between 1999 and 2003 (Kolinski et al. 2004, p. 110; Kolinski et al. 2001, p. 55; Kolinski et al. 2006, p. 509). As described for the green turtle above, hawksbill turtles also recruit to foraging grounds that may be hundreds or thousands of kilometers from their natal beaches (Bowen 1995, p. 532) and as such the CNMI may support only a foraging population of hawksbill turtles.

Potential Threats to Sea Turtles – Nesting Environment

Threats to the green turtle on nesting grounds, as outlined in their recovery plan (NMFS and Service 1993), are representative of those also faced by hawksbill turtles. Storm events, including typhoons, may destroy nests because of flooding or piling of eroded sand on the nest site. Beach erosion due to wave action may decrease the availability of suitable nesting habitats and result in a decline in the nesting rate. A number of non-native and native predators dig into nests and prey upon incubating eggs, while some predators, including birds, may take hatchlings just prior to or during their emergence from nests.

Human crowding of nesting beaches can disturb nesting females and prevent laying of eggs. Flashlight use, beach fires, and artificial lighting on human structures may deter females from coming up onto a beach or may disorient hatchlings as they emerge from nests and try to find the sea (Witherington and Martin 1996, p. 4-5). Emerging hatchlings may respond to the effects of artificial lighting by causing hatchlings to move in the wrong direction (*misorientation*) and/or interfere with their overall ability to orient (*disorientation*), which causes hatchlings to move in circles attempting to orient in the correct direction. Both behaviors can result in hatchling mortality through exhaustion, dehydration, predation, and other causes (Mann 1977, p. 54; Witherington and Martin 1996, p. 4-5).

An increased human presence may lead to an increase in the presence of domestic pets (which can depredate nests) and may lead to an increase in litter (which may attract wild predators). Trampling can increase sand compaction, which may damage nests or hatchlings. Humans may also introduce exotic vegetation in conjunction with beach development that can overrun nesting habitat or make the substrate unsuitable for digging nest cavities.

An increase in human population often relates to an increase in coastal development. Construction on or in the vicinity of sea turtle nesting beaches can result in sand compaction, beach erosion, and increase in direct and ambient light pollution. The rate of habitat loss because of erosion and escarpment may be increased when humans attempt to stabilize the shoreline, either through re-nourishment or through placement of hard structures, such as sea walls or pilings. Off-road vehicle traffic also contributes to habitat loss through erosion, especially

during high tides or on narrow beaches where driving is often concentrated on the high beach and fore dune.

One of the most substantial threats to nesting sea turtles in the Pacific Islands remains the illegal poaching of adults and eggs (NMFS and USFWS 1998a). The direct harvest of adult nesting females can increase the rate of local extinction. Harvesting of eggs reduces the chance that recruitment will replace the reduced breeding population.

Effects of the Action – Sea Turtles

The proposed project construction, operation, and maintenance of facilities on Guam and Tinian will have no direct impact on sea turtle basking and nesting habitat on either island. However, recreational beach use is expected to increase on Guam and Tinian due to the increase in military and civilian populations.

Temporary lighting used during approximately 18 months of harbor dredging and permanent increases in lighting in Apra Harbor resulting from the proposed project may affect sea turtle nesting and hatchling sea turtles. Project lights are expected to be visible from some of the sea turtle nesting beaches of the Spanish Steps. However, currently these sections of the beach already have significant lighting impacts from the commercial port that exists to the northeast of the nesting area. In the beach's current condition, we believe that some nesting females may be deterred from nesting at this location, and emerging hatchlings may become *misoriented* as they attempt to move from their nest to the water. Because a dark cliff runs behind and to the sides of the Spanish Steps nesting sites, current lighting conditions are not likely to result in *disorientation* of hatchlings moving from the nest to the water. The darkened cliffs at Spanish Steps beaches create a silhouette and make it likely that emerging hatchlings will be able to orient towards the water. Once in the water they are likely to navigate toward the existing artificial lights across Apra Harbor, east-northeast of the nesting beaches.

Despite the fact that the proposed project will likely increase the overall lighting in the Apra Harbor, this increase is not likely to result in an increase in adverse effects to nesting females and emerging hatchlings because the current light pollution is already severe and the darkened cliff line along the shore will continue to minimize the impact of the lights and the likelihood hatchlings will be disoriented. Because the project will result in increased lighting east of the nesting beaches, the hatchlings are likely to be drawn across the beach toward the east, in addition to being drawn toward the east-northeast. Because the Spanish Steps area beaches are narrow, the resulting increase in the hatchling's travel distance to water would be less than a maximum of 250 ft (76 m). Because sea turtle nesting beaches are commonly wider than 250 ft (76 m), we do not anticipate the increased travel distance would result in decreased hatchling survival.

Sea turtle nests on Guam and Tinian could be crushed or dug up by recreational beach users and their pets. To minimize potential recreational impacts to sea turtles, the DoN has proposed to protect nesting beaches on Orote Island and Adotgan Point through Ecological Area Reserve expansion and to reduce outdoor recreational beach use impacts by establishing an outdoor recreation area at an upland site adjacent to the Main Cantonment Area, and by developing and implementing sea turtle education and outreach programs at beaches on Guam and Tinian. The DoN's public education program will reduce the likelihood that recreational beach users and

their pets will crush or dig up sea turtle nests or expose them to artificial lights. Because the project will avoid direct impacts to sea turtle habitat, increased lighting in Apra Harbor will not be likely to result in adverse effects to hatchlings at Spanish Steps beaches, and recreational impacts to sea turtle nests will be unlikely as a result of DoN's public education program, we concur with your determination that the proposed project may affect, but is not likely to adversely affect, green or hawksbill turtles.

2.3 STATUS AND ENVIRONMENTAL BASELINE OF THE SPECIES

Introduction

This section presents the biological and ecological information relevant to formulating the Service's Opinion covering one threatened bat species and six endangered bird species (see Table 1). These listed species are either present within the action area on DoD-owned or leased lands, government lands, and private lands and/or their recovery depends on aforementioned lands.

We provide an overview of threats that impact some or all of the species evaluated in this Biological Opinion, and then we discuss life history, habitat, distribution, abundance, threats, conservation needs, and other factors necessary for survival of these species as the basis for analyses in later sections of this Biological Opinion. In the the "environmental baseline" descriptions, we summarize this species information within the action area. Demographic data are utilized where available to generally indicate whether the number of individuals of a species is increasing, decreasing, or stable.

Threats to listed species in the Marianas include small population sizes, habitat fragmentation, predation by non-native vertebrates and invertebrates, browsing by feral ungulates, fire, and tropical storms. Human hunting and harassment negatively impact the population status of several listed species in the Marianas. Below we provide an overview of these threats and their effects to species.

General Threats

Small Population Size

Listed species in the Marianas generally have restricted distributions and few populations, and these populations usually also have a low number of individuals. Threats, such as the brown treesnake, will exacerbate the inherent risks of small populations to further increase the risk of extirpation and extinction of the listed species addressed in this Biological Opinion.

Species that are endemic to single islands are inherently more vulnerable to extinction than species with a broad distribution because of the increased risk of genetic bottlenecks, random demographic fluctuations, and localized catastrophes such as tropical storms and disease outbreaks (Mangel and Tier 1994, p. 607; Pimm et al. 1988, p. 757). These problems are further magnified when the number of populations is small and restricted to a very small geographic area, and when the number of individuals is very small. Populations with these characteristics face an increased likelihood of stochastic extinction due to changes in demography, the environment, genetics, or other factors (Gilpin and Soulé 1986, pp. 24-34).

Small, isolated populations often exhibit reduced levels of genetic variability, which diminishes the species' capacity to adapt and respond to environmental changes, thereby decreasing the probability of long-term persistence (e.g., Barrett and Kohn 1991, p. 4; Newman and Pilson

1997, p. 361). The problems associated with small population size and vulnerability to random demographic fluctuations or natural catastrophes are further magnified by synergistic interactions with other threats, such as those discussed below.

Small populations are more vulnerable than large populations to extirpation from naturally occurring events (environmental stochasticity), reduced reproductive vigor (demographic stochasticity), or a combination of both factors (Dennis et al. 1991; Schemske et al. 1994). Demographic stochasticity refers to the variability in population growth rates arising from random differences among individuals in survival and reproduction within a season. Environmental stochasticity refers to variation in birth and death rates from one season to the next in response to weather, disease, competition, predation, or other factors external to the population. The limited gene pools of small populations also may decrease reproductive vigor through the loss of genetic variation resulting from inbreeding, accumulation of deleterious mutations, and genetic drift. Reduced genetic variability in a population thus results in a decline to both individual fitness and population viability, and resilience to environmental change.

According to our current understanding of conservation biology, demographic and environmental variation, including catastrophic occurrences (such as flooding or fire), are important determinants of population extinction (Menges 1990; Mangel and Tier 1994; Schemske et al. 1994). A general pattern of population collapse has been documented for a wide range of plant and animal species with small population sizes (Dennis et al. 1991; Schemske et al. 1994; Morris et al. 1999; Menges 2000). According to this pattern some species in the action area are already in a phase of quasi-extinction (quasi-extinction refers to a specified population threshold considered too low for species survival). The numbers of individuals of some species is so low, environmental or demographic stochasticity alone could result in extirpation. Quasi-extinct species have a high background risk of extinction and any additional threats, such as training-related wildfire or increased predation due to brown treesnake introduction, could eliminate expectation of their long-term persistence.

Dennis et al. (1991) developed statistical methods for estimating growth rates and quasi-extinction probabilities for populations of several endangered bird and animal species based on 15 to 40 years of time-series monitoring data. Results predicted that, without intensive management, the Yellowstone grizzly bear population, Kirtland warbler, California condor, and Puerto Rican parrot would decrease to 10 or fewer reproducing adults in 13 to 109 years. Graphical representations of population trends for these species indicate the general pattern of population collapse except for the parrot. The number of Puerto Rican parrots is increasing, but solely due to release of captive-reared birds, protection of juveniles, and intensive habitat management; the breeding population has remained nearly constant, and effects of environmental catastrophes like hurricanes were not considered in the model. For plants, Burgman et al. (2001) defined quasi-extinction risk as a 0.1 % probability of decline below 50 adult individuals over 50 years, and used this criterion to determine a species' background probability of persistence.

The factors that caused a species' extinction are often unknown (Gurevitch and Padilla 2004). Norton (1991) was able to document these factors for *Trilepidea adamsii*, an endemic New Zealand mistletoe species. *Trilepidea adamsii* is now presumed extinct due to interacting factors of habitat loss, limited distribution, reduced seed dispersal, overcollection, and browsing by the

non-native brushtailed possum (*Trichosurus vulpecula*). In the United States, the heath hen (*Tympanuchus cupido cupido*) was driven to extinction by a combination of catastrophes including fire, harsh winter weather, predation, and disease (cited in Mangel and Tier 1994). Catastrophes combined with other kinds of environmental fluctuation have been associated with extinction of the great auk (*Pinguinus impennis*) and with the severe population decrease of the Laysan duck (*Anas laysanensis*) and short-tailed albatross (*Phoebastria albatrus*) (cited in Mangel and Tier 1994).

Factors that contribute to demographic and environmental stochasticity in the action area include naturally occurring events such as drought, catastrophic events such as tropical storms and wildfire, competition from non-native invasive plants, predation and herbivory by non-native animals, trampling and uprooting by feral ungulates, disease, and human persecution.

Habitat Modification

The species addressed in this consultation are currently impacted by habitat fragmentation and degradation by ungulates, fire, and tropical storms. Habitat degradation is the primary cause of extinction and endangerment of wildlife (Groom and Vynne 2006, p.173). Habitat degradation and loss is caused by various human activities including: agriculture, mining, forestry, fisheries, aquaculture, groundwater extraction, fires, infrastructure development, dams, urbanization, industry, pollution (including light, noise, and toxic chemicals), and changes in community and ecosystem structure due to invasive species (Groom and Vynne 2006, p. 174). Habitat fragmentation is a change in habitat configuration with the remaining habitat occurring in patches among areas of non-habitat (Noss et al. 2006, p. 213) and can result from the activities listed above.

When habitats are impacted, edges (a type of habitat fragmentation) are created. Edges form the boundary of a habitat and have different properties than the habitat itself. For example, edges often have different microclimate patterns which are drier, less shaded, and warmer than forest interiors. Edge habitats are generally areas of increased predation and the entry point for invasive vegetation, pests, and pathogens to encroach within native habitats (Noss et al. 2006, p. 228). Habitat degradation, fragmentation, and loss can result in localized extinctions, shifts in community composition (including increases in invasive species), increased predation, and can result in suitable habitat becoming unsuitable due to pollution, invasive species, physical size (for species that are area-sensitive), or barriers blocking access to habitats (including distance or lack of corridors and stepping stones, etc.) (Noss et al. 2006, 38 pp.; Groom and Vynne 2006, p. 174).

<u>Habitat Fragmentation</u>

The ecological integrity of the remaining native forest in the Mariana Islands is threatened by development, agriculture, and the long-term ecological impacts of ungulates, invasive plants, and, on Guam, the brown treesnake. Over the past several centuries, the Marianas have lost much of the native forest to agriculture and growing human population, economic development, and military activities (USFWS 2009a, p. 27).

Habitat fragmentation and alteration have been implicated in reduced species richness, avian abundance, productivity, and even food supply (Blake and Karr 1987, VanderWerf 1993, Burke and Nol 1998, Trine 1998, Porneluzi and Faaborg 1999, Coulter 2005). Bayne and Hobson (2001) found that female ovenbirds (*Seiurus aurocapillus*) avoid edges, such that males with territories further from edges had a greater probability of attracting a mate. Burke and Nol (2000) studied nesting success of five species of songbirds in south-central Ontario and found that for four of five species, adult female reproductive success was at or above replacement levels in large forest fragments and continuous forest and below replacement levels in small forest fragments. Herkert et al. (2003) found that nest predation of four grassland species was highest in the small (<250 ac (<100 ha)) and lowest in large (>2,500 ac (>1,000 ha)) prairie fragments. Fort and Otter (2004) studied the effect of habitat disturbance on reproduction of black-capped chickadees (*Poecile atricapillus*) and found that overall, birds nesting in disturbed habitats experienced lower nest success than those breeding in undisturbed habitats. Hagen et al. (1996) also found ovenbirds had lower pairing success in fragmented habitat and suggest this may be a result of behavioral dysfunction resulting from abnormally high densities.

Introduced Ungulates

Non-native ungulate species that occur in the Marianas include pigs (*Sus scrofa*), goats (*Capra hircus*), Philippine deer (*Cervus mariannus*), and Asiatic water buffalo (*Bubalis bubalis*). In the Marianas ungulates have caused severe damage to forests by browsing on plants, causing erosion, inhibiting plant growth and regeneration, and facilitating the establishment of invasive plants, which can impede forest regeneration by displacing or smothering native species (USFWS 2009a, p. 27). Although Guam is dominated by native forest, Wiles (2005) documented a rapid decline in the native breadfruit due to a combination of mortality of mature trees from typhoons and a lack of recruitment caused by deer and pig foraging on fallen fruit and seedlings.

These introduced pigs are extremely destructive and have both direct and indirect impacts on native plant communities. While rooting in the soil in search of invertebrates and plant material, pigs directly impact native plants by disturbing and destroying vegetative cover, and trampling plants and seedlings. They may also reduce or eliminate plant regeneration by damaging or eating seeds and seedlings.

Pigs are a major vector for the establishment and spread of competing invasive non-native plant species, by dispersing plant seeds on their hooves and coats as well as through the spread of their feces (Diong 1982, pp. 169-170), and by fertilizing the disturbed soil with their feces (Matson 1990, p. 245; Siemann et al. 2009, p. 547). Pigs feed preferentially on the fruits of many non-native plants, such as banana poka (*Passiflora tarminiana*) and strawberry guava (*Psidium cattleianum*), spreading the seeds of these invasive species through their feces as they travel in search of food. In addition, rooting pigs contribute to erosion by clearing vegetation and creating large areas of disturbed soil, especially on slopes (Smith 1985, pp. 190, 192, 196, 200, 204, 230–231; Stone 1985, pp. 254–255, 262–264; Medeiros et al. 1986, pp. 27–28; Scott et al. 1986, pp. 360–361; Tomich 1986, pp. 120–126; Cuddihy and Stone 1990, pp. 64–65; Aplet et al. 1991, p. 56; Loope et al. 1991, pp. 1–21; Gagne and Cuddihy 1999, p. 52).

On Guam, feral pigs are distributed island wide, and densities may be as high as 238 pigs per square mi (110 pigs per square km). As has been documented in other locations, wallowing, rooting, and trampling are common in most forested areas and can be locally severe (Conry 1988, p. 27).

Feral goats defoliate vegetation, trample roots and seedlings, cause erosion, and promote the invasion of alien plants. They are able to forage in extremely rugged terrain and have a high reproductive capacity (Clarke and Cuddihy 1980, p. C-20; van Riper and van Riper 1982, pp. 34-35; Tomich 1986, pp. 153-156; Cuddihy and Stone 1990, p. 64). A study of goat predation on a native koa (*Acacia koa*) forest on the island of Hawaii showed that grazing pressure by goats can cause the eventual extripation of koa because it is unable to reproduce (Spatz and Mueller-Dombois 1973, p. 874). If the number of goats remains high, mature trees will eventually die and with them, the root systems that support suckers and vegetative reproduction. An exclosure analysis demonstrated that release from goat pressure by fencing resulted in a rapid recovery in height, growth, and numbers of vegetative resprouts of koa (Spatz and Mueller-Dombois 1973, p. 873). Another study at Puuwaawaa on the island of Hawaii demonstrated that prior to management actions in 1985, regeneration of endemic shrubs and trees in the goat-grazed area was almost absent, contributing to the invasion of the forest understory by exotic grasses and weeds. After the removal of grazing animals in 1985, koa and ohia (*Metrosideros* spp.) seedlings were observed germinating by the thousands (Hawaii Department of Land and Natural Resources 2002, p. 52). Based on a comparison of fenced and unfenced areas, it is clear that goats can devastate native ecosystems. There can be up to an estimated 2 goats per 2.5 ac (1 (ha) in areas in Hawaii (Kessler 2008, pers. comm.).

On Guam, Philippine deer were introduced in the 1770s, and are distributed throughout the island. Heavy browsing pressure has been documented, even at relatively low densities (Conry 1988, p. 27). High densities, and the gregarious habits of carabao, have resulted in habitat damage such as mud wallows, broad trails, vegetation trampling, and tracks. Some areas are so heavily trampled that ground cover has been denuded and soil erosion scars and slumping are evident (Conry 1988, pp. 27-28).

Wildfire Conversion of Forest to Savanna in Southern Guam

Although there is ongoing debate regarding the formation of savanna areas in Guam (Hunter-Andersen 2009 and Athens and Ward 2004), savanna areas are enlarging into previously forested areas as a result of human-caused wildfires. Over a three-year period from 2000 through 2003, 2,020 arson fires burned 6,000 ac (2,400 ha) in Guam and of the approximately 750 wildfires burning each year on Guam, approximately 80% are caused by arson (Wildland Fire Prevention and Education Team Final Report, 2003, as cited in Neill and Rea 2004, p. 6-7). The average annual number of fires reported on non-DoN land increased from 612 during the 1979 through 1989 period to an average of 786 during the 1991 through 2002 period (an increase of approximately 27%). This increase may be due to improved fire reporting. The total area burned per year by these fires dropped by approximately 35% in the 1991 through 2002 period, compared with annual acreage burned in the 1979 through 1989 period.

To estimate the rate of historical forest conversion to savanna, Greenlee (2010) delineated areas which appeared to be dominated by forest vegetation in 1975 aerial photographs which are no longer forested in recent infrared imagery and estimated that 1,119 ac (453 ha) of forest has been converted to savanna in southern Guam since 1975 (Figure 15). This estimate indicates the average rate of forest loss in southern Guam is approximately 37 ac/year (15 ha/year).

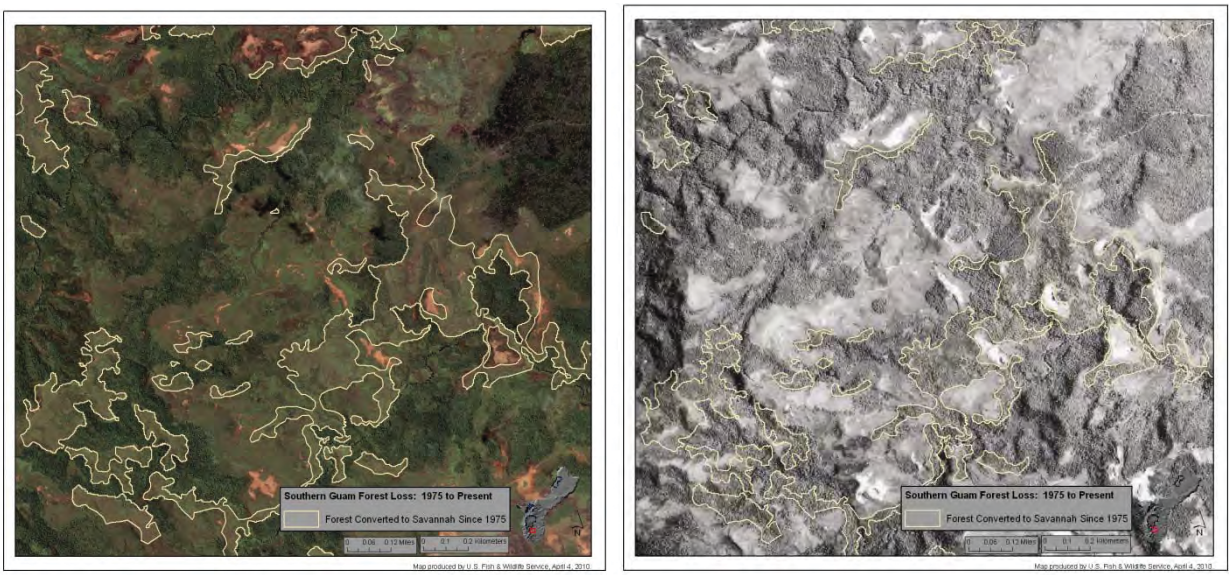

Figure 15. Savanna areas that were forested in 1975 are outlined in 2005 (left) and 1975 (right) aerial photographs.

Southern Guam's savanna and burned forest areas are dominated by 6-ft (2-m) tall swordgrass (*Miscanthus floridulus*) with an estimated 19 tons/ac (43 tonne/ha) fuel loading (Neill and Rea 2004, p. 3). These tall stands of grass do not contain habitat essential for the feeding, breeding, and sheltering of the Guam Micronesian kingfisher, Mariana crow, Mariana fruit bat and they are not suitable for regeneration of the endangered tree *Serianthes nelsonii*. Furthermore, proximity to savanna areas increases fire threat to the forest habitats which are necessary for the recovery of these listed species.

Habitat Destruction and Modification by Hurricanes and Typhoons

Typhoons are a common occurrence in the Marianas. Guam has been affected by typhoons in 37 of the last 50 years (USFWS 2005c p. 32). Supertyphoons (with wind gusts of over 240 km (150 mi) per hour) occur approximately once every five years. Hurricanes occur in the Hawaiian Islands at a much lower frequency. Typhoons and hurricanes have both direct and indirect effects on birds and bats. Direct effects include loss of nests, eggs, and nestlings and direct mortality of bats and their young. Indirect effects include the loss or reduction of food resources and nesting and roosting sites; increased predation and hunting due to loss of cover or altered foraging behavior; and long-term habitat changes. Typhoons and hurricanes adversely impact native habitat by destroying native vegetation, opening the canopy and thus modifying the availability of light, and creating disturbed areas conducive to invasion by non-native pest species (Asner and Goldstein 1997, p. 148; Harrington et al. 1997, pp. 539-540). Because many

plant and animal species persist in low numbers, and in restricted ranges, natural disasters such as hurricanes can be particularly devastating (Mitchell et al. 2007, p. 4-3). Supertyphoons fragment and decrease the suitability of existing habitat, and exacerbate the effects of introduced plants and ungulates (USFWS 2005c p. 34). Following a typhoon, forest canopies may be disrupted, facilitating the establishment and spread of introduced plants.

Avian Diseases

The importance of avian malaria and pox on native forest birds in the Marianas is uncertain due to lack of formal studies (USFWS 2007a, p. 20). Research on the role of avian disease in the decline of native forest birds on Guam did not identify disease as an important factor (USFWS 2007a, p. 20). However, the presence of avian disease has been noted in white-eye populations on Saipan and Tinian (USFWS 2007a, p. 20).

The most prevalent disease affecting waterbirds is avian botulism (USFWS 2005a). It is caused by a toxin produced by anaerobic bacteria (*Clostridium botulinum*) in stagnant water. It may reappear at affected locations annually and can affect all waterbirds, causing paralysis and eventual death.

Predation

The Marianas

A serious threat to listed species in the Mariana archipelago is the potential for the establishment of the brown treesnake on additional islands in the Mariana archipelago. The brown treesnake was found to be the main cause of the decline of the native forest birds on Guam as it opportunistically preys upon eggs, nestlings, and adult birds (Conry 1988, Savidge 1986, 1987). Extirpations of all but two resident forest avian species in southern Guam occurred within 27 to 32 years after accidental introduction of the brown treesnake. In northern Guam, the average time for the bird populations to decline by 90% was 8.9 years (Wiles et al. 2003). Because the ecosystems on Saipan, Rota, and Tinian are biologically similar to that of Guam, establishment of a brown treesnake population on these other islands would be likely to have consequences similar to those of Guam, (Brown Tree Snake Working Group 2009). Equipment and materials (*e.g.*, for construction) shipped from Guam to Saipan, Rota, or Tinian have the potential to carry, and therefore, spread brown treesnakes to areas throughout the island, increasing the ability of the snake to establish itself island-wide.

There have been 77 credible sightings of brown treesnakes on Saipan since 1982. These sightings have resulted in eleven captures of live brown treesnakes, eight of which were in the vicinity of the seaport or airport and three were in the interior of the island (Hawley 2007, pers. comm.). Evidence of an established or recruiting population of brown treesnakes is lacking for Saipan; however, the snake has been found there (Rodda and Savidge 2007). Brown treesnakes have also been reported on Tinian (9 sightings), and three dead brown treesnakes have been found in cargo delivered to Rota (Hawley 2007, pers. comm.).

The extent of the threat posed by introduced predators, aside from the brown treesnake, in the Mariana Islands is under debate (*e.g.*, Amar 2004, Sachtleben 2005, VanderWerf et al. 2007). There is evidence that the threat posed by the suite of introduced predators is high (Mosher 1999, Mosher 2006) and warrants further study. For example, Mosher (2006) found that out of 28 active nightingale reed-warbler nests that failed, 75% failed due to predation: 15 from rats, 1 from a feral cat, and 5 due to unknown predator(s). Rat predation has been documented to reduce reproductive success and contribute to the decline and extinction of avian species in other areas including island ecosystems (Atkinson 1985, Lindsey et al. 1999, Thibault et al. (2002), Tomich 1986, VanderWerf 2001a, VanderWerf and Smith 2002).

The black drongo (*Dicrurus macrocercus*) was intentionally introduced to Rota in the 1930s and naturally colonized Guam in the 1960s (USFWS 2007a, p. 21). Black drongos are primarily insectivorous, but have been observed eating small birds. Research concluded that black drongo predation of listed species could have an impact on already reduced populations, but that they are not a primary cause of species decline (USFWS 2007a, p. 21).

Climate Change

The information currently available on the effects of global climate change does not allow precise estimates of the location and magnitude of effects. Consequently, the exact nature of the impacts of global climate change and increasing temperatures on listed species addressed in this Biological Opinion are unknown.

We currently do not have a good understanding of how the globally predicted effects of climate change may impact the Mariana Islands. The Center for Island Climate Adaptation and Policy at the University of Hawaii has produced a summary of how Hawaii's climate is changing (Fletcher 2010). This summary is the most current assessment available. Guam and Tinian are expected to have climate change effects similar to those in Hawaii, but the effects on birds may be somewhat less from an overall perspective (North American Bird Conservation Initiative 2010, p. 4). Fletcher (2010, p. 1) identifies six changes to Hawaii's climate that have already occurred:

1. Increased air temperature. The global average temperature has risen by approximately 0.74^{o}C (1.33^{o} F) in the past 100 years (Trenberth and Josey 2007, p. 237). According to modeling projections, global average temperature is expected to rise, even if carbon emissions remain at current levels (IPCC 2007, p. 13). In the Hawaiian Islands, the difference between average high temperatures and average low temperatures is decreasing, resulting in a warmer environment, especially at higher elevations and at night (Giambelluca et al. 2008, p. 2). An analysis of over 80 years of weather station data in the Hawaiian Islands indicates that: (1) higher elevations (above 800 m (2625 ft)) have warmed at a higher rate per decade than lower elevations; (2) warming is lower in summer and greater in winter when compared to annual trends; and, (3) minimum temperature is increasing, especially at higher elevations. The average ambient temperature (at sea level) is projected to increase by 1 to 6°C (2.0 to 11.5^{o}F) by 2100 (Karl et al. 2009, p. 24). This change will increase monthly average temperatures in the Hawaiian Islands from 25°C to 30°C (77°F to 86°F). However, actual observations in the Hawaiian Islands indicate that the rate of increase at low elevation is below the observed global temperature rise per decade (Trenberth and Josey 2007, p. 252;

Meehl et al. 2005). The physical impact of higher temperatures on most listed species has not yet been calculated. However, we do expect increases in the distribution of avian malaria as higher elevation transition from being cool and unsuitable for malaria to warmer and suitable for malaria (Benning et al. 2002, pp. 14246 and 14248).

2. Increased sea surface temperatures. Sea temperature in the Hawaiian Islands has increased and future increases may have negative effects on coral reefs (Jokiel and Brown 2004, p. 1636) and other systems. For the listed species addressed in this Biological Opinion, effects that damage reefs may increase the effects of storms on coastal wetlands and habitat.

3. Decreased rainfall and stream flow. Oki (2004, p. 4) has noted long-term evidence of decreased precipitation and stream flow in the Hawaiian Islands, based upon evidence collected by stream gauging stations. This long-term drying trend, coupled with existing ditch diversions and periodic El Niño-caused drying events, has created a pattern of severe and persistent stream dewatering events. Future changes in precipitation and the forecast of those changes are highly uncertain because they depend, in part, on how the El Niño-La Niña weather cycle (a disruption of the ocean atmospheric system in the tropical Pacific having important global consequences for weather and climate) might change (Hawaii Climate Change Action Plan 1998, pp. 2–10). Initial modeling of future precipitation around 2100 indicates that the dry season may see a 5% increase in precipitation and the wet season seeing a 5-10% decrease in precipitation (Timm and Diaz 2009, p. 4279).

4. Increased rainfall intensity. Heavy rain events have increased during the period from 1958 and 2007 by approximately 12% (Fletcher 2010, p. 3). This could have implications for endangered species by increasing the flooding of habitat, increasing landslide events that affect habitat, increased mortality of nestlings, and reduced reproductive output.

5. Increased sea levels. Current sea level rise in Hawaii is close to 0.6 inches (in (1.5 centimeters (cm)) per decade (Fletcher 2010, p. 3). Future sea level rise may reach one meter (three ft) by 2100 (Vermeer and Rahmstorf 2009, p. 12236).

6. Ocean acidification. The ocean around Hawaii is apparently acidifying at a rate similar to the rest of the Pacific (Dore et al. 2009, p. 12236). Ocean acidification may have significant direct effects on a number of marine ecosystems (Fletcher 2010, p. 4). For the listed species in this Biological Opinion, the primary effect may be reduced coral reef structure, which could, in turn, increase the effects of storms on coastal wetlands and habitat.

Environmental changes that may affect these species are expected to include habitat loss or alteration and changes in disturbance regimes (e.g. storms and hurricanes), in addition to direct physiological stress caused by increased temperatures. The probability of a species going extinct as a result of these factors increases when its range is restricted, habitat decreases, and population numbers decline (Intergovernmental Panel on Climate Change 2007, p. 8). The listed species addressed in this Biological Opinion have limited ranges, restricted habitat requirements, small population sizes, and low numbers of individuals. Therefore, we would expect these species to be particularly vulnerable to projected environmental impacts that may result from

changes in climate, and subsequent impacts to their habitats (e.g., Pounds et al. 1999, pp. 611–612; Still et al. 1999, p. 610; Benning et al. 2002, pp. 14,246 and 14,248).

Species-Specific Status and Baseline

Status of the Guam Micronesian Kingfisher

Species Description

The Guam Micronesian kingfisher, known in the Chamorro language as "sihek," is a subspecies of kingfisher endemic to Guam. Other subspecies, *Todiramphus* [=*Halcyon*] *c. pelewensis* and *T. c. reichenbachii*, exist on Palau (Republic of Palau) and Pohnpei (Federated States of Micronesia), respectively. The Guam subspecies is a small, sexually dimorphic forest kingfisher (Baker 1951, pp. 227–228). The adult male has a cinnamon-brown head, neck, upper back, and underparts. A black line extends around the back of the neck and the eye ring is black.

Listing Status

The Guam Micronesian kingfisher was listed as endangered in 1984 (USFWS 1984, 9 pp.). A five-year status review was completed in 2008 (USFWS 2008a, 17 pp.) and a revised recovery plan for the Guam Micronesian kingfisher was completed in 2008 (USFWS 2008a, 117 pp.). Critical habitat for this species was designated on October 28, 2004.

Historical and Current Distribution

The Guam Micronesian kingfisher was considered "fairly common" and occurred throughout forested areas on Guam in 1945 (Baker 1951, p. 229). Populations in southern and central Guam disappeared by the 1960s (Jenkins 1983, p. 25) and 3,023 individuals were recorded in 1981 in northern Guam (Engbring and Ramsey 1984, p. 34). This population subsequently declined rapidly, and by 1985, fewer than 30 individuals were recorded on Guam (Marshall 1989, p. 210) and the taxon was considered extirpated from the wild by 1988 (Wiles et al. 2003, p. 1,354). Between 1984 and 1986, 29 Guam Micronesian kingfishers were captured and sent to zoological institutions in the mainland United States (Hutchins et al. 1996, p. 4). Currently the captive population consists of approximately 101 individuals in 19 captive rearing facilities (Bahner 2010, pers. comm.).

Ecology

Guam Micronesian kingfishers feed on invertebrates and small vertebrates, including insects, segmented worms, hermit crabs, skinks, geckoes, and possibly other small vertebrates (Marshall 1949, p. 210; Baker 1951, pp. 228–229; Jenkins 1983, p. 23). The species typically forages by perching motionless on exposed branches or telephone lines and swooping down to capture prey off the ground with their bill (Jenkins 1983, p. 24). They will also capture prey off nearby foliage and have been observed gleaning insects from bark (Maben 1982, p. 78).
The Guam Micronesian kingfisher nests in cavities, and breeding activity appears to be concentrated from December to July (Baker 1951, p. 228; Jenkins 1983, p. 24). Nests have been

reported in a variety of trees, including *Ficus* spp., *Cocos nucifera*, *Artocarpus* spp., *Pisonia grandis*, and *Tristiropsis obtusangula* (Baker 1951, p. 228; Jenkins 1983, p. 24; Marshall 1989, p. 475). Pairs may excavate their own nests in soft trees, arboreal termitaria (the nests of termites [*Nasutitermes* spp.]), arboreal fern root masses, or they may utilize available natural cavities such as broken tree limbs (Jenkins 1983, p. 24; Marshall 1989, p. 474). Jenkins (1983, p. 23) observed that some excavated cavities were never used as nesting sites, which suggests that the process of excavating nest sites may be important in pair-bond formation and maintenance.

Both male and female Guam Micronesian kingfishers incubate eggs, and brood and feed nestlings (Jenkins 1983, p. 24). Clutch sizes from wild populations (n=3) were either one or two eggs (Baker 1951, p. 228; Jenkins 1983, p. 24) and clutch sizes of one to three eggs have been reported in the captive population (Bahner, et al. 1998, p. 21). Incubation, nestling, and fledgling periods for populations of Guam Micronesian kingfishers in the wild are unknown. However, incubation and nestling periods of captive birds averaged 22 and 33 days, respectively (Bahner, et al. 1998, p. 21).

Jenkins (1983, pp. 22–23) reported that the Guam Micronesian kingfishers nested and fed primarily in mature, secondary growth, and, to a lesser degree, in scrub limestone forest. It was also found in coastal strand vegetation containing coconut palm as well as riparian habitat. However, Jenkins (1983, p. 22) reported it was probably most common along the edges of mature limestone forest. Few data exist about specific kingfisher nest sites in the wild, but in one study in northern Guam, 16 nest sites were correlated with closed canopy cover and dense understory vegetation. In this study, nest cavities were excavated in the soft, decaying wood of large, standing dead trees averaging 17 in (43 cm) in diameter (Marshall 1989, p. 475). Research on the Pohnpei Micronesian kingfisher indicates that the average home range size is 29.58 ac (6.28 ha) while the average territory size was 20 ac (8.1 ha; Kesler and Haig 2007a, pp. 386–387). Kesler and Haig (2007b, pp. 769–770) found that kingfisher home ranges on Pohnpei consisted of mixed forest and open areas and at least part of this area included mature forest. However, it should be noted that Guam Micronesian kingfisher territories may differ from Pohnpei Micronesian kingfisher territories due to differences in forest structure (Mueller-Dombois and Fosberg 1998, pp. 269–275, 288–291).

Threats

Primary threats to kingfishers include: low productivity in captive propagation; incremental habitat loss due to development and fire; habitat degradation from feral ungulate browsing and trampling; and predation risk from brown treesnake which currently limits reintroduction to Guam (USFWS 2008a, pp. 16–26). Currently, high density of brown treesnakes is the primary factor preventing the kingfisher's survival and recovery on Guam. The continual loss and degradation of habitat for the kingfisher from development and feral ungulates are also factors limiting recovery of the species on Guam.

Conservation Needs of the Species

The recovery plan (USFWS 2008a) calls for a total population of 2,000 adults on Guam within two subpopulations of 1,000 adults each. These subpopulations would also include juveniles which are needed to replace adults that are lost; however, juveniles are not explicitly included in the recovery plan's population criteria. One subpopulation should be in northern Guam, while the second subpopulation should be in southern Guam to reduce the risk of a second extirpation event due to random, stochastic events. Each subpopulation must have brown treesnakes and other predators controlled to a level where a sustainable kingfisher population is feasible and habitat to support this population level must be protected and managed. In the interim, Guam Micronesian kingfishers may also need to be established in the wild on other islands outside their native range to reduce the detrimental consequences of long-term captivity. In the future, the ability to translocate wild birds versus captive birds to Guam should increase success of their survival on Guam.

The 2002, proposal to designate critical habitat for the species identified essential habitat (USFWS 2002, 34 pp.). In 2006, the U.S. Forest Service completed the first island-wide assessment of landcover on Guam (Liu and Fischer 2006, p. 14). Because this assessment represents the best available information for landcover on Guam we used these data to assess the amount of potential recovery habitat for the Guam Micronesian kingfisher on Guam.

The recovery plan identifies that at least 1,000 adult birds in northern Guam, and at least 1,000 adult birds in southern Guam, are needed as one criterion for recovery. The ability of these subpopulations to sustain themselves is dependent on the vital rates (e.g., breeding success, adult and juvenile survival) of these subpopulations. If, for example, breeding success is very poor then additional breeding pairs may be needed to produce the number of juveniles needed to sustain the adult population. This in turn could mean that additional adults are needed to sustain the 1,000 adults considered necessary to reach the recovery criteria. Therefore, prior to using the recovery population criteria and space requirements to estimate acreage required for recovery, we first need to determine the number of juveniles and adults, specifically breeding pairs, needed to maintain a subpopulation of 1,000 adults. These estimates are:

1. Juvenile Population Requirements – A sustainable population of 1,000 adult Guam Micronesian kingfishers requires that a floater population of juveniles be present to replace adults that succumb to mortality. Population modeling for kingfishers on Pohnpei indicates that the adult and juvenile survival rate is approximately 58% and 37%, respectively (Kesler and Haig 2007c, p. 525). We compiled adult and juvenile survival rates of 57 avian species from available sources (Kikkawa and Wilson 1983, p. 191; Robertson et al. 1994, p. 1083; Brook and Kikkawa 1998, p. 493; Saether and Bakke 2000a, pp. 1–3; Nicoll et al. 2004, p. 544; Armstrong et al. 2005, p. 164; Brown et al. 2006, p. 456; Ha et al. 2008, p. 5) and calculated a mean adult (71%) and juvenile (42%) survival rate. We used the mean because Guam Micronesian kingfishers are in the middle of what Saether and Bakke (2000b, pp. 650–651) call a "fast-slow" spectrum (Kesler and Haig 2007c, p. 527). Based on the survival rates above, approximately 690 juveniles would be needed to maintain a population of 1,000 adult kingfishers.

2. Breeding Pair Population Requirements – We used reproductive success information from the Pohnpei kingfisher population (1.7 breeding attempts per year, nestling survival 53%, eggs per clutch = 2, Kesler and Haig 2007c, p. 525) to estimate the number of territorial pairs needed to sustain an adult population of 1,000 individuals. If 690 juveniles are needed to sustain the adult population then 383 pairs would have to breed to produce 690 juveniles a year. This means that 766 of the 1,000 adult kingfishers must be breeders and that a minimum of 383 territories must occur in both northern and southern Guam.

3. Non-paired Adult Population – As noted above, a minimum of 383 core pairs would be needed in both northern and southern Guam to maintain a population of 1,000 adults. The remaining 234 adults in both northern and southern Guam may be breeders or non-breeders. However, because kingfisher home ranges overlap and estimating space requirements for each unpaired kingfisher would require additional complexity, we assumed that the remaining adults were paired.

4. Total Population Requirements – Based on the assessments above, a total of 500 pairs (1,000 adults/2 = 500 pairs) would be needed in both northern and southern Guam to meet recovery criteria. In addition, a population of at least 690 juveniles would be needed to replace adults lost from the population in both northern and southern Guam.

Kesler and Haig (2007a, p. 387) reported that the mean territory size for the Pohnpei Micronesian kingfisher was 20 ac (8.1 ha). The territory size estimate defines the core area that is utilized by a kingfisher pair. However, it does not include all of the area utilized by an individual bird to meet its resource requirements throughout its lifetime. In addition, D. Kesler noted that the territory size estimate is related to home range estimates, which can vary depending on computation method (see Mitchell 2007, pp.1–7, for details). Based on the recommendation of D. Kesler and space use requirement calculations using home range estimates for adult territories, we determined 25 ac (10 ha) as the approximate amount of area required by a pair of Guam Micronesian kingfishers. This acreage is consistent with the estimate used in the Service's 2004, final designation of critical habitat for this species (USFWS 2004b, 46 pp).

In addition to space requirements for territory holders, juvenile kingfishers require space to forage and roost. However, Kesler and Haig (2007a, p. 386) found that juvenile home ranges typically overlapped with those of adults, except for prospecting forays. Therefore, we assumed that the space required by juvenile kingfishers was contained within the 25 ac (10 ha) required for a territorial pair.

Typhoon Impacts to Recovery Habitat

Typhoon data for Guam collected since 1959 indicates that on average four typhoon events (sustained winds greater than or equal to 74 mi per hour (119 km per hour)) could occur each decade (U.S. Navy, Typhoon Joint Warning Center, pers. comm. 2010). Typhoons can cause a wide range of damage to forests (Brokaw and Walker 1991, p. 442) and, if the damage is severe

(e.g., tree uprooting and trunk snapping), could limit the availability of appropriate nesting trees for Guam Micronesian kingfishers. These forests are expected to regenerate after the storm event; however, these storms likely will lead to an extended temporary loss of habitat. In other words, regenerated habitat should eventually be available for a breeding pair to move into if the availability of appropriate habitat within their current territory is diminished due only to damage from a typhoon event.

The amount of regenerated habitat is dependent on the type of damage caused by the storm, the amount of forest impacted by the storm, the time required for the forest to recuperate from the damage from the storm, and the number of storms that occur during that recuperation period. The research required to provide good estimates of all of this information has not been conducted in the Mariana Islands. Therefore, only rough estimates are possible until this information is obtained.

Typhoons can cause defoliation, loss and damage to branches, and snapping and uprooting of stems (Brokaw and Walker 1991, p. 442) which can all impact Micronesian kingfisher habitat. However, of these impacts, the snapping and uprooting of trees is likely to require the longest time for recovery and could have the most impact on long-term kingfisher breeding success. For example, the loss of trees of sufficient size for breeding could limit breeding until appropriate trees were available. Therefore, an assessment of extent of stem snapping and uprooting from typhoons would be important for determining habitat needed to offset impacts from typhoons.

Data on tree snapping and uprooting from storms in the Mariana Islands is limited. Hirsh and Marier (2002, p.598) assessed damage to *Cycas micronesica* trees on Guam after supertyphoon Paka and found that 10% of the trunks had snapped and 2% of the trees were uprooted from the storm. Wiles (2005, p. 514) assessed damage to *Artocarpus mariannensis* after supertyphoon Paka and found that 5.8% of the trunks had snapped and 2.5% were knocked down. Wiles (1991, 1998) also described forest damage associated with typhoon Russ and supertyphoon Paka. In general, Wiles (1991, p. 120) reported that the majority of the trees impacted by typhoon Russ were defoliated, but that few branches were broken and that uprooted and broken trees were uncommon. More severe damage to trees was reported for Paka but it was not quantified (Wiles 1998, p. 103). Donnegan et al. (2004, pp. 27-28), in their assessment of forest resource on Guam, found that approximately 26% of the trees they sampled were damaged and 7% of the damaged trees had broken trunks. Only 36% of the damage was related to typhoons and other weather events so not all trees with broken trunks were related to typhoons. In addition, the damage was not specific to any one typhoon or weather event. Published information on the percentage of trees uprooted and with snapped stems is more widely available outside the Mariana Islands. In the Caribbean, trunk snapping and uprooting rates ranged from 3 to 39% depending on the storm, island, and tree sizes measured (Brokaw and Walker 1991, p. 443). In Samoa, Elmquist et al. (1994, p.387) reported uprooting and trunk snapping percentages from 16 to 67 in trees greater than or equal to 5 cm diameter at breast height from cyclones Ofa and Val. While in Madagascar, Birkinshaw (2007, p. 19) reported that 14% of the living trees greater than or equal to 10 cm diameter at breast height were either uprooted or had snapped trunks due to cyclone Hudah.

Clearly the extent of damage is highly variable and some of this variability may be related to the size, species, location, and previous disturbance history of a tree may affect the level of damage inflicted (Ostertag et al. 2005, pp. 18-22). Because typhoon events are common and the native species on Guam are likely to be typhoon adapted (Stone 1970, p. 14, Wiles 2005, p. 517) the uprooting and trunk breakage rates for Guam are likely to be on the lower end of the impact spectrum. This is consistent with damage estimates provided by Hirsh and Mariar (2002) and Wiles (2005) for two species on Guam as well as the estimates of damaged trees from Donnegan et al. (2004). Therefore, we used the 7% damage estimate from Donnegan et al. (2004) as our estimate of the percentage of forest likely to be severely impacted by a typhoon and thus, not usuable for Micronesian kingfisher breeding habitat until it recovered. It is likely that this may be an overestimate as damage estimates provided by Hirsh and Mariar and Wiles were for a supertyphoon and the estimate by Donnegan et al. (2004) includes non-weather sources of damage. However, the Donnegan et al. estimate provides a multi-species and island-wide assessment of potential damage. In addition, as the intensity of typhoons is expected to increase due to climate change (Webster et al. 2005, p. 1846; Emanuel et al. 2008, p. 365) we believe that this estimate is appropriate.

The amount of forest impacted by each typhoon event is dependent on the intensity of the storm, its distance from the island, its direction, previous impacts to the forest, and the topography of the island (Brokaw and Walker 1991, pp. 442-445; Boose et al. 1994, pp. 377-389). With such variability it is impossible to accurately predict how much forest will be impacted by each typhoon. However, utilizing estimates from a range of storm intensities could provide some general guidelines. Wiles (1991, pp.120–122; 1998, pp. 103–107) provided overviews of impacts on natural resources on Guam from two typhoons, typhoon Russ (1990; maximum 120 mph sustained winds) and supertyphoon Paka (1997; 150 mph sustained winds and gusts up to 185 mph). Wiles did not identify the amount of forested area impacted by each typhoon but did describe which areas were impacted. When these areas were mapped using GIS and compared to available forest, we estimated that 3% of the forest on Guam was impacted by typhoon Russ and 14% was impacted by supertyphoon Paka. These are extremely rough estimates of damage, as the Wiles reports appeared to focus on particular areas of interest and not all forest resources on the island. However, they do provide an estimate of potential typhoon impacts on Guam. Donnegan et al. (2004, pp.27-28), in their assessment of forest resource on Guam, found that approximately 26% of the trees they sampled were damaged and 36% of the damage was related to weather events, like typhoons. Therefore, 9.5% of the trees sampled showed signs of storm damage (Donnegan et al. 2004). Though not specific to any particular storm it does provide a cumulative estimate based on the likely impacts of multiple recent storms. Because this estimate includes a wide range of damage and the likely effects of multiple storms we decided to round up the 9.5% estimate to 10% and use it as the estimated area of forest impacted by each typhoon. This estimate falls close to the average extent of damage (8.5%) from supertyphoon Paka and typhoon Russ estimated by Wiles (1991, 1998), although it is closer to the high end and may be an overestimate for each storm. However, erring on the high end is reasonable as climate change models predict that typhoon intensity will increase (Webster et al. 2005, p. 1846; Emanuel et al. 2008, p. 365).

While natural regeneration of the forest is expected to occur after a typhoon event, calculations of recovery habitat needed must take into account that a portion of the habitat will be non-

functional for Guam Micronesian kingfisher for an extended period of time. Unfortunately, tree growth rate data are not available for the Mariana Islands so forest regeneration time is uncertain. In addition, typhoons create disturbance in the forest which leads to increased growth for some species after the disturbance event (Vandermeer et al. 1997, pp. 154-157). Therefore, there is a great deal of uncertainty in how long it would take for a forest in the Mariana Islands to recuperate from typhoon damage. Franklin (2003) reported on annual growth rates of trees in Tonga, an island with likely similar conditions to other Pacific Islands, including the Mariana Islands. Therefore, we used the average maximum growth rate for the species assessed by Franklin (2003, p. 672) to estimate average growth for Guam after a storm (1.01 cm a year), with the assumption that these maximum growth rates would reflect increased growth after a typhoon. Kingfisher nest chamber diameters were on average 5 in (13 cm, Kesler and Haig 2005, p. 191) so a tree would need to have a larger diameter. We used 8 in (20 cm) as the minimum diameter for a kingfisher nest tree. Because average growth is estimated to be approximately 1 cm a year we expect it would take 20 years for a forest to recuperate from a typhoon and be sufficient for kingfisher breeding. This estimate may be conservative based on available information on *Artocarpus atilis* and *Cocos nucifera* annual growth (Chan and Elevitch 2006, p. 11; Ragone 2006, p. 7). The growth rates of these two species indicate that they may be sufficient size for a kingfisher cavity (i.e., at least 6 m tall and 20 cm diameter; Marshall 1989) in 12 to 15 years. However, growth rates of native forest species may differ from the growth rates of these two agricultural species and so we used the longer duration.

Typhoon data collected since 1959 (U.S. Navy, Joint Typhoon Warning Center, pers. comm. 2010) indicates that on average there were 1.6 supertyphoons and 6 typhoons over a 20-year period. Therefore, over the 20-year period we would expect for a forest to regenerate there would be 7.6 typhoon events of varying magnitude. Each of these severe typhoons would impact approximately 10% of the available forest on the island and 7% of that forest is damaged to such an extent that it is no longer kingfisher habitat. Therefore, if there were 29,310 ac (11,861 ha) of forest for kingfisher recovery, approximately 2,931 ac (1,186 ha) could be impacted by a typhoon and 205 ac (83 ha) would be impacted to such an extent that it would no longer be kingfisher habitat. If typhoons were to occur on average 7.6 times over a 20-year period then 1,559 ac (630 ha) of additional forest across the island of Guam or 780 ac (316 ha) of additional forest in northern and southern Guam would be needed for Micronesian kingfishers to use while the previously damaged forest regenerates.

Based on the above assessment, a minimum total of 13,134 ac (5,2315 ha) of appropriate habitat in northern Guam and 13,134 ac (5,2315 ha) in southern Guam would be needed to recover the species on Guam. This includes 12,355 ac (5,000 ha) for territorial adults and juveniles and 780 ac (316 ha) to buffer habitat loss due to severe typhoons. These calculations are subject to change as a function of additional or revised information on recovery goals for the Guam Micronesian kingfisher.

Ongoing Conservation Actions

The Guam Micronesian kingfisher is currently protected under Guam and Federal law. The captive population is currently managed in 17 captive breeding institutions with the intent of increasing the captive population and maintaining genetic diversity (Bahner and Bier 2007, p. 1)

for eventual reintroduction back into the wild. In conjunction with the Northwest Field training facility and ISR Strike Projects, the Air Force is working toward construction of ungulate exclosures around and eradicating ungulates from approximately 627 ac (254 ha) of forested and disturbed land to increase the quality of the habitat for the Guam Micronesian kingfisher and other listed species (USFWS 2006a, pp. 12, 29). The Air Force was also to set aside approximately 148 ac (60 ha) of forested land in a new experimental habitat management unit (USFWS 2006a, p. 29). A brown treesnake barrier is proposed for construction around this habitat management unit to help support listed species recovery efforts on Guam. The Air Force was also to initiate native foraging tree planting and other conservation actions (USFWS 2006a, p. 12 and U.S. Air Force 2006, pp. 2-36 to2-39). The ungulate management plan for non-fenced areas is being drafted (Cobb, pers. comm. 2010c).

Environmental Baseline for the Guam Micronesian Kingfisher

Status of the Species in the Action Area

The Guam Micronesian kingfisher is extirpated from the wild and is therefore not currently found in the action area. However, habitat required to support the reintroduction and recovery of the species is located within the action area and impacts to this habitat could impact the recovery of the kingfisher on Guam.

As stated in the "Status of the Species" section above, Guam Micronesian kingfishers utilized a wide variety of forested habitats including limestone, coastal strand with coconuts, and ravine forests (Jenkins 1983, pp. 22–23). However, Guam Micronesian kingfishers were most abundant in limestone forest (Jenkins 1983, p. 22). The Forest Service vegetation map of Guam includes the following forest types: 1) Limestone Forest, 2) Ravine Forest, 3) Palma Brava Grove, 4) Scrub Forest, 5) Leucaena Stand, 6) Casuarina Thicket, 7) Acacia Plantation, and 8) Coconut Plantation (Liu and Fischer 2006, pp. 5–7). Of these forest types, only Limestone Forest, Ravine Forest, Coconut Plantation, and Palma Brave Grove were considered likely habitat to support Guam Micronesian kingfisher recovery.

Guam Micronesian kingfishers previously nested in Limestone Forest (Marshall 1989, p. 474). Ravine Forest is found in the areas where kingfishers were reported in southern Guam prior to the 1970s (Drahos 2002, p. 421). This forest type includes some mature native forest (primarily near Fena Reservoir) and coconut trees which have been utilized for nesting (Jenkins 1983, p. 24). Coconut Plantation includes abandoned coconut groves and, as noted above, coconut trees were used for nesting. No information is available on use of Palma Brava Groves by kingfishers. However, Stone (1970, p. 140) states that *Heterospathe elata* (palma brava) typically have a diameter of 8 in (20 cm) which is larger than a kingfisher cavity (5 in (13 cm)); (Kesler and Haig 2005, p. 191) and so kingfishers may use dead or dying palma brava for nesting.

Leucaena Stand, Casuarina Thicket, and Acacia Plantation are dominated by *Leucaena leucocephala*, *Casuarina equisetifolia*, and *Acacia confusa*, respectively (Liu and Fischer 2006, p. 6). None of these tree species are known to be utilized for nesting by Guam Micronesian Kingfishers (USFWS 2008a, p. 11). Therefore, these forest types were not included as potential habitat even though these forest types could be used for foraging. Finally, Scrub Forest is considered disturbed forest dominated by *Artocarpus atilis*, *Cocos nucifera*, and *Leucaena*

leucocephala trees, clumps of *Bambusa vulgaris*, agricultural fields and patches, pastures, scrub vegetation, and home sites (Liu and Fischer 2006, p. 6). While Guam Micronesian kingfishers have utilized *Artocarpus atilis* and *Cocos nucifera* trees for nesting, the landcover map does not discriminate between forests with these tree species and agricultural fields, pastures, and home sites which are not likely to contain appropriate trees for nesting. Therefore, we did not include Scrub Forest as a potential recovery habitat for the Guam Micronesian kingfisher. This may lead to an underestimate of potential habitat; however, our analysis errs on the side of the species and we will not include it unless more detailed data on landcover becomes available and it is warranted to do so.

Micronesian kingfisher home ranges on Pohnpei encompassed nearly all forested areas and edges and some home ranges included extensions to include particular forest features (Kesler and Haig 2007b, p. 769). Pohnpei Micronesian kingfisher dispersal distances on Pohnpei ranged from 561 to 4,501 ft (171 to 1,372 m) while mean prospecting movements ranged from 253 to 1,407 ft (77 to 429 m; Kesler and Haig 2007a, pp. 385, 389). We therefore expect that a wide range of different sized forest patches could be included in a territory and that a territory could include multiple patches. We also expect that kingfishers can disperse up to 4,501 ft (1,372 m) to isolated patches that are large enough for a potential territory and can move reasonable distances (1,407 ft, 429 m) to explore neighboring areas. However, we also expect there may be patches which are too small and far away from other patches to be included in a territory due to the effort it would require a pair holder to defend.

Specific information on how far a territory holder will travel to defend a territory is not available. Therefore, we considered how far a territory holder would have to move to defend a circular and rectangular territory and used the average of those estimates as the distance a kingfisher might move between patches to defend a 25-ac (10-ha) territory. The resulting distances a territory holder would have to move to defend a circular and rectangular territory were between 591 to 1,640 ft (180 and 500 m), with an average of 1,115 ft (340 m). We then assumed any forest patch less than 25 ac (10 ha) within 1,115 ft (340 m) of a 25 ac (10 ha) or greater patch could be part of a territory. In addition, we also assumed that a series of patches that were within a cluster totaling at least 25 ac (10 ha) and contained within the 1,115 ft (340 m) of the center were potential habitat. All other patches less than 25 ac (10 ha) were considered too small and isolated for a kingfisher territory.

Based on the information and assumptions discussed above, we estimate there are 15,822 ac (6,403 ha) of potential recovery habitat in northern Guam and 13,488 ac (5,458 ha) in southern Guam. As noted above under “Conservation Needs of the Species”, a minimum total of 13,134 ac (5,2315 ha) of appropriate habitat in northern Guam and 13,134 ac (5,2315 ha) in southern Guam would be needed to recover the species on Guam. A total of 286 ac (116 ha) of recovery habitat currently exists within the 376-ac area designated as critical habitat for this species.

Threats in the Action Area

Habitat Loss and Degradation

Guam Micronesian kingfisher habitat within the action area is impacted by feral ungulates, invasive weeds and insects, fire and typhoons. On Andersen Air Force Base, densities of Philippine deer and feral pigs were estimated at 0.8 deer per ac (1.8 deer per ha) and 0.2 pigs per ac (0.4 pigs per ha), some of the highest densities recorded in the world (Knutson and Vogt 2003, p. 4). These introduced ungulates are suspected of significantly impacting native floral communities on Guam by consuming seeds, fruits, and foliage, ingesting or trampling seedlings, and promoting the spread of introduced weeds (Wiles et al. 1999, p. 193; Wiles 2005, pp. 514–515). These impacts as well as damage to forests on the base from naturally occurring typhoons and introduced weeds and insects, are degrading the quality of the remaining forest. How this additional degradation will impact the suitability of forests on Guam for the Micronesian kingfisher is unknown. Habitat loss resulting from human-caused wildfires, including conversion of forest to grassland, is detailed in the General Status and Baseline section.

Habitat for the Guam Micronesian kingfisher is also being impacted by the Air Force's development of a training area in the Northwest Field area of the base and their Intelligence, Surveillance, Reconnaissance, and Strike Capability Project. Once these projects are fully completed, it is expected that the amount of habitat remaining for Guam Micronesian kingfisher in northern Guam will be 15,822 ac (6,403 ha) in the north.

Predation by Brown Treesnakes

Brown treesnake predation is the primary factor that caused the extirpation of the Guam Micronesian kingfisher (USFWS 2008a, p. 39). Snake densities are not known specifically; however, densities appeared to level off in the 1990s to around 20 individuals per ac (50 per ha) in favorable habitats (Rodda and Savidge 2007, p. 315). These high snake densities continue to hamper recovery efforts for the Guam Micronesian kingfisher.

Conservation Needs in the Action Area

As noted above, brown treesnake predation is considered a primary factor in the decline of the Guam Micronesian kingfisher. Therefore, large-scale control and/or eradication of brown treesnakes are essential for this species to be successfully reintroduced and to recover. Habitat loss and degradation are believed to be important threats to the recovery of the Guam Micronesian kingfisher (USFWS 2008a, pp. 17–19). Protection of the remaining habitat for this species is needed along with efforts to increase the quantity of appropriate habitat and quality of the remaining habitat. Due to the high populations of feral pigs and deer, control and/or eradication of these feral ungulates would help improve the quality of the remaining habitat in the action area. Preventing and controlling introduced insect pests and weeds will also increase the quality of the remaining habitat. Wildfire impacts to forest habiat in southern Guam are significant; increased support for fire suppression program development in Guam is needed to minimize conversion of forest to grassland. Reforestation of degraded areas would also improve the amount of habitat available to support the eventual recovery of these species.

Finally, the recovery criteria for the Guam Micronesian kingfisher include establishing a population in northern and southern Guam (USFWS 2008a, p. 43). The Guam Micronesian kingfisher is extirpated from the wild on Guam and will need to be reestablished through reintroduction efforts.

Ongoing Conservation Actions in the Action Area

As noted in "Ongoing Conservation Actions" in the species Status section above, the Air Force was to construct ungulate exclosures around and eradicate ungulates from forested areas in the Northwest Field area of Andersen Air Force Base to increase the quality of the habitat for the Guam Micronesian kingfisher and other listed species. The Air Force was also to set forested land near the Potts Junction area as an experimental habitat management unit with a brown treesnake barrier.

Relationship of the Action Area to the Survival and Recovery of the Guam Micronesian Kingfisher

As discussed above under the "Conservation Needs of the Species" section above, a total of 13,257 ac (5,365 ha) of appropriate habitat in northern Guam and 13,257 ac (5,365 ha) in southern Guam would be needed to recover the species. Andersen Air Force Base, Naval Computer Telecommunications Station Finegayan, the former FAA site, and areas south of Route 15 in northern Guam, and the Naval Munitions Site in southern Guam were believed to be occupied by the Guam Micronesian kingfisher prior to its extirpation from the wild (Jenkins 1983, p. 21; Drahos 2002, p. 421). Much of the habitat for the species is currently found on DoD facilities in northern and southern Guam and the species cannot be recovered without this habitat. Therefore, an action which reduces the amount of available habitat could preclude the recovery of the species.

Status of the Guam Rail

Species Description

The Guam rail is a flightless rail that is endemic to Guam. It is approximately 28 cm (11 in) in total length (Pratt et al. 1987). Head, neck, and eye stripes are brown with rufous-tipped feathers on sides of neck; throat and upper breast are near gray; short wings are dark with brownish spots and barred with white; lower breast, abdomen, under-tail coverts, and tail are blackish with white barrings; bill is gray; long legs and dark feet are brown; and irises are red. Females are similar in appearance but slightly smaller than the males (Baker 1951).

Listing Status

The Guam rail was emergency listed as endangered on April 11, 1984. On August 27, 1984, the final rule listing the Guam rail as endangered along with two bats and six other birds was published. A nonessential experimental population was proposed on Rota on June 19, 1989 and the final rule published on October 30, 1989. A recovery plan covering native forest birds of

Guam and Rota was prepared in 1990. Critical habitat has not been designated for the Guam rail.

Historical and Current Distribution

This species was once distributed throughout Guam, but by 1981 the population was reduced to approximately 2,300 individuals and only existed in northern Guam (Engbring and Ramsey 1984, p. 28). In 1983, estimates of population size indicated that fewer than 100 individuals remained on Guam and 22 individuals were moved to captive propagation facilities (Haig and Ballou 1995, p. 446). The Guam rail was believed to have been extirpated in the wild on Guam by 1987 (Wiles et al. 1995, p. 38) and is now found only in captivity and in an experimental population on Rota (Wenninger 2008, pers. comm.). As of June 2008, there are approximately 158 Guam rail in captivity on Guam and in mainland zoological institutions (USFWS 2008b, p. 5).

Efforts to establish a nonessential experimental population on the island of Rota have been underway since 1989 (Beauprez and Brock 1999a). As of June 2008, a total of 918 Guam rail were released on Rota as part of an effort to establish an experimental population on that island (Witteman and Beck 1990; Beck 1991; Brock and Beck 1995; Beauprez and Brock 1996; 1997; 1998; 1999a; Medina and Aguon 2000, p. 176; Wenninger 2008, pers. comm.). Breeding has been documented and Guam rail have been observed several years post-release in some regions of the island (Wenninger 2008, pers. comm.). In 2007, approximately 60 to 80 Guam rail were believed to be persisting in the Duge and Apanon areas of Rota (Wenninger 2007, pers. comm.). However, additional releases and intensive cat control is needed as cat predation is believed to be the primary factor preventing the establishment of a self-sustaining population on Rota.
In addition to releases on Rota, there have been two releases of Guam rail on Guam since the species was listed. In 1998, 16 Guam rail were released in Area 50 in northern Guam (Beauprez and Brock 1999b). A temporary brown treesnake barrier was constructed around Area 50 and snake populations in the barrier were reduced through snake control. Breeding was documented; however, the small population was believed to have been extirpated by feral cats and other predators (Beauprez and Brock 1999b). In 2003, a total of 44 Guam rail were released in a snake-reduced area of the Northwest Field Naval Munitions Area on Andersen Air Force Base (Wenninger 2008, pers. comm.). Of the Guam rails released with radio transmitters attached (n = 26), over 80% were preyed upon by feral cats (Wenninger 2008, pers. comm.). Efforts to reduce cat predation were limited due to difficulty obtaining approval to control cats in the area. No Guam rails are believed to be persisting in the wild on Guam at this time (Wenninger 2008, pers. comm.).

Ecology

Guam rails are omnivorous and forage on the ground for skinks, geckos, insects, snails, and carrion, as well as seeds and palm leaves (Jenkins 1979, p. 405). Guam rails may nest year-round laying 3 to 4 eggs in shallow nests of leaves and grass on the ground (Jenkin 1979, p. 406). Incubation is 21 days (Beck 1985, unpubl. data as cited in Service 1990a p.9) with both sexes sharing in the nesting duties. In captivity, rails reproduced for the first time at 5 months of age and in at least one case, laid a second clutch while still feeding 3-week old chicks (Beck 1990).

Perez (1969 as cited in Service 1990a p.9) suggested a peak breeding period during the rainy season (May–Oct). The extremely precocial young hatch asynchronously and leave the nest within 24 hours of hatching to forage with the aid of their parents (Jenkins 1979). Observations of radio-tagged individuals indicated that the species prefers edge habitats, especially grassy or secondary vegetation areas which provide good cover (Wenninger 2008, pers. comm.). All observations of breeding by wild individuals over the last decade have also been associated with edge habitats or secondary vegetation on Rota and Guam (Beauprez and Brock 1999a; 1999b; Wenninger 2008, pers. comm.).

Guam rails were predominately found in scrubby secondary growth areas and the edges of mixed forest areas (Jenkins 1979, Engbring and Ramsey 1984). Jenkins (1979) reports that they were seldom observed in the interior of mature limestone forests or savanna areas and did not occur in wetlands. As Guam was probably mostly limestone forest before the arrival of man (Fosberg 1960), the rail may have become more common after much of the mature forest had been converted to scrubby second-growth or mixed forest (Engbring and Ramsey 1984).

The U.S. Forest Service vegetation map of Guam includes the following vegetation types: (1) Limestone Forest, (2) Ravine Forest, (3) Palma Brava Grove, (4) Scrub Forest, (5) Leucaena Stand, (6) Casuarina Thicket, (7) Acacia Plantation, (8) Coconut Plantation, (9) Savanna Complex, (10) Strand Vegetation, (11) Other Shrubs and Grasses, (12) Agricultural Field, (13) Urban Builtup, (14) Urban Cultivated, (15) Barren Land, and (16) Wetlands (Liu and Fischer 2006). Of these vegetation types, only Scrub Forest, Other Shrubs and Grasses, and Urban Cultivated were considered primary Guam rail habitat because they include shrubby edge habitat. The remaining forested areas were excluded because rails were less common in interior forested areas.

Rails are believed to use the edges of these vegetation types; however, these areas are likely bordered by secondary scrub, shrub, and urban cultivated vegetation types which are included. Savanna complex was also not included though they may use the edge of this habitat type. Wetlands and barren lands were not included because the available data does not list these vegetation types as being used by rails. Guam rails may utilize agricultural fields; however, there was no data available indicating they use such areas. Finally, areas classified as Urban Builtup were excluded because rails were not reported in urban areas and these areas likely do not contain appropriate habitat for the species.

Threats

While the loss of habitat likely played a part in the extirpation of the Guam rail from Guam, the primary reason is believed to be from predation by cats and brown treesnakes. These are the two known threats that preclude the successful reestablishment of Guam rail on Guam. Of the released Guam rail with radio transmitters, over 80% were preyed upon by feral cats (Wenninger 2008, pers. comm.). Birds released in Area 50 were believed to have been extirpated by feral cats and other predators (Beauprez and Brock 1999b). See the Brown Treesnake section in General Effects for additional information regarding the effect of the snake on birds.

Conservation Needs of the Species

The primary conservation needs of the species are (1) habitat conservation; (2) intensive cat and snake control; and (3) reintroduction of the species to protected areas.

No information is available on the average size of a Guam rail territory. Similar species, such as the Lord Howe woodhen (*Gallirallus sylvestris*), have an average territory size of 2.4-10 ac (1–4 ha) (NSW National Parks and Wildlife Service 2002), while the weka (*Gallirallus australis*), another rail species of conservation concern, has an average territory size of 5 or 12 ac (2 or 5 ha) depending on location (Beauchamp 1987). Assuming the territory of the Guam rail is similar to the maximum territory size of the weka, patches smaller than 25 ac (10 ha) (the average territory size of two weka pairs [12 ac (5 ha) x 2]) and over 0.6 mile (mi) (1 kilometer (km)) away from the nearest patch are likely too small and isolated to be viable habitat for rail recovery. Conversely, assuming the territory of the Guam rail is similar to the minimum Lord Howe woodhen territory size, patches less than 2.5 ac (1 ha) and over 410 ft (125 m) (the approximate radius of a 12-ac (5-ha) territory) from the nearest patch above 2.5 ac (1 ha) are considered too small and isolated to be viable habitat for rail recovery. Finally, any patch completely isolated from the nearest patch by lands classified as Urban Builtup (excluding roads) by the U.S. Forest Service is considered too isolated to be viable rail habitat due to the potential for urban developed areas to impede movement of rails.

The interim recovery objectives for downlisting the Guam rail from endangered to threatened call for 1,000 birds in northern Guam and 1,000 birds in southern Guam (total = 2,000 individuals; Service 1990b). No criteria were defined for delisting. Trail et al. (2009) recently proposed that a minimum viable population target of 5,000 individuals is an appropriate target for species conservation. If we consider the entire rail population on Guam as one unit, then we would need 5,000 rails to achieve recovery (delisting).

Engbring and Ramsey (1984) estimated Guam rail densities between 0.07 and 0.33 birds per ha on Guam in 1981. Weka had densities ranging from 0.3 to 0.8 birds per ha (Beauchamp 1987) while the Cocos buff-banded rails (*Gallirallus philippensis andrewsi*) typically had densities from 4 to 9 birds per ha (Reid and Hill 2005). Guam rail and weka densities both reflected species undergoing population declines. Therefore, their density estimates may not reflect the potential densities that could be obtained from a recovered population. However, because the maximum Guam rail density overlaps with the weka estimates it does serve as a sound conservative estimate of potential densities until further data are collected.

Therefore, to meet the population goal of 5,000 individuals on Guam we would need 41,184 ac (16,667 ha) (5,000 birds/0.3 birds per ha) of appropriate habitat on Guam. In addition, to meet the downlisting criteria of 1,000 birds in both northern and southern Guam 8,236 ac (3,333 ha) (1,000 birds/0.3 birds per ha) of appropriate habitat would be needed in both northern and southern Guam.

Ongoing Conservation Actions

Efforts are underway to release Guam rails on Cocos Island because rats have not been observed (Vice 2010b, pers. comm.) since rodent eradication operations were completed during March–April 2009 (Lujan et al. 2010 in prep), and monitor lizards continue to be removed. A rail release date has not been established but has been proposed for October or November 2010 (Vice 2010a, pers. comm.). See the Brown Treesnake section in General Effects for additional information regarding ongoing snake control.

Environmental Baseline for the Guam Rail

Status of the Species in the Action Area

There are currently no Guam rails on Guam in the wild. They have been extirpated from the wild. There are currently only captive-reared rails remaining in captivity on Guam.

Threats in the Action Area

Habitat Loss and Degradation

As stated in the "Threats" section of the Guam rail Status section above, though the primary threats to Guam rail are brown treesnakes and cats, the loss of suitable habitat resulting from development may affect the ability of the species to recover. Currently, there are an estimated 24,698 ac (9,995 ha) of Guam rail recovery habitat available in the north of Guam and 24,866 ac (10,063 ha) in the south.

Conservation Needs in the Action Area

Intensive snake and cat control is needed in the action area to make it suitable for a Guam rail reintroduction.

Ongoing Conservation Actions in the Action Area

See Brown Treesnake section in General Effects for a discussion of ongoing conservation actions.

Relationship of the Action Area to the Survival and Recovery of the Guam Rail

Recovery of the species on Guam will depend on the reestablishment of a wild population on Guam and sufficient habitat to support a recovered population. The action area overlaps habitat that may be necessary for the recovery of the species.

Status of the Mariana Common Moorhen

Species Description

The Mariana common moorhen is a duck-like slate gray waterbird with a chicken-like bill and broad red shield on the forehead (Pratt et al. 1987, p. 128, Service 1991a, p. 2). They are an obligate (limited to a particular habitat) wetland species. They are generally secretive and utilize all areas of a wetland, even foraging and swimming in open water, though their feet are not webbed (Pratt et al. 1987, p. 128). This subspecies is endemic to the Mariana archipelago and is a member of the cosmopolitan common moorhen species (*Gallinula chloropus*) that has subspecies in North America, Eurasia, the North Pacific, and South America (American Ornithologists' Union 1984). It is thought to have a New World origin (Hartert 1898, Baker 1951, Ripley 1977). The sexes are similar in appearance, though females have a smaller frontal shield (Baker 1951, p. 127, Service 1991a, p. 2). Immature birds are browner than the adult, with duller legs, and a smaller frontal shield that is pale yellow or brown (Pratt et al. 1987, p. 128, Service 1991a, p. 2).

Listing Status

The Mariana common moorhen was federally listed as an endangered species in 1984 (USFWS 1984). The recovery plan for the Mariana common moorhen was finalized in 1991 (USFWS 1991a, 55 pp.). A five-year status review completed in 2009 determined that the Mariana common moorhen still meets the definition of endangered (USFWS 2009b, p. 9). No critical habitat has been designated for this species.

Historical and Current Distribution

The Mariana common moorhen occurred historically on the islands of Guam, Tinian, Saipan, and Pagan (Baker 1951, p. 127, Service 1991a, p. 2, Stinson et al. 1991, p. 38). Archaeological evidence also indicates they were present on Rota between 1,500–2,000 years ago (Butler 1988). The Mariana common moorhen may have been extirpated from Rota due to human-related loss of wetlands, elimination of wetlands due to sea-level changes, hunting, or introduced predators (Becker and Butler 1988, Steadman 1992, Stinson et al. 1991, p. 42). The Mariana common moorhen is believed to be extirpated from Pagan due to the volcanic eruption in May 1981, and destruction of vegetation by feral ungulates (Stinson et al. 1991, pp. 41–42). Artificial wetlands (ponds for a wastewater treatment plant and a golf course) were constructed on Rota in 1994, and were subsequently colonized by a small number of adults, chicks, and juveniles (Worthington 1998, p. 414). Surveys completed in 2001 indicate the Mariana common moorhen population had declined on Tinian and Guam since 1991 when surveys were previously conducted (Stinson et al. 1991, p. 40, Takano and Haig 2004a, pp. 247–248 and 249). The most recent survey information indicates there are approximately 90 Mariana common moorhen on Guam, 154 on Saipan, 41 on Tinian, and only two individuals on Rota (Takano and Haig 2004a, p. 247 (Table 9)).

Although a complete census has not been completed since 2004, the number of Mariana common moorhens has recently decreased at the Fena Valley reservoir, in southern Guam, potentially due

to the loss of *Hydrilla verticillata,* a wetland plant used as a nesting substrate, as a result of eutrophication of the lake after a typhoon (Brooke, 2007). While it is possible that the birds moved to other wetlands and the Guam population has not declined overall, comprehensive surveys on Guam would be needed to determine the impact of the loss of habitat at Fena Lake to the population.

Table 9. Estimated population sizes of the Mariana common moorhen in the Mariana Islands.

	Service 1991a	Stinson et al. 1991*	Takano and Haig 2004a (mean)
Guam	100 – 200	100 – 125	90 (88)
Rota	0 (Pre-historic: Present 1,500-2,000 years ago**)	0	2***
Tinian	20 – 125	100	41 (36)
Saipan	60 – 120	100	154 (122)
Pagan	0 (Present prior to 1981)	0	0
Total	180 – 265	300 – 400	287

* Number includes juveniles and estimates of areas that weren't surveyed, see Takano and Haig (2004a).
** Becker and Butler (1988 cited in Stinson et al. 1991).
*** see also Worthington (1998).

Ecology

Habitat

The Mariana common moorhen prefers wetlands with diverse, non-persistent, emergent vegetation containing deep and shallow water areas with equal areas of vegetation cover and open water (Ritter and Savidge 1999, p. 286, Stinson et al. 1991, p. 39). This species avoids wetlands with dense vegetation monocultures such as sites dominated by *Phragmites karka* (Ritter and Savidge 1999, pp. 285–286). Edge and emergent vegetation is used for breeding, nest building, and escape cover (Ritter 1994, p. 129, Service1991a, p. 17). Primary habitats (as defined in the recovery plan) include: Agana marsh, Fena Valley reservoir, and the Naval Station Marsh, Guam ; Lake Hagoi on Tinian; and Lake Susupe, Puntan Muchot, and Garapan wetlands on Saipan (USFWS 1991a, pp. 4–16). Several secondary wetland habitats were identified on Guam and Saipan; only one secondary wetland (Magpo) on Tinian was considered important for the recovery of the species (USFWS 1991a, pp. 4–16). Mariana common moorhen that occur on all the Mariana Islands are the same subspecies and there is no difference in habitat use or other aspects of their ecology, except that because there are river systems on Guam, they also use river systems there (Takano and Haig 2004b, p. 661). Many permanent wetlands are impacted by the presence of introduced tilapia (*Oreochromis mossambicus*) which is believed to degrade habitat for wetland birds by depleting the invertebrate prey base used by these birds (Marshall and Worthington 1996, USFWS 2005). Small seasonal wetlands are therefore considered important to this species.

Home Range

During a study in 2000 to 2001, adult Mariana common moorhens were radio-marked on Guam and Saipan to determine home range and movement patterns (Takano 2003, p. 30, Takano and Haig 2004b, p. 656). During the dry season, birds mostly remained in a single wetland and little interisland movement was detected. During the wet season however, inter- and intra-island movements increased (Takano 2003, pp. 50–54, Takano and Haig 2004b, pp. 657–660). Home range estimates on Guam averaged 7.7 ± 11.9 ac (SD) (3.1 ± 4.8 ha) and did not differ significantly between the sexes; however, during the dry season females exhibited significantly smaller mean core areas than males (Takano 2003, p. 48, Takano and Haig 2004b, pp. 658–661). Takano and Haig (2004b, p. 661) also found that rivers are important for the Mariana common moorhen on Guam and the use of rivers increased in the wet season.

Feeding Habits

The food habitats of the Mariana common moorhen have not been thoroughly examined but it is likely they are similar to that of other subspecies of the common moorhen, which appear to be opportunistic feeders. Mariana common moorhens feed on plant and animal matter in or near wetlands (USFWS 1991a). Seale (1901, p. 31) found grass, insects, and larvae in the stomachs of the Mariana common moorhen on Guam. Pratt et al. (1987, p. 128) reported that Mariana common moorhen eat mollusks and plants. The Hawaiian common moorhen (*Gallinula chloropus sandvicensis*) is reported to feed on algae, aquatic insects, and mollusks as well as other invertebrates and seeds (Schwartz and Schwartz 1949, Service 2005a, p. 23).

Life Cycle

Little is known about the reproduction of the Mariana common moorhen (USFWS 1991a, p. 17); they are considered socially monogamous (Takano 2003, p. 4). Marshall (1949, p. 219) believes the birds nest year–round. Nests have been constructed in *Scirpus litoralis*, *Panicum muticum*, and *Cyperus* spp. (Ritter 1994, p. 128, Service 1996, p. 7). Clutch size for Mariana common moorhens varies between 1 to 6 eggs (Ritter 1994, p. 129, Service 1996, p. 23). Birds often nest multiple times in a year and juveniles from early broods are known to stay on their natal territory and help rear siblings from later broods (Ritter 1994, p. 130, Takano 2003, pp. 4–5).

Threats

The threats affecting this species are discussed in Section I, Reasons for Declines and Current Threats, of the recovery plan (USFWS 1991a, p. 19). Currently, the main two threats to the Mariana common moorhen are: (1) loss and degradation of wetland habitat, including filling, alteration of hydrology, invasion of habitat by non-native plants, and unrestricted grazing of domestic and feral ungulates; and 2) predation by introduced species (USFWS 1991a, p. 19, Service 1996, pp. 11–12). The impacts of disease are not known at this time but botulism is responsible for the loss of many waterbirds in Hawaii, including the Hawaiian common moorhen (USFWS 2005a, p. 49). Other natural or manmade factors that threaten the species are environmental contaminants, fires, and global climate change. Overutilization may have been a threat in the past in the form of hunting as the Mariana common moorhen was historically used

as a food item by the local Chamorro people. Although hunting of the species is not currently legal, poaching may be a problem (USFWS 1991a, p. 19); hunting is known to have occurred in 1977 (Drahos 2002, p. 264).

Habitat Loss

Wetland habitat on Guam, Saipan, Tinian, Rota, and Pagan is declining in area and habitat quality. According to the 1983 National Wetland Inventory maps for the CNMI there were approximately 740 ac (300 ha) of wetlands (although this figure apparently does not include some wetland types) on Saipan, Tinian, Rota, and Pagan; wetlands occupied less than 2% of the total land area of the CNMI (Burr et al. 2005). The 1983 National Wetland Inventory maps for Guam indicate that there were approximately 5,000 ac (2,023 ha) of wetlands at that time, or slightly less than 4% of the total land area of Guam (Guam EPA 2008). Undated anecdotal reports indicate that there used to be three times as many wetlands in the CNMI as occur now (Burr et al. 2005). Guam has more wetlands and a wider variety of wetland types than does the CNMI, and although it is difficult to quantify the extent of loss, significant losses of wetlands have occurred on Guam as well (Wiles and Ritter 1993, pp. 129–133).

The condition of remaining wetlands in the Mariana Islands is generally poor for a number of reasons, including filling, dredging, altered hydrology, invasive introduced plants, introduced vertebrate predators, ungulate disturbance, fires, erosion, pollution, and even volcanic activity (Stinson 1993, pp. 276–277, Wiles and Ritter 1993, pp. 129–133). Reports indicate that many of Guam's natural wetlands are becoming heavily invaded by the *Phragmites karka* reed (Ritter and Savidge 1999, Takano and Haig 2004b). Lake Hagoi is also subject to encroachment by *P. karka* and *Scirpus litoralis* (USFWS 1996, p. 11). Many wetlands on Saipan are also overgrown with vegetation, particularly *P. karka* (Marshall pers. comm. 2007). Permanent wetlands on Saipan and Guam are also impacted by the presence of tilapia (*Oreochromis mossambicus*) which is believed to degrade habitat for wetland birds by depleting the invertebrate prey base used by these birds (Marshall and Worthington 1996, p. 48, Service 2005a, pp. 82–83, Stinson 1993, p. 42). Development and implementation of a plan is essential to secure and manage the wetlands necessary for the recovery of this species. The ability to secure and protect wetlands is made more difficult due to the fact that in the CNMI, only those of Chamorro descent may own lands. However, the National Park Service has leased lands at American Memorial Park on Saipan which includes the last mangrove wetland on Saipan, and it is possible to develop cooperative agreements with private landowners. For example, the Guam Division of Aquatic and Wildlife Resources is interested in working on a Safe Harbor Agreement for the Guam rail (*Gallirallus owstoni*). The CNMI government has also considered the possibility of establishing a wetland mitigation bank (Gilman 1997).

Predation

A number of different predators impact the Mariana common moorhen throughout its range. Monitor lizards (*Varanus indicus*) were recorded in Lake Hagoi, Tinian during Mariana common moorhen nest searches (USFWS 1996, p. 12). The extent of predation on the Mariana common moorhen by monitor lizards is unknown, but monitor lizards are opportunistic and omnivorous, eating small mammals, insects, other lizards, birds, and eggs (McCoid and Witteman 1993; Vogt,

2006, pers. comm.). In the Mariana Islands, monitor lizard predation has been confirmed on Mariana common moorhen eggs, Micronesian megapodes, and a yellow bittern (*Ixobrychus sinensis*) chick in a nest in a coconut tree (Vogt 2006, pers. comm.). Rats (*Rattus* spp.) are also suspected of preying on eggs (USFWS 1996, p. 12). Additionally, it is possible feral dogs and cats may prey on birds in some areas (USFWS 1991a, p. 19, Stinson et al. 1992, p. 42).

According to Wiles et al. (2003, pp. 1356 and 1357–1358), the Mariana common moorhen population appeared to show little if any decline in northern Guam when other species disappeared or declined significantly, but it was noted that systematic surveys and quantitative documentation were lacking, so the actual impacts of the brown treesnake on the Mariana common moorhen are unknown. Takano and Haig (2004a, p. 249) found that Mariana common moorhens are subject to heavy egg and chick loss on Fena Reservoir and they believe that the brown treesnake is a major predator of Mariana common moorhen eggs and chicks on Guam. Eggs disappeared at night with no egg shell fragments and two brown treesnakes were observed swimming on Fena Reservoir at night (Takano and Haig 2004a, p. 249). The Mariana common moorhen is a medium to large bird, susceptible to snake predation only in the egg stage or when very young and of small body size.

Conservation Needs

Only interim recovery objectives were identified in the recovery plan due to a lack of data necessary to fully understand the needs of viable populations of this species (USFWS 1991a, p. 21). The primary task is to promote the survival of the species by providing stable, productive habitat throughout the historical Mariana common moorhen range. This entails 1) securing and managing all primary habitats to maximize the habitat conditions; 2) maintaining the secondary habitats as wetlands or creating new wetlands for those that are lost; and 3) minimizing mortality from predation, poaching, and other factors including human disturbance. Recovery needs also include determining basic biological and population data to further refine recovery actions. Downlisting criteria included protecting and managing 600 ac (240 ha) of suitable wetland habitat on Guam, 300 ac (120 ha) on Saipan, and 75 ac (30 ha) on Tinian. Population threshold numbers for downlisting include: 600 adult birds on Guam, 75 on Tinian, and 300 on Saipan (USFWS 1991a, pp. iii–iv).

Managing vegetation and water levels and controlling predators would improve the quality of wetlands and the number of Mariana common moorhens that can be supported (Ritter and Savidge 1999, p. 287, Ritter and Sweet 1993, p. 687, Service 1996, pp. 11–12, Worthington 1998, p. 416). Takano and Haig (2004b, p. 661) suggest that protecting rivers on Guam would be important to the survival of the species. Conducting regular surveys and monitoring would also allow better assessment of how populations are doing, and indicate if additional management is needed in some areas. Additional research is needed on the ecology of the species, particularly regarding impacts to reproductive success, population growth, impacts of predators, and carrying capacity of habitats.

Conservation Actions

On Guam, the developers of Manenggon Hills Resort agreed to construct 50 wetlands on the property to benefit the Mariana common moorhen (Ritter and Sweet 1993, p. 686). One of the wetlands was completed in January 1992, and by August of that year, adults and chicks were detected in the vicinity of the new wetland (Ritter and Sweet 1993, p. 687). Two adults were also detected the following January (Ritter and Sweet 1993, p. 687), possibly indicating continued use of the site.

Susupe Wetland on Saipan is regulated under CNMI Public Law #2-51 for the protection, restoration, and preservation of freshwater wetlands, habitat and species (Stinson 1993). The Service Recovery Land Acquisition provided funds to the CNMI Department of Lands and Natural Resources to purchase 9.5 ac (3.8 ha) of habitat along Lake Susupe, (Henry 2007, pers. comm.). The site is one of the only known large, freshwater wetlands in the CNMI. The lake and potholes in this area are known to be important habitat for the Mariana common moorhen.

Costco Park Wetland Mitigation Pond on Saipan was created for wetland mitigation under the Clean Water Act of 1972 to mitigate the wetland impacts from the Costco development (Williams 2008, pers. comm.). The wetland cannot maintain open water (a requirement of the applicants permit issued by the U.S. Army Corps of Engineers) without annual clearing and dredging to remove abundant reeds (*Phragmites* spp). The endangered Mariana common moorhen utilizes the wetland as do other native species, including the nightingale reed-warbler. A few other wetlands have been created or modified on Saipan as mitigation for take of other wetlands and impacts to the Mariana common moorhen, including Annie's pond (seasonal) and an area at Lower Base (Falig pond) (Marshall 2010, pers. comm.).

Environmental Baseline for the Mariana Common Moorhen

Status of the Species in the Action Area

Current Distribution

Table 9 above includes summaries of the current estimated populations of the Mariana common moorhen on Guam and Tinian. In addition to the survey information summarized in the Status of the Species section, the following sections provide details regarding the current distribution of the species in the action area.

Guam

Most recent survey information indicates there are approximately 90 Mariana common moorhen on Guam (Takano and Haig 2004a, p. 247). Wetlands that are important to the Mariana common moorhen on Guam include Agana Swamp, Yling River, and Fena Valley Reservoir, as well as various water treatment ponds (Stinson et al. 1991, p. 39, Takano 2003, p. 71). Many of the wetlands utilized by the Mariana common moorhen on Guam are ephemeral. Wetlands as a whole on Guam have been reduced in size and habitat quality (Stinson et al. 1991, p. 40).

On Guam, Mariana common moorhens use Fena Reservoir, an approximately 203-ac (82-ha) wetland located within the Naval Munitions Site (see Figure 4). Fena Reservoir is used more in the dry season (January through May) than the wet season (October through December) when Mariana common moorhens typically disperse to other wetlands or rivers on Guam (Ritter and Savidge 1999, p. 286; Takano and Haig 2004b, p. 656). Recent survey data indicate the number of Mariana common moorhen routinely detected at Fena Reservoir during the dry season (when maximum abundance is anticipated) has declined since surveys were initiated in 1987 (Brooke and Grimm 2008, p. 3). Though surveys have been sporadic since 2004, breeding and recruitment appear to be low to nonexistent at Fena Reservoir, as the last nest was detected during January 2004, and the last juveniles were detected in July 2005 (Brooke and Grimm 2008, pp. 1–3). Recently (April 2009), only six Mariana common moorhens were observed at Fena Reservoir (Eggleston 2009, p. 1). The reduced numbers of Mariana common moorhens and the lack of breeding and recruitment at Fena Reservoir have been hypothesized to correlate with the loss of *Hydrilla verticillata*, a non-native invasive aquatic plant that forms extensive mats, which was used as foraging and nesting habitat by the moorhen (Brooke and Grimm 2008, pp. 1–2). Mariana common moorhens also use other scattered sites in the Naval Munitions Site, sites along the Talafofo and Ugum River basins, and Naval Base Guam.

Tinian

The most recent survey information indicates there are approximately 41 Mariana common moorhen on Tinian (Takano and Haig 2004a, p. 247). Tinian's limited wetland areas include Lake Hagoi, Makpo (or Magpo) Swamp, Bateha Wetland, and the Mahalang Wetlands (USFWS 1996, p. 2). Lake Hagoi and the Mahalang Wetlands are located within the Navy Exclusive Military Use Area, and Bateha Wetland is located in the Navy Military Lease Area (USFWS 1996, p. 2). Magpo Wetland has been heavily degraded for many years through drainage of water by the village and no longer supports Mariana common moorhens (Marshall 2010, pers. comm.). Mariana common moorhens are occasionally reported at the Mahalang and Bateha Wetlands (USFWS 1996, p. 6). Lake Hagoi supports the largest population of the Mariana common moorhen on Tinian (USFWS 1996). Most past estimates there have been between 25 and 100 birds (Engbring et al. 1986, Stinson et al. 1991, p. 41, Takano 2003, p. 70). There were an estimated 41 birds on Tinian in 2004 (Takano and Haig 2004a, p. 247), compared to 75 (Stinson et al. 1991, p. 41) and 50 (USFWS 1996, p. 10) birds in past count efforts. Takano and Haig (2004a, pp. 247–248) found fewer birds on Tinian in 2004 than previous surveyors found, and they believe their survey methods produced more accurate counts than past surveys by minimizing counting errors due to inter-island movements between islands (Takano and Haig 2004a, p. 248).

On Tinian, an index survey of Mariana common moorhen at Lake Hagoi shows variability in counts by year, which likely reflects changing conditions, such as the amount of water in the lake, but overall the average population counts by year were similar to surveys conducted between 1999 and 2007 (Vogt 2008, p. 3). The greatest number of Mariana common moorhens seen at Lake Hagoi was 46 birds in 2002; 26 birds were found in 2001, and since then counts have ranged from 0 to 23 birds (Vogt 2008, p. 3). Nest and egg production have been and continue to remain low, which may be the result of predation by monitor lizards (Vogt 2008, p. 9). The secondary wetlands on Tinian are not routinely monitored for the presence or abundance

of Mariana common moorhen. Overall, the current numbers of Mariana common moorhens on Tinian appear to be lower than they were in the past.

Threats in the Action Area

The main threats to the species on Guam and Tinian are wetland loss and degradation, and predation by alien species. In addition, other natural and human-caused factors threaten the species, including disease, fire, environmental contaminants, and climate change. Threats are described for each site in the "Current Distribution" section, above.

Conservation Needs in the Action Area

Conservation needs include securing (protecting) and managing wetland habitat on Guam and Tinian (including minimizing human disturbance of wetlands); predator control, particularly preventing the introduction of the brown treesnake to Tinian; monitoring; and research to help better manage the species and its habitat (USFWS 1991a, pp. 23–39). Control of invasive plants such as *Phragmites karka, Scirpus litoralis* and invasive tilapia fish are also necessary to improve habitat availability for the Mariana common moorhen. Development and implementation of a program to secure and manage the Guam wetlands is necessary for the recovery of this species.

Ongoing Conservation Actions in the Action Area

Ongoing conservation actions in the action area include construction of a small number of wetlands on Guam.

Relationship of the Action Area to the Survival and Recovery of the Mariana common moorhen

In order to recover the Mariana common moorhen, the recovery plan criteria (USFWS 1991a, pp. iii–iv and 21–22) require stable populations of 600 birds on Guam and 75 birds on Tinian. In addition, a total of 600 ac (240 ha) of suitable wetland habitat must be protected and managed on Guam and 75 ac (30 ha) must be protected on Tinian. At this time, none of these goals have been met, and declines of the Mariana common moorhen have occurred on Guam and Tinian (Takano and Haig 2004a, pp. 247 and 249). Maintaining connectivity among multiple island wetlands throughout the year is important to the recovery of this species (Takano and Haig 2004a, p. 661). The continued loss and degradation of wetlands these islands will likely have a negative impact on the Mariana common moorhen. For example, a loss of the wetlands on Tinian could decrease the ability of the species to disperse through this area to utilize wetlands on Guam when needed. Both Guam and Tinian are believed to be important in supporting seasonal populations of the Mariana common moorhen.

Status of the Mariana Crow

Species Description

The Mariana crow, known as "aga" in Chamorro, is a small forest crow and is the only member of the genus *Corvus* occurring in Micronesia (Jenkins 1983, p. 25). Black in color, the adult Mariana crow has a dark-green gloss to its head, neck, and back, and a bluish tint to the tail. During molt, a short gray feather-base is visible around the body and neck region and grows lighter toward the head. The Mariana crow has brown eyes, a slender, black bill, and short visible nasal bristles. On average, females weigh less (8.5 oz [242 g], n = 11) than males (9.0 oz [256 g], n = 5) (Baker 1951, p. 245), although otherwise the sexes are outwardly similar. With the exception of the occasional brown gloss to its tail, the immature Mariana crow closely resembles the adult bird.

There are no genetic or morphological differences documented between the Mariana crow on Rota and Guam. Prior to the disappearance of the native Mariana crow population from Guam (the last known bird of Guam origin was observed in 2001), preliminary genetic studies indicated that the Rota population was most likely a genetic subset of the Guam population (Tarr and Fleischer 1999, p. 946–947). Genetic diversity is therefore lower than it was a decade ago and is lower than that of mainland corvids, presumably due to the highly restricted natural range of the Mariana crow (Tarr and Fleischer 1999, p. 945).

Listing Status

The Mariana crow was federally listed as endangered on August 27, 1984 (USFWS 1984, 9pp). A five-year status review was completed in 2007 (USFWS 2005c, 4 pp.) and a draft revised recovery plan for the Mariana crow was completed in 2005 (USFWS 2005c). Approximately 376 ac (152 ha) were designated as critical habitat for the Mariana crow on Guam and 6,033 ac (2,552 ha) were designated on Rota in 2004 (USFWS 2004b, 46 pp).

Historical and Current Distribution

The Mariana crow is known historically only from the islands of Rota and Guam (Baker 1951, p. 245). In 1976, Mariana crows were considered relatively common and widely distributed on Rota (Pratt et al. 1979, p. 234). The first island-wide survey for crows on Rota was conducted in 1982, and resulted in a population estimate of 1,318 individuals (Engbring et al. 1986, p. 95). Subsequent surveys in 1995 and 1998 indicated the population had declined to 592 individuals and 234 breeding adults, respectively (Fancy et al. 1999, p. 3; Plentovich et al. 2005, p. 211). Mariana crows were also once considered abundant and widely distributed throughout Guam (Baker 1951, p. 246). However, by the mid-1960s, Mariana crows had disappeared from the southern region of Guam, and by the mid-1970s, they were absent from central Guam (Jenkins 1983, p. 32). By 1981, the population was restricted to northern Guam and consisted of less than 400 individuals (Engbring and Ramsey 1984, p. 30). Ten years later, in 1991, fewer than 50 individuals were found on Guam (Wiles et al. 1995, p. 34). Currently, the population is estimated to be approximately 60 breeding pairs and 24 non-breeding individuals on Rota and two male birds on Guam.

Ecology

Mariana crows were known to use secondary, coastal, ravine, and agricultural forests, including coconut plantations (Baker 1951, p. 246; Jenkins 1983, p. 25), but all evidence indicates they were most abundant in native limestone forests (Michael 1987; Morton et al. 1999, p. 22). Nesting occurs in closed canopy forests in native tree species that are on average 6.7 in (17 cm) in diameter at breast height and 25.6 ft (7.8 m) high, and away from forest edges [i.e., greater than 735 ft (224 m) from the nearest road] (Ha et al., unpubl. manuscript, p. 8). All nest trees recorded on Rota are native (USFWS 2005c, p. 16). Breeding likely occurs all year on Rota, while peak nesting activity generally occurs between August and February (USFWS 2005c, p. 18). Crows are omnivorous and their diet include insects, skinks, geckos, juvenile rats, bird eggs, foliage, fruit, seeds, and buds (S. Plentovich, Service, unp. data).

On Rota, Morton, et al. (1999, pp. 22–24) found that breeding crows on six study areas averaged one pair per 50 ac (22 ha) of forested habitat, and each territory was dominated by native forest. Pair densities ranged from one per 91 ac (37 ha) in relatively fragmented forest, to as high as one pair per 30 ac (12 ha) in mostly intact limestone forest along a coastal terrace. Territories were aggressively defended from July through January, although established pairs occupied these areas throughout the year.

Life History

Mariana crows breed year-round on Rota. During a three-year period (1996 to 1999), Morton and coworkers (1999) observed nest initiation as early as July 31 and fledging as late as May 22. Peak nesting activity occurs from August through February, but the timing can vary considerably depending on typhoon activity during the previous breeding season (see section below on typhoons). In contrast, breeding activity in the remnant crow population on Guam was truncated, apparently due to nest predation, poor physiological vigor of the few remaining adults, and egg nonviability. In recent years (1998 to 2007), nesting by Mariana crows on Guam was recorded only from October into mid-April (Morton 1996, pp. 12–17; USFWS 2005c, p. 18).

A minimum of 65 days is necessary to build the nest, incubate the eggs, and rear the brood through fledging (Morton et al. 1999, p. 12–17). Both parents generally participate in all aspects of breeding, although the female incubates most of the time. Nest construction typically takes a week to complete by both parents and develops through three stages with progressively smaller-diameter nest materials: platform, cup, and nest lining (Morton 1996, Lusk and Taisacan 1996). The incubation period is 21 to 23 days, and the nestling period is 36 to 39 days (Morton et al. 1999). Mariana crows will often reinitiate the nest cycle within 2 weeks after abandoning an empty nest, and within 4 weeks after losing a clutch or brood (Service 2005c, p. 18).

The percentage of nests that produced fledglings between 1996 and 2006 varied from 12% to 50% and Mayfield estimates of nest success ranged from 13% to 41% (Ha et al. 2008). Mean clutch size, number of nestlings, and number of fledglings for nests monitored between 1996 and 2006 was 2.59 ± 0.08 standard error (SE), 1.42 ± 0.06 SE , and 1.28 ± 0.07 SE, respectively (Ha et al. 2008; Berry 2008, pers. comm.). Large clutches (four eggs) have been observed on Rota, but not on Guam. This occurred most frequently (seven of eight observed nests) during the year

immediately following supertyphoon Paka (December 1997). During that year (1998), one female even deposited a second four-egg clutch immediately after losing her first clutch of four eggs (Morton et al. 1999).

Although Mariana crows generally produce only a single brood per year; however, nest failure and other factors lead to multiple nest attempts each breeding season. From 1996 to 1999, 32 crow pairs on Rota constructed a mean of 2.2 nests per year (SE = 0.14, n = 78), with one pair building as many as 7 nests in one season (Morton et al. 1999, p. 13). However, not all nests resulted in egg-laying. On average, Rota pairs produced about one nest per year that advanced to the level of egg deposition. Of 148 nests with known fates over a three-year period, 18% were only partially constructed, 13% were abandoned after completion, 4% had inviable clutches, 28% were depredated, and 16% were destroyed by typhoons; the remaining 22% fledged young (Morton et al. 1999, p. 12–18). Similarly, on Guam, crow pairs have been known to attempt nesting seven times in one season (Morton 1996). However, nest failures on Rota in more recent years have been attributed to premature abandonment (either as a result of predators or human-induced disturbance), interference by unmated males (due to skewed sex ratios), black drongo mobbing, and possibly senescence (*i.e.*, poor physiological vigor and infertility) (Morton 1996; National Research Council 1997).

Mariana crows typically produce from zero to one brood a year, exceptions have been documented. One pair on Rota successfully fledged and raised two broods of singletons in one breeding season; in contrast, another pair tended a single juvenile for 18 months, skipping an entire breeding season (Morton et al. 1999, pp. 17–18). This latter consequence of an extended parental attendance period is not uncommon in Mariana crow. Over a three-year study period, 4 of 30 pairs were deemed nonbreeders during at least one year because of the extended dependence of the previous season's juveniles (Morton et al. 1999, pp. 18–20).

After fledging, Mariana crows will typically remain in family groups until the following breeding season, a period that averaged 241 days (SE = 33, median 197 days) for 15 banded family groups (Morton et al. 1999, pp. 18–20). However, the period of parental attendance after fledging varies widely, from 99 to 537 days. Recruitment into the adult population is low. Of 19 crows that were banded as juveniles on Rota, 4 (21%) were known to be alive at age of entry into the adult cohort (3.5 years old). Assuming that all birds not resighted died, roughly 1 in 5 fledglings made it into the adult cohort (Morton et al. 1999, pp. 18–20).

Survival to one year of age for male and female crows banded on Rota between 1990 and 2006 was 36.8 and 54.1%, respectively (Ha et al. 2008). Annual survivorship for adult male and female crows was 80.6 and 76.1%, respectively. Male first year survivorship was significantly lower than female first year survivorship, but the reason for this difference is currently unknown. An assessment of dispersal distances for male and female aga did not indicate any significant difference between the sexes (Ha and Ha 2010, p. 47). In general, first year survival was lower then estimates reported for stable populations of Amercian crow (*Corvus brachyrhynchos*) in California (68%; Caffrey 1992) but similar to those reported for the Hawaiian crow (*Corvus hawaiiensis*; 43%; National Research Council 1992). Adult survivorship estimates were between those reported for the Hawaiian crow (70%; National Research Council 1992) and American crow (97% for females and 93% for males; Caffrey 1992).

Threats to the Species

Primary threats to the Mariana crow throughout its range are habitat destruction and modification, predation by introduced predators such as cats, rats, mangrove monitor lizards (*Varanus indicus*), and brown treesnakes, human persecution, typhoons, and reproductive and small population problems (USFWS 1984, p. 33883–33884, Service 2005c, pp. 22–34). Factors that may have had an impact on Mariana crow are: brown treesnake, disease, nutritional deficiencies, contaminants, and harassment by and competition with introduced species such as the black drongo.

Severity of threats differs between Guam and Rota. Brown treesnake predation is believed to be the overriding factor in the decline of Mariana crow on Guam (USFWS 2005c, p. 39). Habitat degradation due to grazing by feral ungulates and range expansion of invasive plants are also factors (USFWS 2005c, pp. 27–29). On Rota, habitat loss and degradation in concert with predation by introduced predators are likely the primary causes of pronounced population declines. However, other factors such as human persecution, habitat degradation from typhoons and wildfire (see General Status and Baseline section) and reproductive problems associated with small populations adversely impact the species and its habitat.

Conservation Needs of the Species

The draft revised recovery plan for the Mariana crow calls for three stable ($\lambda \geq 1.0$ for 10 consecutive years) populations of 75 territorial pairs each (one on Rota; one in northern Guam; and one in southern Guam) (USFWS 2005c), sufficient habitat to support these pairs (see below); brown treesnake and other predator control, brown treesnake interdiction efforts to prevent establishment of brown treesnakes on Rota, and efforts to resolve landuse conflicts (USFWS 2005c, pp. 48–50). The Rota crow population needs to increase to a point where it is robust enough to support translocations to Guam when suitable conditions are present. In the interim, translocations to other islands in the Mariana archipelago, population supplementation on Rota through a captive rear and release program, or establishment of a captive population may be necessary to conserve the species.

The draft revised recovery plan (USFWS 2005c) identifies areas needed for recovery on Guam and the 2002 proposal to designate critical habitat for the species identified essential habitat (USFWS 2002, pp. 34). In 2006, the U.S. Forest Service completed the first island-wide assessment of landcover on Guam (Liu and Fischer 2006, pp. 14). Because this assessment represents the best available information for landcover on Guam we used this data to assess the amount of potential recovery habitat for the Mariana crow on Guam.

Mariana crow territory sizes on Rota ranged from 29.7 to 91.4 ac (12 to 37 ha) with an average territory size of 54.4 ac (22 ha) (Morton et al. 1999, p. 22). In general, fragmented and degraded habitats tend to have larger crow territories (USFWS 2005c, p. 15). Ungulate populations on Guam appear to be impacting regeneration of some native tree species which, along with typhoon impacts and human habitat modification, may be degrading the remaining forested areas (Wiles et al. 1996, p. 234; Perry and Morton 1999, pp. 133-137; Ritter and Naugle 1999, p. 279; Wiles 2005, pp. 514-519). In addition, the available land cover information for the island is very

general and does not distinguish between degraded and non-degraded areas. Therefore, a conservative estimate of the required amount of forested area to support a pair of Mariana crows would be 91 ac (37 ha). If the goal is to have 75 territorial pairs in northern and southern Guam then approximately 6,857 ac (2,775 ha) of appropriate forested habitat would be required in both northern and southern Guam for recovery. The draft revised recovery plan for Mariana crow has not been finalized and recovery goals are subject to revision as well.

In addition, a sustainable population of breeders requires that a floater population of unmated adults and juveniles be present to replace pair members that succumb to mortality. Population modeling on Rota indicates that the adult and juvenile mortality rate is approximately 20% and 50%, respectively (Ha et al. 2008, p. 5). These mortality rates indicate that approximately 40% of the adult breeding population would need to be in non-breeding crows in order to replace breeding adults. Therefore, 75 territorial pairs would require a floater population of at least 60 individuals. Each of these birds would require space to forage and roost. The home range requirements of a non-breeding Mariana crow are not known at this time. However, in general, non-breeding birds share territories with one or several breeding pairs (Zack and Stutchbury 1992, p. 198). Therefore, we assumed that the floaters would utilize areas within pair territories and as the number of non-breeders is not greater than the number of pairs then the space required by floaters would be included in the pair territories.

Typhoon Impacts to Recovery Habitat

Typhoon data for Guam collected since 1959 indicates that on average four typhoon events (sustained winds greater than or equal to 74 mi per hour (119 km per hour)) could occur each decade (U.S. Navy, Typhoon Joint Warning Center, pers. comm. 2010). Typhoons can cause a wide range of damage to forests (Brokaw and Walker 1991, p. 442) and, if the damage is severe (e.g., tree uprooting and trunk snapping), could limit the availability of appropriate nesting trees for Mariana crows. These forests are expected to regenerate after the storm event. However, these storms likely will lead to an extended temporary loss of habitat. In other words, regenerated habitat should eventually be available for a breeding pair to move into if the availability of appropriate habitat within their current territory is diminished due only to damage from a typhoon event.

The amount of recovery habitat suitable for Mariana crow breeding available at any one time is dependent on the type of damage caused by the typhoon, the amount of forest impacted by the typhoon, the time required for the forest to recuperate from the typhoon damage, and the number of typhoons that occur during that recuperation period. The research required to provide good estimates of all of this information has not been conducted in the Mariana Islands. Therefore, only rough estimates are possible until this information is obtained.

Typhoons can cause defoliation, loss and damage to branches, and snapping and uprooting of stems (Brokaw and Walker 1991, p. 442) which can all impact Mariana crow habitat. However, of these impacts, the snapping and uprooting of trees is likely to require the longest time for recovery and could have the most impact on long-term crow breeding success. For example, the loss of trees of sufficient size for breeding could limit breeding until appropriate trees were

available. Therefore, an assessment of extent of stem snapping and uprooting from typhoons would be important for determining habitat needed to offset impacts from typhoons.

Data on tree snapping and uprooting from storms in the Mariana Islands is limited. Hirsh and Marier (2002, p.598) assessed damage to *Cycas micronesica* trees on Guam after supertyphoon Paka and found that 10% of the trunks had snapped and 2% of the trees were uprooted from the storm. Wiles (2005, p. 514) assessed damage to *Artocarpus mariannensis* after supertyphoon Paka and found that 5.8% of the trunks had snapped and 2.5% were knocked down. Wiles (1991, 1998) also described forest damage associated with typhoon Russ and supertyphoon Paka. In general, Wiles (1991, p. 120) reported that the majority of the trees impacted by typhoon Russ were defoliated, but that few branches were broken and that uprooted and broken trees were uncommon. More severe damage to trees was reported for Paka but it was not quantified (Wiles 1998; p. 103). Donnegan et al. (2004, pp.27-28), in their assessment of forest resource on Guam, found that approximately 26% of the trees they sampled were damaged and 7% of the damaged trees had broken trunks. Only 36% of the damage was related to typhoons and other weather events so not all trees with broken trunks were related to typhoons. In addition, the damage was not specific to any one typhoon or weather event. Published information on the percentage of trees uprooted and with snapped stems is more widely available outside the Mariana Islands. In the Caribbean, trunk snapping and uprooting rates ranged from 3 to 39% depending on the storm, island, and tree sizes measured (Brokaw and Walker 1991, p. 443). In Samoa, Elmquist et al. (1994, p.387) reported uprooting and trunk snapping percentages from 16 to 67 in trees greater than or equal to 5 cm diameter at breast height from Cyclones Ofa and Val. While in Madagascar, Birkinshaw (2007, p. 19) reported that 14% of the living trees greater than or equal to 10 cm diameter at breast height were either uprooted or had snapped trunks due to Cyclone Hudah.

Because typhoon events are common and the native species on Guam are likely to be typhoon adapted (Stone 1970, p. 14, Wiles 2005, p. 517) the uprooting and trunk breakage rates for Guam are likely to be on the lower end of the impact spectrum. This is consistent with damage estimates provided by Hirsh and Mariar (2002) and Wiles (2005) for two species on Guam as well as the estimates of damaged trees from Donnegan et al. (2004). Therefore, we used the 7% damage estimate from Donnegan et al. (2004) as our estimate of the percentage of forest likely to be severely impacted by a typhoon and thus, not usuable for Mariana crow habitat until it recovered. It is likely that this may be an overestimate of average damage as damage estimates provided by Hirsh and Mariar and Wiles were for a supertyphoon and the estimate by Donnegan et al. (2004) includes non-weather sources of damage. However, as the intensity of typhoons is expected to increase due to climate change (Webster et al. 2005, p. 1846; Emanuel et al. 2008, p. 365) we believe this estimate is appropriate.

The amount of forest impacted by each typhoon event is dependent on the intensity of the storm, its distance from the island, its direction, previous impacts to the forest, and the topography of the island (Brokaw and Walker 1991, pp. 442-445; Boose et al. 1994, pp. 377-389). With such variability it is impossible to accurately predict how much forest will be impacted by each typhoon. However, utilizing estimates from a range of storm intensities could provide some general guidelines.

Wiles (1991, pp.120–122; 1998, pp. 103–107) provided overviews of impacts on natural resources on Guam from two typhoons, typhoon Russ (1990; maximum 120 mph sustained winds) and supertyphoon Paka (1997; 150 mph sustained winds and gusts up to 185 mph). Wiles did not identify the amount of forested area impacted by each typhoon but did describe which areas were impacted. When these areas were mapped using GIS and compared to available forest, we estimated that 3% of the forest on Guam was impacted by typhoon Russ and 14% was impacted by supertyphoon Paka. These are extremely rough estimates of damage, as the Wiles reports appeared to focus on particular areas of interest and not all forest resources on the island. However, they do provide an estimate of potential typhoon impacts on Guam. Donnegan et al. (2004, pp.27-28), in their assessment of forest resource on Guam found that approximately 26% of the trees they sampled were damaged and 36% of the damage was related to weather events, like typhoons. Therefore, 9.5% of the trees sampled showed signs of storm damage (Donnegan et al. 2004). Alhough not specific to any particular storm it does provide a cumulative estimate based on the likely impacts of multiple recent storms. Because this estimate includes a wide range of damage and the likely effects of multiple storms we decided to round up the 9.5% estimate to 10% and use it as the estimated area of forest impacted by each typhoon. This estimate falls close to the average extent of damage (8.5%) from supertyphoon Paka and typhoon Russ estimated from Wiles (1991, 1998), although it's closer to the high end and may be an overestimate for each storm. However, erring on the high end is reasonable as climate change models predict that typhoon intensity will increase (Webster et al. 2005, p. 1846; Emanuel et al. 2008, p. 365).

While natural regeneration of the forest is expected to occur after a typhoon event, calculations of recovery habitat needed must take into account that a portion of the habitat will be non-functional for Guam Micronesian kingfisher for an extended period of time. Tree growth rate data are not available for the Mariana Islands so forest regeneration time is uncertain. However, Franklin (2003) reported on annual growth rates of trees in Tonga, an island with likely similar conditions to other Pacific Islands, including the Mariana Islands. Typhoons create disturbance in the forest which leads to increased growth for some species after the disturbance event (Vandermeer et al. 1997, pp. 154-157). Therefore, we used the average maximum growth rate for the species assessed by Franklin (2003, p. 672) to estimate average growth for Guam after a storm (1.01 cm a year). The average diameter at breast height of a Mariana crow nesting tree was 7 in (17 cm; Ha et al., in review, p. 8). Therefore, it would take approximately 18 years (17/1.01 = 18) for a tree to grow to a size large enough for an average Mariana crow nest tree. We then used 18 years as the timeframe for Mariana crow breeding habitat regeneration on Guam.

Typhoon data collected since 1959 (U.S. Navy, Joint Typhoon Warning Center, pers. comm. 2010) indicates that on average there were 1.4 super typhoons and 5.1 typhoons over an 18 year period. Therefore, over the 18 year period we would expect for a forest to regenerate there would be 6.5 typhoon events of varying magnitude. Each of these severe typhoons would impact approximately 10% of the available forest on the island and 7% of that forest would be damaged to such an extent that it would no longer be crow habitat. Therefore, if there were 26,650 ac (10,785 ha) of forest for crow recovery, approximately 2,665 ac (1,078 ha) could be impacted by a typhoon and 186 ac (75 ha) would be impacted to such an extent that it would no longer serve as crow recovery habitat. If typhoons were to occur on average 7.6 times over a 20-year period

then 1,212 ac (491 ha) of additional forest across the island of Guam or 606 ac (245 ha) of additional forest in northern and southern Guam would be needed for Mariana crows to use while the previously damaged forest regenerates.

Based on the above assessment, a minimum total of 7,463 ac (3,020 ha) of appropriate habitat in northern Guam and 7,166 ac (2,900 ha) in southern Guam would be needed to recover the species on Guam. This includes 6,857 ac (2,775 ha) of habitat for breeding pairs and floater juveniles and 606 ac (245 ha) to buffer potential temporary habitat loss due to typhoons.

Ongoing Conservation Actions

Between 1997 and 2003, a total of 31 Mariana crows were translocated from Rota and released on Guam (USFWS 2009a, pp. 42–44). Currently, the Guam population consists of only two male crows (Quitigua 2009, pers. comm.). Translocated crows were carefully monitored and, in general, did not breed successfully and had low survivorship. Also, in conjunction with the Northwest Field training facility and Intelligence, Surveillance, Reconnaissance, and Strike Capability Projects, the Air Force was to construct ungulate exclosures around and eradicate ungulates from approximately 627 ac (254 ha) of forested and disturbed land to increase the quality of the habitat for the Mariana crow and other listed species (USFWS 2006a, pp. 12, 29). The Air Force was also to set aside approximately 148 ac (60 ha) of forested land in a new experimental habitat management unit (USFWS 2006a, p. 29). A brown treesnake barrier is proposed for construction around this habitat management unit to help support listed species recovery efforts on Guam. The Air Force was also to initiate native foraging tree planting and other conservation actions (USFWS 2006a, p. 12 and U.S. Air Force 2006, pp. 2-36 to2-39). The ungulate management plan for non-fenced areas is being drafted (Cobb, pers. comm. 2010c).

On Rota, funding was provided to construct a brown treesnake containment barrier at the Rota port. The land was identified for the barrier but construction has not been initiated (Hawley 2009, pers. comm.). Efforts also continue to address land use conflicts associated with agricultural homesteads on the island. Finally, research is also being conducted to better understand the factors causing the population decline on Rota.

Environmental Baseline for the Mariana Crow

Status of the Species in the Action Area

Only two male Mariana crows are currently known to exist on Guam; both individuals are located on Andersen Air Force Base (Navy 2010, p. 237).

As mentioned above, Mariana crows were known to use a variety of habitats, but all evidence indicates they were most abundant in native forests. The Forest Service vegetation map of Guam includes the following forest types: 1) Limestone Forest, 2) Ravine Forest, 3) Palma Brava Grove, 4) Scrub Forest, 5) Leucaena Stand, 6) Casuarina Thicket, 7) Acacia Plantation, and 8) Coconut Plantation (Liu and Fischer 2006, pp. 5–7). Of these forest types, only Limestone Forest and Ravine Forest are considered likely habitat to support Mariana crow recovery. Palma Brava Grove, Leucaena Stand, Casuarina Thicket, Acacia Plantation, and Coconut Plantation are

dominated by non-native *Heterospathe elata*, *Leucaena leucocephala*, *Casuarina equisetifolia*, *Acacia confusa*, and *Cocos nucifera*, respectively (Liu and Fischer 2006, pp. 5–7). None of these tree species are known to be used for nesting by Mariana crows (USFWS 2005c, p. 16). Therefore, these forest types were not included as potential habitat even though these forest types could be used for foraging. Finally, Scrub Forest is considered disturbed forest dominated by *Artocarpus atilis*, *Cocos nucifera*, and *Leucaena leucocephala* trees, clumps of *Bambusa vulgaris*, agricultural fields and patches, pastures, scrub vegetation, and home sites (Liu and Fischer 2006, p. 6). None of the woody species listed for this forest type are known to be used for nesting by Mariana crows and the inclusion of open areas (e.g., agricultural fields, pastures, home sites) and scrub vegetation in this forest type indicates that it may not be viable breeding habitat for the species. Therefore, we did not include Scrub Forest as potential recovery habitat for the Mariana crow.

Mariana crows can use small patches of forest for nesting (Morton et al. 1999, p. 20–22). However, data collected on the Rota population indicates that the species typically nests in forest interiors far from edges, roads, and human habitation (Morton et al. 1999, p. 20-22; Ha et al., in review, p. 8). Therefore, not all forest patches would likely be used for nesting by Mariana crows. To account for this we developed criteria for determining whether a forest patch was considered potential Mariana crow breeding habitat. We considered any forest patch less than 91 ac (37 ha; the maximum territory size for a pair [Morton et al. 1999, p. 22]) and over 0.8 mi (1.3 km), the median dispersal distance (n=14) from natal to breeding nest on Rota (Ha and Ha, 2010, p. 47), away from the nearest patch too small and isolated to be viable crow habitat. In addition, all patches less than 30 ac (12 ha; the minimum territory size on Rota [Morton et al. 1999, p. 22]) and 1,148 ft (350 m; the approximate radius of a 91 ac [37 ha] territory) from the nearest patch above 30 ac (12 ha) were considered too isolated and small to be crow habitat. Finally, any patch less than 91 ac (37 ha) and separated from the nearest patch by lands classified as Urban Builtup or Urban Cultivated (excluding roads) by the Forest Service was considered too isolated to be viable crow habitat because Mariana crows have been observed to be sensitive to human disturbance (USFWS 2005c, pp. 30–31). It should be noted that these criteria incorporate the available information on crow nest distances from roads and buildings. However, some modifications were required to account for the use of the Munitions Storage Area, an area heavily bisected by roads, by Mariana crows in the 1980s and 1990s (Engbring and Ramsey 1984, p. 30; Wiles et al. 1995, p. 34). Types of disturbance may vary among the islands which could lead to differences in habitat use. For example, human persecution may be a factor in the Mariana crow decline on Rota while it is not considered an important factor on Guam (USFWS 2005c, pp. 30-31). Additional research is needed so these criteria may be modified as more information becomes available.

Based on the above assessment, we estimate there are approximately 14,831 ac (6,002 ha) of potential recovery habitat for the Mariana crow in northern Guam and 11,819 ac (4,783 ha) in southern Guam. As noted above under “Conservation Needs of the Species”, a minimum total of 7,463 ac (3,020 ha) of appropriate habitat in northern Guam and 7,166 ac (2,900 ha) in southern Guam would be needed to recover the species. The draft revised recovery plan for the Mariana crow has not been finalized and recovery goals are subject to revision as well.

Threats to the Species in the Action Area

Habitat loss due to military development is a threat to the Mariana crow on Guam. Habitat for the Mariana crow in the action area is being altered by the Air Force's development of a training area in the Northwest Field area of the base and their Intelligence, Surveillance, Reconnaissance, and Strike Capability Project. Once these projects are fully completed, it is expected that the amount of habitat remaining for Mariana crow in northern Guam will be 14,812 ac (5,994 ha).

Much of the remaining forest has also been severely degraded by introduced Philippine deer, feral pigs, and feral Asiatic water buffalo (*Bubalus bubalis*), that were introduced to Guam in the 1600s and 1700s (Conry 1988, Wiles et al. 1999). These introduced ungulates are suspected of significantly impacting native floral communities on Guam by consuming seeds, fruits, and foliage, ingesting or trampling seedlings, and promoting the spread of introduced weeds (Wiles et al. 1999, p. 193; Wiles 2005 pp. 514–515). Philippine deer and feral pigs are found throughout Guam. On Andersen Air Force Base, densities of Philippine deer and feral pigs were estimated at 0.8 deer per ac (1.8 deer per ha) and 0.2 pigs per ac (0.4 pigs per ha), some of the highest densities recorded in the world (Knutson and Vogt 2003, p.4). Feral Asiatic water buffalo are found predominately on the Ordnance Annex and surrounding non-Navy lands in southern Guam, where the population is estimated to be at least 50–60 animals (Brooke 2007, pers. comm.).

Predation by Brown Treesnakes

Brown treesnake predation is the primary factor in the decline of the Mariana crow on Guam (USFWS 2005c, p. 39). Snake densities within the action area are not known specifically; however, densities appeared to level off in the 1990s to around 20 individuals per ac (50 per ha) in favorable habitats (Rodda and Savidge 2007, p. 315). These high snake densities continue to hamper recovery efforts for the Mariana crow.

Human Persecution

Human persecution may be a source of mortality for adult and juvenile crows. Unfortunately, the level of human persecution, as well as the motivation behind it, is poorly understood.

Conservation Needs of the Species in the Action Area

In addition to the overall conservation needs identified above in the section above that discusses the general baseline conditions within the Mariana Islands, the following actions are necessary for the conservation of the Mariana crow. On Guam, large-scale control and/or eradication of brown treesnakes is essential for crow recovery on Guam. Additional conservation needs include protection of habitat from anthropogenic losses, grazing by feral ungulates, invasion of introduced plants, and loss of pollinators such as the Mariana fruit bat. Population intervention via the establishment of an additional population on another island and/or a captive population is necessary at this time.

Ongoing Conservation Actions for the Species in the Action Area

The "Ongoing Conservation Actions" section of the Mariana crow Status of the Species section details ongoing efforts to conserve the species within the action area.

Relationship of the Action Area to the Survival and Recovery of the Mariana Crow

The draft revised recovery plan for the Mariana crow calls for three stable ($\lambda \geq 1.0$ for 10 consecutive years) populations of 75 territorial pairs each (one on Rota; one in northern Guam; and one in southern Guam) (USFWS 2005c).

Status of the Mariana Fruit Bat

Species Description

The Mariana fruit bat is a medium-sized bat in the family Pteropodidae that weighs 0.66 to 1.15 lb (330 to 577 g) and has a forearm length ranging from 5.3 to 6.1 in (13.4 to 15.6 cm). The underside (abdomen) is colored black to brown, with gray hair interspersed, creating a grizzled appearance. The shoulders (mantle) and sides of the neck are usually bright golden brown, but may be paler in some individuals. The head varies from brown to dark brown. The well-formed and rounded ears and large eyes give the face a canine appearance; medium and large members of the genus *Pteropus* are often called flying foxes.

Listing Status

The Guam population of the Mariana fruit bat was federally listed as endangered in 1984 (USFWS 1984, p. 33,881). In 2005, the Mariana fruit bat was listed as threatened throughout the Mariana archipelago and reclassified from endangered to threatened on Guam (USFWS 2005b, pp. 1,190–1,191). A five-year status review was completed in 2007 for this species (USFWS 2007b, 4 pp.). A draft revised recovery plan for the Mariana fruit bat was completed in 2009 (USFWS 2009c, xiv + 83 pp.). Critical habitat was designated for this species on October 28, 2004 (USFWS 2004b, 46 pp).

Historical and Current Distribution

The Mariana fruit bat is endemic to the Mariana archipelago (Guam and the CNMI), where it is found on most of the fifteen major islands. General population data are available but should be considered with caution because survey methods have varied by island, and data for all of the islands north of Anatahan are 10 years old. Based on the best information currently available, the total population of the Mariana fruit bat is estimated to be approximately 6,810 to 6,930 animals. The following represents the species' known distribution and estimated number of individuals: Guam (fewer than 20); Rota (1,200–1,400); Aguiguan (40 to 60); Tinian (transient bats only); Saipan (50); Farallon de Medinilla (transient, only one bat has been observed); Anatahan (1,000); Sarigan (300 to 400); Guguan (550); Alamagan (100); Pagan (1,500); Agrihan (1,000); Asuncion (800); Maug (50) (Brooke 2010, pers. comm., Boland pers. comm. 2009;

Brooke 2008, p. 1 and references cited therein; Brooke 2009, p. 1; CNMI Division of Fish and Wildlife 2000b, p. 4; CNMI Division of Fish and Wildlife 2000c, p. 35; Johnson 2001, p. 19; DoN 2009, p. 89; Wiles and Johnson 2004, p. 585). There are no known records of Mariana fruit bats on Uracas (as Farallon de Pajaros in Wiles et al. 1989, p. 69). Initial impressions of information gathered in field surveys in 2010 indicate Mariana fruit bat numbers may be lower in the northern islands of the Mariana Islands than previously estimated (Amidon pers. comm. 2010). Reliable trend information does not exist for the entire population; the following sections detail trends on individual islands, where this information is available.

Ecology

The Mariana fruit bat uses several forest types for foraging, roosting, and breeding, including native primary and secondary limestone forest, volcanic (or ravine) forest, old coconut plantations, and groves of *Casuarina equisetifolia* (Glass and Taisacan 1988, pp. 6–13; Worthington et al. 2001, pp. 137–138; Wiles and Johnson 2004, pp. 589–591). Although Mariana fruit bats have been observed to feed on introduced and cultivated food plants and roost in non-native tree species, non-native species make up only a small fraction of the plants they use (Wiles 1987a p. 94); they are thus reliant on native forest and its constituent species. Several hours after sunset, bats depart their daytime roost sites to forage for fruit and other native and non-native plant materials such as leaves and nectar (USFWS 1990b, p. 8). At least 21 plant species are used as food sources by the Mariana fruit bat; of these, 17 are native species found principally in native forest (Wiles 1987a, p. 94; Service 1990b, pp. 7–8). Native forest and tree species are preferred for roosts; Wiles (1987a, p. 94) described six bat roost sites on Guam, all within native limestone forest. Major roost trees included *Ficus* spp. and *Neisosperma oppositifolia*. On Rota, fruit bats used at least eight native tree species for roosting (Glass and Taisacan 1988, p. 13). *Pteropus* bats are strong fliers and traverse long distances (Eby 1991, p. 554; Wiles and Johnson 2004, p. 593 and references cited therein).

Fruit bats are important components of tropical forest ecosystems because they disperse seeds of their forage plants widely and thereby help maintain forest diversity and contribute to plant regeneration following typhoons and other catastrophic events (Cox et al. 1991). The Mariana fruit bat likely flies between islands in the archipelago, although the frequency and regularity of interisland transits are unknown (Wiles and Glass 1990, pp. 2–4; Wiles and Johnson 2004, p. 593 and references cited therein). This and other species in the genus *Pteropus* often travel several or many km each night from their roosts in search of food resources such as fruit and flowers (Nelson 2003, Mildenstein et al. 2005, p. 98; p. 81–82; Janeke 2006, p. 51).

Life History

Mariana fruit bats are highly colonial, and most animals roost during daylight in colonies in one or several adjacent large trees. Grooming, breeding, and other important social interactions as well as sleeping take place in the colonies (USFWS 1990b, p. 8). Some colonial roosts are composed of harems (one male and as many as 15 female), others are composed of bachelor males (Wiles 1987, pp. 93–94). Some bats roost solitarily or in smaller groups (Wiles and Johnson 2004, p. 589). Data from Guam indicate that some roost sites may be selected for their inaccessibility by humans and, thus, limited human disturbance (Wiles et al. 1995. p. 39). Fruit

bats will abandon roost sites if disturbed and have been reported to move to new locations as far as 6 mi (10 km) away (USFWS 1990b, p. 9).

Reproduction in Mariana fruit bat may occur throughout the year (Glass and Taisacan 1988, p. 6). Female fruit bats typically raise only a single pup each year (Pierson and Rainey 1992 p. 1). Therefore it is likely that population growth, and hence recovery following a decline, would be slow (Pierson and Rainey 1992, p. 1–2; McIlwee and Martin 2002). Fruit bat pups are flightless and females carry them until they become too heavy (Eby 1991, pp. 547–548; Esselstyn et al. 2006, p. 535). Once the juveniles are too large to carry, they are left at their roost at night while the majority of adult bats leave the roost to forage (Eby 1991, p. 548). These juveniles are still flightless and have not weaned or begun to forage on their own (Eby 1991, p. 548).

Threats

The initial (20th century) declines in the Mariana fruit bat in the southern islands of the archipelago (Guam, Rota, Aguiguan, Tinian, and Saipan) resulted from a combination of hunting with firearms, habitat loss and destruction, and the introduction of alien species (e.g., alien plant species and ungulates) that degraded native habitat (USFWS 2009c, p. 5–11, see Table 3 and references cited therein). Current and ongoing threats include illegal hunting, loss and degradation of native forest, predation by the brown treesnake, and the increased extirpation risk owing to the high vulnerability of very small populations to chance environmental catastrophes and demographic shifts (USFWS 2009c, p. 19). Military activities, uurbanization, and other forms of development also are a threat to the Mariana fruit bat because they result in loss, fragmentation, or degradation of forest habitat; direct disturbance of bats by noise, lights, or physical intrusion on roost sites; and/or increased likelihood of introductions of the brown treesnake or other predators to islands where they do not occur now. Mariana fruit bats evolved in the presence of typhoons, the principal natural disturbance in the archipelago, but today these storms are a threat to the species because they can exacerbate the effects of the anthropogenic threats listed above (USFWS 2009c, p. 34).

Conservation Needs of the Species

Re-establishing and maintaining a widely distributed, robust population of the Mariana fruit bat requires several broad categories of actions (USFWS 2009c), pp. xi–xii, 37–38). Habitat protection and enhancement on islands where bats occur now is needed to ensure adequate resources for foraging and roosting are present to support growing bat numbers as the species recovers. Additionally, habitat restoration and protection on islands where bats do not currently or regularly occur is necessary to fill gaps in distribution and facilitate interisland movement.

Effective control of unlawful hunting throughout the archipelago through outreach, education, and enforcement measures is required, especially on Rota, which harbors a relatively large number of bats and where hunting pressure is high and chronic. Brown treesnake control on Guam and Saipan is needed to protect the few bats left on Guam and minimize the impact of treesnakes on Saipan. Most importantly, interdiction to prevent the brown treesnake from dispersing to other islands is imperative to prevent predation from affecting fruit bats elsewhere in the archipelago. Finally, continued research and monitoring in necessary to improve our

knowledge of the Mariana fruit bat's biology, ecology, and population status and trend in response to threats and conservation actions.

Ongoing Conservation Actions

Efforts to minimize hunting and trade of the Mariana fruit bat as well as efforts to monitor and study the species are ongoing. The Mariana fruit bat is fully protected from hunting under Guam, CNMI, and federal law, but this important conservation action is not adequately enforced, and illegal hunting continues (USFWS 2009c, p. 19–26 and references cited therein). In January 1990, declines in bat populations throughout Micronesia resulted in the reclassification of *Pteropus mariannus* from Appendix II to Appendix I of CITES. This reclassification was an effort to control shipments of other subspecies from Palau, Yap, and Kosrae into the Mariana Islands and to encourage exporting countries to conserve their bat populations. Enforcement of CITES regulations, outreach by the Service and the governments of Guam and the CNMI, and Palau's change in political status to one of free association with the United States resulted in the termination of all legal *Pteropus* imports into the Marianas in 1994. CITES protection has been highly successful and very few illegal shipments of bats now enter Guam and the CNMI (Wiles and Brooke 2010).

Since the 1970s, surveys of Mariana fruit bat populations have been conducted on various islands and at variable intervals by the Guam Division of Aquatic and Wildlife Resources (DAWR) and CNMI Division of Fish and Wildlife. Personnel at these agencies, the Guam National Wildlife Refuge, the DoN, and research institutions have conducted studies to obtain information about the ecology, life history, movements, and take by hunters of this species (USFWS 2009c, p. 35). Some outreach and education efforts directed toward conservation of the Mariana fruit bat are underway in Guam and the CNMI (see the discussion below under Environmental Baseline).

Other projects in Guam and the CNMI may not specifically address bat conservation, but indirectly benefit the species. Examples of such projects include: the designation of conservation status for Guguan, Asuncion, and Maug, the three northernmost islands of the CNMI; locally legislated conservation lands in the CNMI Sabana Conservation Area and on Guam; the establishment of Guam National Wildlife Refuge at Ritidian Point and the overlay refuges on most military lands on Guam; ungulate eradications on Sarigan and Anatahan; ongoing, multi-agency research and management to control brown treesnakes on Guam; and research and recovery implementation for other listed species in the Marianas, for example the Mariana crow, the Rota white-eye, and the nightingale reed-warbler (USFWS 2009c, p. 35).

Environmental Baseline for the Mariana Fruit Bat

Status of the Species in the Action Area

Guam

Other than a few isolated periods of increase, fruit bats have been in long-term decline on Guam (USFWS 2009c, pp. 6–7 and references cited therein), in response to a combination of threats. Fruit bats had ceased to be common on Guam by the early 1930s (Coultas 1931), probably owing more to the introduction of firearms and improved hunting efficiency than to wholesale habitat loss (Wiles 1987b, p. 154). Guam currently supports a small, remnant population of Mariana fruit bats in a single colony at Pati Point on Andersen Air Force Base (Brooke 2008, p. 2). This colony has declined sharply since the early 1980s when approximately 500 bats were observed there (Wiles 1987b; Figure 16). The most recent surveys at this colony, now located in the Natural Area at Pati Point, have yielded counts of fewer than 20 bats (Brooke 2010, pers. comm.; Guam Division of Aquatic and Wildlife Resources 2010, unpublished data).

During the late 1980s and the 1990s, numbers of Mariana fruit bats on Guam remained in the range of several hundred animals with occasional spikes to nearly a thousand bats. Presumably these spikes reflected temporary immigration events from Rota (Wiles 1987b, p. 151; Wiles et al. 1995, p. 39; Wiles 1996, p. 2; Wiles 1998, p. 3). Individual bats have been detected at multiple locations within the proposed project action area on Guam, including all of Andersen Main Base and Northwest Field, the Main Cantonment area (referred to as Naval Computer and Telecommunications Station (NCTS) Finegayan in the source documents), and the Naval Munitions Site (DoN 2009, pp. 71–71, 89; Brooke 2008, p. 1). No bats were detected in Andersen South or at the Route 15 Range complex area (DoN 2010a, p. 177). Sightings of bats in the Naval Munitions Site and the Main Cantonment Area are limited to a few individuals flying during daytime or low light conditions (Brooke 2008, p. 1). While these sightings are not representative of a population count, it is unlikely that large numbers of bats are using these areas (Brooke 2008, p. 1; Wiles 1987b, pp. 153–156).

The effect on the Mariana fruit bat of ongoing and increased noise resulting from increased jet aircraft and helicopter use of the main runways at Andersen Air Force Base were analyzed in the ISR Strike Biological Opinion (USFWS 2006a). In that consultation, we expected that noise effects would adversely affect the Mariana fruit bat to the extent that the nearby Pati Point colony would be abandoned by the 21 bats estimated to remain there in 2006. We determined that fruit bats relocating from Pati Point to other, less-protected areas on the island likely would be shot opportunistically by hunters (USFWS 2006a, p. 49). In the ISR Strike Biological Opinion, we concluded that the remaining fruit bats on Guam would be taken as a result of the proposed action, but that this take would not jeopardize the continued overall existence of the Mariana fruit bat (USFWS 2006a, pp. 49–52). Most recent information indicates the Mariana fruit bats at the Pati Point colony have moved farther east, into the natural area, and their numbers have dwindled to ten (Cobb pers. comm. 2010b).

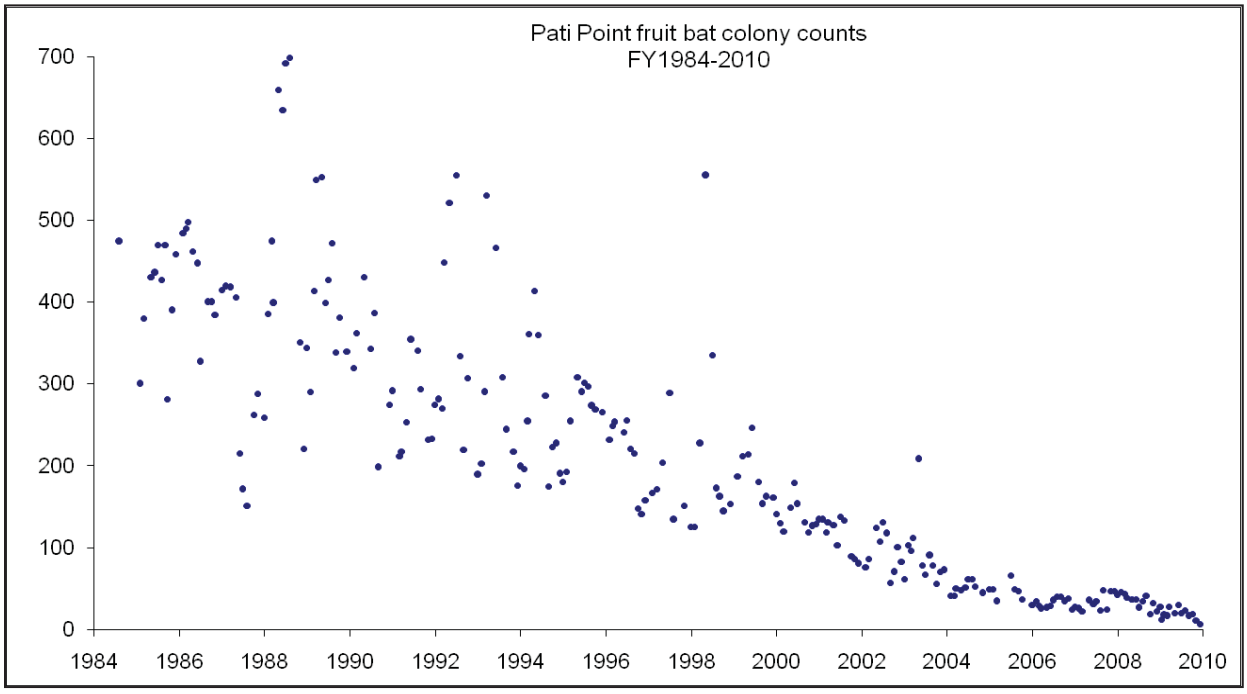

Figure 16. Mariana fruit bats counted at the Pati Point colony, 1984 to present. Guam Division of Aquatic and Wildlife Resources, unpublished data.

Tinian

Mariana fruit bats are thought to be transient on Tinian and have been observed in the Kastiyu Forest (Lemke 1984, p. 5), the cliff line forest near Maga, and flying over the island (DoN 2009, p. 72). Habitat use is generally restricted to the native limestone forest on the island.

Threats in the Action Area

Habitat Loss and Degradation on Guam and Tinian

Over the past several centuries, the southern Marianas have lost most of their original native forest, primarily to agriculture, growing human populations, economic development, and military activities (Bowers 1950, pp. 29–59; Fosberg 1960, pp. 36–37). Although significant portions of the land area on the islands in the action area may be considered fruit bat habitat (Guam = 48% and Tinian = 64% Service 2009c, Table 4), most or all of this area today is undergoing chronic degradation by a combination of feral ungulates and invasive weeds and insects (USFWS 2009c, Table 3 and references cited therein). Introduced ungulates in particular are suspected of significantly degrading native floral communities by consuming seeds, fruits, and foliage, ingesting or trampling seedlings, and promoting the spread of introduced weeds (Rice 1992; Wiles 2005, p. 519). For example, although Guam is dominated by native forest, Wiles (2005) recently documented a rapid decline in the native breadfruit, an important bat food, in the remaining native forest on the northern end of the island. This decline was attributed to a combination of mortality of mature trees in the wake of several severe typhoons and a lack of recruitment caused by deer and pig foraging on fallen fruit (with seeds) and seedlings. The

densities of deer and feral pigs on northern Guam are among the highest recorded in the world. The specific impacts of this degradation on habitat quality for fruit bats have not been quantified.

Habitat for the Mariana fruit bat on Guam has also been lost as a result of the Air Force's development of a training area in the Northwest Field area of the base. The Air Force (2006) estimated 64 ac (26 ha) of potential Mariana fruit bat habitat would be lost as a result of the training area construction and that a total of 330 ac (137 ha) of potential Mariana fruit bat habitat might be indirectly affected by intense training activities and clearing at the training facility. A total of 29,308 ac (11,860 ha) of Mariana fruit bat recovery habitat remains on Guam.

Hunting on Guam and Tinian

Guam: Today, although few bats remain on Guam, they are probably still hunted opportunistically on private property when they transit the island, and by deer hunters or poachers on Andersen Air Force Base and other military lands on northern Guam near the last remaining colonial roost (Guam National Wildlife Refuge, unpublished data, 2005).

Tinian: In 1987, there was a report of nearly 90 bats shot and killed on Tinian from a colony that roosted on the island briefly (Sutterfield 1998, pers. comm.). We have no recent reports of fruit bats being shot on Tinian.

Predation by Brown Treesnakes on Guam and Tinian

Guam: The brown treesnake is believed to adversely affect fruit bat recruitment on Guam. Predation by brown treesnakes has caused the decline, extirpation, or extinction of most landbird species on Guam (Savidge 1987, Wiles et al. 2003) and is probably responsible for decreases in recruitment of young bats observed in the island's low remaining numbers of bats (Wiles 1987a). Although only two or three cases of snake predation have been reported (e.g., Wiles 1983, p. 14), the snake is considered capable of preying on non-volant young bats (USFWS 1990b, pp. 14–15). Data collected at the island's last remaining colony from 1982 to 2006 indicated a consistent pattern wherein small pups were routinely recorded with their mothers, but medium-sized young are much rarer and large young are virtually absent (Wiles 1987b; G. Wiles, unpubl. data; Janeke 2006, pers. comm.). Most observations were made in areas where native forest bird populations had collapsed, indicating the establishment of high densities of brown treesnakes; in contrast, for several months in 1983, after the colony moved to a new location where native birds persisted, sizable numbers of larger pups were detected, strongly suggesting predation by treesnakes was responsible for the absence of larger juveniles at the original site (Wiles 2007, pers. comm.).

Noise

No studies exist of the impact of noise on fruit bats, but the general impacts of noise on wildlife described above in the "General Effects" section likely apply to fruit bats as well. Within the action area, significant impacts of noise are probably restricted to Guam and aircraft are the chief source of this threat. Observations of foraging individuals indicate that Mariana fruit bats are likely to avoid areas within (328 ft) 100 m of the Aircraft Staging Area facility on Andersen Air Force Base because of the aircraft noise and moderate human activity at night (Wiles 2006, pers.

comm.). Approximately 197 ac (80 ha) of foraging habitat for the species north, east, and west of the Aircraft Staging Area facility are likely to be affected by aircraft noise at the facility. Ongoing and anticipated noise resulting from jet aircraft and helicopter use of the main runways at Andersen Air Force Base, resulting from actions addressed ISR Strike Biological Opinion was expected to result in the loss, due to harassment from aircraft noise, and the death, due to exposure to human disturbance resulting from the colony's move from the Natural Area at Pati Point to less protected areas, of the 21 Mariana fruit bats known to occur on Guam in 2006 (USFWS 2006a, p. 49).

Other Human Disturbance

No studies of Mariana fruit bat habitat use in relation to human disturbance have been conducted, but the selection of roost sites in remote areas on islands inhabited by humans, where bats are hunted, suggests that these animals are sensitive to human presence. Wild animals may react similarly to human disturbance and predators (Frid and Dill 2002). Therefore Mariana fruit bat shifts in habitat use may occur as a result of the species' history of being hunted (Kitchen and Gese 2000, p. 854; Kilgo et al. 1998, p. 1361). Observations by biologists on Guam indicate that foraging fruit bats can be fairly tolerant of human disturbance at night if they are not harassed (Wiles 2006, pers. comm.); however, this tolerance can vary based upon the type and extent of the disturbance (Wiles 2006, pers. comm.) as has been reported in other species (Lafferty 2001, p. 315; Rees, et al. 2005, p. 370). On Rota, the presence and sound of people in close proximity to fruit bat roosts (i.e., not only the discharge of firearms and direct mortality caused by illegal hunters) are thought to have played a role in the abandonment of roosts over the past several years (Boland 2010a, pers. comm.).

Natural Disturbance – Typhoons

Evidence suggests that severe typhoons usually do not directly kill fruit bats at their roost sites (Lemke 1992; Esselstyn et al. 2006; Wiles and Brooke 2010; Wiles 1987b), but as noted above, the synergistic effect on Mariana fruit bats of illegal hunting and severe storms is well documented on Rota (e.g., Stinson et al. 1992 and Esselstyn et al. 2006). Severe storms can alter fruit bat foraging and roosting behavior by decimating food resources, removing protective foliage cover, temporarily modifying forest structure, and changing vegetation composition, especially by facilitating encroachment of non-native species (Lemke 1992). Loss of food resources can drive bats to forage closer to areas of human activity in daylight hours, thereby increasing their vulnerability to illegal hunting (Craig and Taisacan 1994; Pierson et al. 1996).

Conservation Needs in the Action Area

In addition to the overall conservation needs identified above and in the section describing general threats to species in the action area, the following summarizes actions needed to conserve the Mariana fruit bat on Guam and Tinian.

Illegal hunting of Mariana fruit bats is a major factor in their overall decline, and hunting must be controlled to halt this decline. Potential measures for reducing or eliminating illegal hunting are increased protection of Mariana fruit bat roosting colonies and individual bats by limiting

access to roost sites and foraging areas, outreach and education to improve public understanding of this threat, and increased efforts by law enforcement to prosecute illegal hunters.

Guam and Tinian both harbor tracts of native forest, but we do not know if these are sufficient to support self-sustaining numbers of Mariana fruit bats. Because fruit bat numbers on these islands are very low or declining as a result of threats such as hunting, noise, brown treesnake predation, and other human-caused disturbances, we have insufficient data to estimate with confidence how much forest is necessary to support fruit bat recovery. Nonetheless, we do know that fruit bats require forested areas much larger than the immediate vicinity of colonial roost sites for foraging, sheltering, and reproduction. Therefore, conservation of the remaining forest habitat and restoration of additional habitat in areas where threats are controlled are necessary for the recovery of the species.

Ongoing Conservation Actions in the Action Area

Several outreach projects have been implemented or are underway to improve public awareness of the threats faced by the Mariana fruit bat and increase participation by local communities in conservation activities. In Guam, "Espiritun i Fanihi" took place on May 1, 2010. This was a locally-sponsored, one-day festival to celebrate the wildlife of the Mariana Islands, with special emphasis on the Mariana fruit bat (Defley 2010, pers. comm.). In addition, CNMI Division of Fish and Wildlife has leased a British Broadcasting Corporation documentary about fruit bat ecology and conservation entitled "Flying Foresters" and scheduled showings in schools and other public venues in the CNMI and on Guam, along with a video produced on Rota entitled "Fanihi: A Cultural Digest" that uses interviews to explore the cultural and ecological ramifications of the decline of Mariana fruit bats on Rota (Boland 2010b).

Relationship of the Action Area to the Survival and Recovery of the Mariana Fruit Bat

The *Draft Revised Recovery Plan for the Mariana Fruit Bat or Fanihi* includes the following criterion (one of seven) for evaluating the progress of the species toward recovery:

> "The total size of the fanihi population has increased…and stable or increasing subpopulations of sufficient size to avoid… risks associated with very small populations are distributed among the Mariana Islands so that the probability of the fanihi's persistence over 100 years is high (at least 90%).
>
> To meet this criterion, we propose that stable or increasing fanihi subpopulations should be distributed as follows: three of the five southern islands (Saipan, Tinian, Aguiguan, Rota, and Guam), and six of the eight islands north of Saipan where fanihi have persisted historically…" (USFWS 2009c, p. 40–41). The recovery criteria may change as a result of recently completed public review and appropriate additional analysis for the revised recovery plan.

Actions that reduce or eliminate the potential for islands in the archipelago to harbor self-sustaining numbers of resident fruit bats, as specified above, thus may hamper or preclude recovery of the species. The reduction or elimination of this potential may take many forms:

degradation or loss of habitat and resources required by the fruit bat for foraging, roosting, and reproduction; increased exposure of fruit bats to illegal hunting; introduction of non-native predators that prey upon fruit bats; or human disturbance.

We regard both of the islands in the action area as potentially important to the recovery of the Mariana fruit bat because, owing to the precarious status of the fruit bat currently on all five of the southern islands, it is not clear now which or how many of these five islands are now, or will be, the best candidates for meeting the criterion described above. The threats described above—habitat loss and degradation, illegal hunting, predation by non-native predators, and human disturbance—all affect the Mariana fruit bat to some extent on one or more of the islands in the action area. An appreciable change for the worse in any of these threats on Guam or Tinian may make one or more islands increasingly inhospitable for resident fruit bats and ultimately reduce the likelihood of meeting this recovery criterion.

2.4 EFFECTS OF THE ACTION

General Effects

The following section discusses the likely impacts of the proposed action on habitat and wildlife in general. That analysis is followed by an assessment of how those impacts are likely to affect the listed species presented in Table 1.

Exposure Analysis Approach

The Service has developed an analysis framework for Section 7 consultations that incorporates the general structure, primary concepts, and nomenclature of the U.S. Environmental Protection Agency's ecological risk assessment framework (USFWS 2005). Factors causing adverse effects or impacts are called "stressors" and beneficial effects are called benefits. In this approach, the Service determines the listed resources that will be exposed to the proposed action's stressors and benefits by evaluating the location, timing, duration, frequency, and intensity of potential exposure to each stressor and benefit and identifying the physical, chemical, and biotic features that will be directly and indirectly exposed. Then the causal relationships between sources of stressors and benefits and the response of listed resources are analyzed. The exposure analysis also estimates future changes in the abundance or distribution of listed species expected to result from exposure to stressors and benefits.

Habitat Loss, Degradation, and Fragmentation

Habitat degradation is one of the primary causes of extinction and endangerment of wildlife (Groom and Vynne 2006, p.173). Habitat degradation and loss is caused by various human activities including: agriculture, mining, forestry, fisheries, aquaculture, groundwater extraction, fires, infrastructure development, dams, urbanization, industry, pollution (including light, noise, and toxic chemicals), and changes in community and ecosystem structure due to invasive species (Groom and Vynne 2006, p. 174). Habitat fragmentation is a change in habitat configuration with the remaining habitat occurring in patches among areas of non-habitat (Noss et al. 2006, p. 213) and can occur via the activities listed above. When vegetation is affected by activities, edges (a type of habitat fragmentation) are created. Edges form the boundary of a habitat and have differing properties than the habitat itself. For example, edges often have different microclimate patterns which are drier, less shaded, and warmer than forest interiors. Edge habitats are generally areas of increased predation and the entry point for invasive vegetation, pests, and pathogens to encroach within native habitats (Noss et al. 2006, p. 228). Habitat degradation, fragmentation, and loss can result in localized extinctions, shifts in community composition (including increases in invasive species), increased predation, and can result in suitable habitat becoming unsuitable due to pollution, invasive species, physical size (for species that are area-sensitive), or barriers blocking access to habitats (including distance or lack of corridors and stepping stones, etc.) (Noss et al. 2006, 38 pp.; Groom and Vynne 2006, p. 174).

Habitat suitable for the survival and recovery of the Guam Micronesian kingfisher, Guam rail, Mariana crow, and Mariana fruit bat has been identified on Guam. In addition, we determined the threshold level of recovery habitat needed in northern and southern Guam (Amidon 2010a, b,

c, and Bruegmann 2010) to support the reproduction, numbers, and distribution of self-sustaining populations of these species as described in recovery plans.

Forest habitat will be removed as a result of project actions and additional development that will occur because of the project. Facilities construction, roadways, and training activities proposed by DoD will impact habitats on Guam and Tinian. Effects of the action under consultation are analyzed together with the effects of other activities that are interrelated to, or interdependent with, that action. An interrelated activity is an activity that is part of the proposed action and depends on the proposed action for its justification. An interdependent activity is an activity that has no independent utility apart from the action under consultation. Impacts to recovery habitat resulting from project vegetation clearing within the project footprint and within areas that will be developed as an indirect result of the project are summarized in the text below and in Table 10.

Table 10. Anticipated loss of listed species recovery habitat on Guam resulting from project-related development.

	Guam Micronesian Kingfisher		**Guam Rail**		**Mariana Crow**		**Mariana Fruit Bat**	
	Acres	**Hectares**	**Acres**	**Hectares**	**Acres**	**Hectares**	**Acres**	**Hectares**
Current Recovery Habitat Remaining								
Northern Guam	15,822	6,403	49,564	20,058	14,831	6,002	15,577	6,304
Southern Guam	13,488	5,458			11,819	4,783	13,731	5,557
Total Necessary for Species Recovery								
Northern Guam	13,134	5,315	41,184	16,668	7,463	3,020	Not Determined	
Southern Guam	13,134	5,315			7,463	3,020		
Amount of Remaining Recovery Habitat Above Minimum Threshold Level Necessary for Species Recovery								
Northern Guam	2,688	1,088	8,380	3,390	7,368	2,982	Not Determined	
Southern Guam	354	143			4,356	1,763		
Recovery Habitat Within Project Vegetation Clearing Footprint								
Northern Guam	1,520	615	1,317	533	1,518	614	1,520	615
Southern Guam	4	2			4	2	4	2
Recovery Habitat Likely to be Cleared as a Result of Interdependent/Interrelated Civilian Development								
Northern Guam	353	143	2,635	1,066	313	127	353	143
Southern Guam	6	2			6	2	6	2
Percent of Recovery Habitat to be Cleared as a Result of the Direct and Indirect Project Effects								
Northern Guam	11.8%		8.0%		12.3%		12.0%	
Southern Guam	0.1%				0.1%		0.1%	
Recovery Habitat Remaining after DOD and Indirect Civilian Development are Completed								
Northern Guam	13,949	5,645	45,612	18,459	13,001	5,261	13,704	5,546
Southern Guam	13,477	5,454	0	0	11,810	4,779	13,720	5,552
After Project Completion - Amount of Habitat Above Minimum Threshold Necessary for Species Recovery								
Northern Guam	**815**	**330**	**4,428**	**1,791**	**5,538**	**2,241**	**Not Determined**	
Southern Guam	**343**	**139**			**4,347**	**1,759**		

Construction Worker Housing

At the peak of construction, an estimated 18,347 construction worker jobs will be filled. Housing for construction workers is addressed in the "DoD Development of Infrastructure and Construction Worker Housing on Guam" section of the Project Description. Housing capacity for 2,000 to 18,000 temporary construction workers is planned for a 250 ac (101 ha) parcel in North Tumon, near Two Lovers Point. Although the parcel was previously disturbed, intact limestone forest occurs on the sites adjacent to the planned housing area. Existing housing and housing (on and off installations) that could be retrofit in northern and southern Guam is also likely to be used. Recovery habitat does not occur within the proposed construction worker housing areas.

Guam International Raceway Relocation

Purchase of private and Chamorro Land Trust and the Ancestral Lands Commission lands will be necessary for DoD's development of the Andersen South and Route 15 Range Complex. A non-profit organization operates the Guam International Raceway on the northernmost portion of the proposed training range complex. In the event DoD acquires the land, the Guam International Raceway would have to decide whether to continue operation in another location. If it chose to continue operations it may be eligible for relocation assistance from DoD pursuant to the Uniform Assistance and Real Property Acquisition Polices Act of 1970. If eligible, DoD would provide relocation assistance in the form of advisory services, and some specific financial assistance related to a move, but would not fund the physical relocation of the operations of the Guam International Raceway. Selection of any new raceway location would be subject to land use decisions by the Government of Guam. Should the Guam International Raceway decide to continue operations at an alternate location and be eligible for relocation assistance from DoD, DoD will work with Government of Guam land use and natural resource officials to ensure that project impacts to recovery habitat are minimized in any relocation effort.

DoD Civilian Employee and Indirect/Induced Development

During the construction period, an additional estimated 16,988 off-island workers will move to Guam to fill non-Federal non-construction jobs such as teacher and food service worker in areas adjacent to construction worker housing. The DoN refers to this population increase as "indirect" or "induced" growth (see Table 3). Induced development during the construction period will be geographically influenced by proposed construction worker housing sites.

After construction is completed, the service industry and other support jobs will shrink to a level of approximately 4,482. Approximately 1,836 civilian Federal employees (and their dependents) and the 4,482 non-Federal employees (and their dependents) will live in areas outside the installations, for the duration of project implementation. Civilian Federal employees and the longer-term induced jobs are likely to be similar to other civilians whose move to Guam was military-related (U.S. Census Bureau, 2000). The geographic distribution of the anticipated indirect/induced population increase resulting from the project is shown, by U.S. Census Subdivision, in Figure 8.

We derived the area that will be developed by the new civilian population within each U.S. Census Subdivision on Guam by calculating the current development footprint per person within each Census subdivision and applying that to the Census subdivision's anticipated increase in population. Based on the U.S. Forest Service 2002 land cover map (U.S. Forest Service 2002), and 2000 U.S. Census Bureau data (U.S. Census Bureau, 2000), we calculated that the area developed within the Census subdivisions ranges from 0.63 to 0.70 ac (0.25-0.28 ha) per person. Using the population increases described in the Project Description and summarized above, we calculated the total area of anticipated project-related civilian development within each Census subdivision. We applied this anticipated new development evenly across areas zoned for development based on current Government of Guam land use plans (Government of Guam 2009, p. 2-14 and 2007, p.1) on slopes less than 30% and calculated anticipated impacts of development resulting from the indirect/induced population (Table 10).

Wildfire

Military training with live-fire and incendiary materials, bivouacing with campfires, cigarette smoking, and vehicular malfunctions can result in the ignition of wildfires. Fires can lead to a variety of direct, indirect, and interrelated affects to wildlife and their habitats. Between 1991 and 2002, an average of 28 fires per year burned on DoN lands on Guam. This is approximately double the average annual number of fires burning on DoN lands from 1979 to 1989. Burned acreage on DoN lands was approximately 425 ac per year (172 ha per year) during this period of time, and remained approximately the same, at an average of 429 ac per year (174 ha per year) during the 1991 through 2002 period. Arson and debris burning account for approximately 70% of fires and 87% of area burned on DoN lands from 1979 to 2002. Smoking (8%), unknown (3%), and miscellaneous causes (including children, campfires, and equipment) account for approximately 4% of fires on DoN lands on Guam (Nelson 2009, Ch. 3 p. 4).

Direct effects to birds from fires are not routinely documented (Epanchin et al. 2002, p. 139). However, eggs, nestlings, ground nesting birds and flightless birds (including waterfowl during wing molt) are susceptible to fire (Erwin and Stasiak 1979, pp. 247-248). In general, adult birds fly away from fire (Vogl 1973, p. 336; Erwin and Stasiak 1979, p. 248), although some species have been documented to purposely forage near the fire line (Smallwood et al. 1982, p. 171; Erwin and Stasiak 1979, p. 248; Vogl 1973, p. 336). Epanchin et al. (2002, p. 141) noted direct mortality of white ibis (*Eudocimus albus*) after a wildfire in the Everglades. They hypothesized that the fire moved quickly through the area and suggested that the ibis may have been trapped by low overhead smoke or smoke inhalation, purposely foraging close to the fire line, or seeking refuge from the smoke and flames (Epanchin et al. 2002, p. 141). Smoke inhalation can also adversely affect birds as smoke can result in irritation and inflammation of the respiratory tract. In a severe case documented for a captive bird, smoke inhalation (from multiple kitchen fires) caused wheezing, respiratory distress, weakness, infections, behavioral changes (including decreased vocalization and activities), inability to coordinate voluntary muscle movements, collapse, and eventually death (Simone-Freilicher 2008, pp. 138-145).

Fire can indirectly affect endangered and threatened species by changing physical and biological characteristics of the area, which subsequently results in secondary habitat degradation and loss of forage base. Physical features that will be exposed to heat and flames include soil structure

and microclimate conditions. Fire will increase soil temperatures, alter soil moisture holding capacity, and modify soil rainfall infiltration (DeBano et al. 1979, pp. 2-7; Wells et al. 1979, p. 17; Neary et al. 2005, p. 2). These physical features will be indirectly exposed to post-fire erosion and alterations of light and shade, temperature, humidity, and wind as a result of vegetation destruction (Rice 1973, p. 30). Light levels, temperatures, and wind speeds will increase with destruction of canopy plants, and relative humidity will decrease (DeBano et al. 1979, p. 4; Rothermel and Rinehart 1983, p. 5; Hoffmann et al. 2003, p. 4-4). Because vegetation cover affects erosion rate, soil erosion may occur after fire except where rapid establishment of non-native invasive grasses are prevalent. Grass invasion may occur following removal of shrub and tree canopy (D'Antonio and Vitousek 1992, p. 63; Tunison et al. 2001, pp. 123-126). Chemical features that will be exposed to heat, flames, smoke, and ash include soil nutrients and water, which will be indirectly exposed to post-fire changes in content and cycling rates. Soil nutrient availability will be altered through volatilization of certain elements to the atmosphere in smoke (e.g., carbon, nitrogen, and sulfur), conversion to more available forms in the ash (e.g., potassium, phosphorus, and divalent cations), wind dispersal of the ash, and surface erosion (Clayton 1976, p. 162, 164; Agee 1993, pp. 160-163).

Biotic features of the habitat that will be exposed to heat, flames, smoke, and ash include all living organisms in the exposure area, litter layers on the forest floor, organic matter within the surface soil horizon, and seeds within the litter and surface soil. Soil invertebrates will be directly exposed to injury or death, and seeds, litter, and organic matter will be directly exposed to destruction and loss (Kinnaird and O'Brien 1998, p. 955). These effects in turn will indirectly expose soils to long-term changes in fertility and structure as a result of changes in decomposition and nutrient cycling processes, changes in nutrient and water retention by organic matter, increased nutrient losses in runoff and leaching, and changes in net primary production due to loss of leaf area and photosynthesis (Kinnaird and O'Brien 1998, p. 955).

To minimize the indirect effects to listed species resulting from fire impacts on their recovery habitats, the DoN proposes to develop and implement a comprehensive fire management plan. The fire management plan will be prepared to minimize fire threat associated with existing and proposed actions on Guam. The DoN's fire management program will be developed to achieve the objective that DoD training actions will not result in fire impacts to vegetated areas that can be used by the Mariana fruit bat, Guam Micronesian kingfisher, Mariana crow, Guam rail, or Mariana common moorhen. Additionally, the stationing of additional large helicopters on Guam may facilitate increased DoN contributions to the suppression of fires threatening forest habitat on Guam. Although the DoN's fire management plan may minimize fire impacts by instituting fire prevention, detection, and suppression programs as well as implementing landscape-level fuel modifications in the Naval Munitions Site.

National Wildlife Refuge Overlay

A total of 621 ac (251 ha) of the proposed action's project footprint within Guam National Wildlife Refuge Overlay boundaries are in the areas that were proposed as critical habitat for the Guam Micronesian kingfisher, Mariana crow, and Mariana fruit bat (67 FR 63738-63764). These areas were excluded from critical habitat designation pursuant to the Sikes Act (16 USC 670a-670o, 74 Stat. 1052, Public Law 86-797), as amended.

Noise

Overview of Noise Resulting From the Proposed Action

The proposed training activities will result in noise from the use of a variety of vehicles (construction equipment, fixed-wing aircraft, helicopters, trucks, tanks, and other convoy vehicles) and weapons (small arms, demolitions, and other ammunition), and loud voices. Noise greater than 60 dB resulting from project actions will occur in portions of listed species' ranges (Figure 17). Noise levels greater than 93 dB will occur only in limited areas in the immediate vicinity of airfields, landing zones, and construction sites. In addition, loud noise, resulting from actions in the Andersen Air Force Base Northwest Field area that are not specified due to their classified nature, will periodically occur in northern Guam.

Noise resulting from weapons training and aircraft on Guam and Tinian will frequently impact areas occupied by listed species (see Figure 17). Noise levels in recovery habitat in these areas will also be increased as a result of the proposed action. Increased jet and helicopter aircraft traffic at Andersen Air Force Base will regularly expose the Mariana fruit bat to high levels of noise. Portions of the recovery habitat for the Guam Micronesian kingfisher, Guam rail, Mariana crow, and Mariana fruit bat are in areas where elevated noise from jet and helicopter aircraft traffic will occur. Helicopter operations will expose Mariana crow, Mariana fruit bat, and Mariana common moorhen individuals to periods of elevated noise. Training use of weapons including demolitions and small arms at the Andersen South and Route 15 Range Complex will expose cliff areas not currently known to be used by listed species, to elevated noise. The Mariana common moorhen and Mariana fruit bat will be exposed to noise from small arms training on Tinian where loud noise resulting from training will impact approximately one-third of the forested FAA mitigation site.

Overview of Noise Impacts to Animal Physiology and Behavior

We established 60 dB and 93 dB as two thresholds of biological significance based on our review of impacts of noise to similar species. Noise levels above 60 dB have been found to affect acoustic communication, breeding biology, survival of eggs and young, and non-auditory bird and mammal physiology (Bunnell et al. 1981, Burger 1983, Brown 1990, Awbrey and Hunsaker 1997, Mock and Tavares 1997, Delaney et al. 1999, South San Francisco Ferry Terminal Project EA 2003, and as reviewed in Dooling and Popper 2007, p. 25 and pp. 33-34). Noise levels above 93 dB may temporarily or permanently affect hearing (reviewed in Dooling and Popper 2007, 74 pp.). In addition to noise level, the frequency and regularity of the noise also affect species sensitivity. The physiological and behavioral effects of military, aircraft, and vehicle noise to wildlife have been investigated numerous times with mixed results due to differences in wildlife sensitivity and habituation to noise (VanderWerf et al. 2000, p. 3). The following information is summarized from Larkin et al. (1996, p. 21-52), unless otherwise stated, and is meant to provide an overview of the types of avian responses to military and aircraft noise that have been documented.

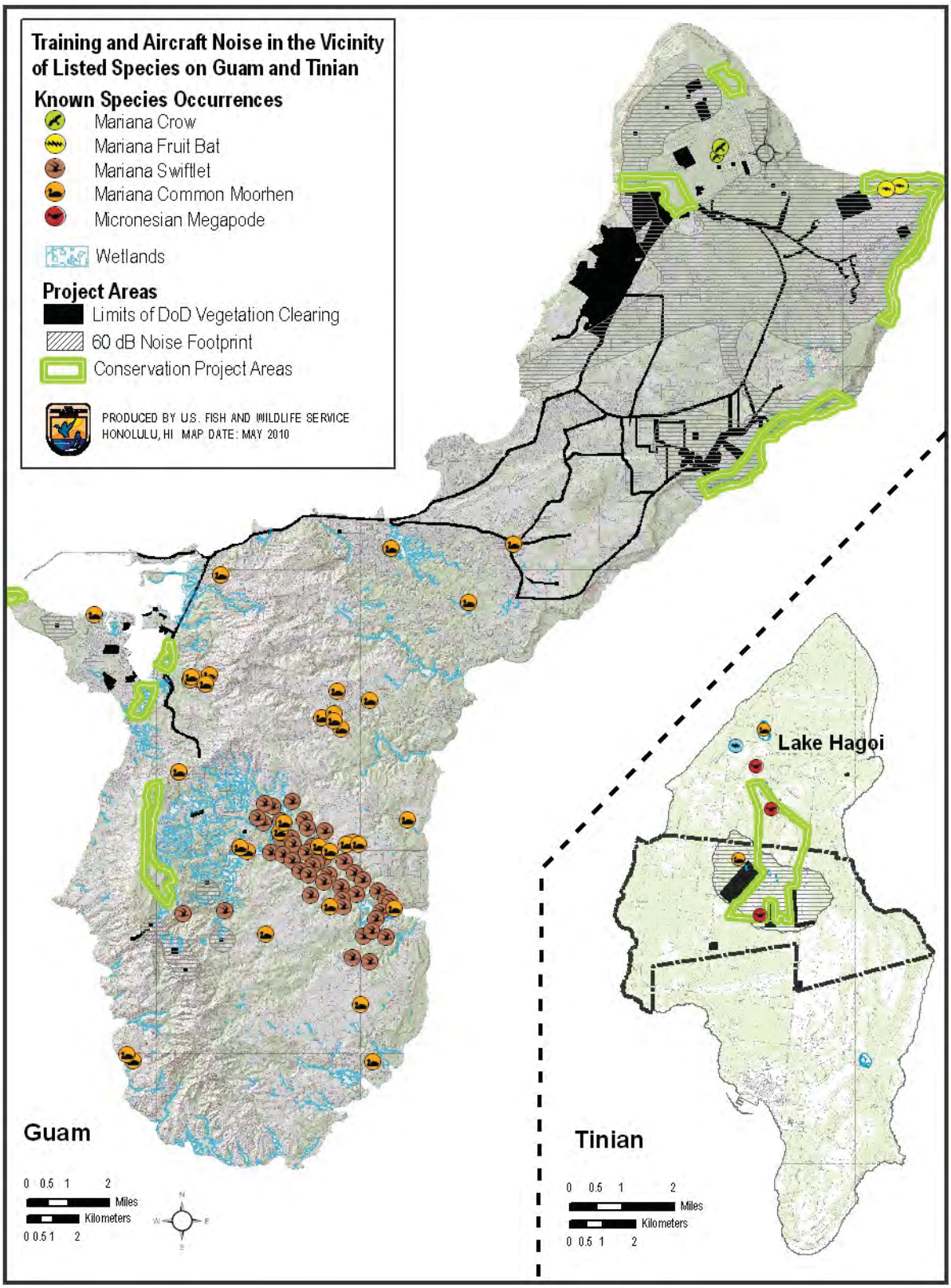

Figure 17. Project training and aircraft noise in the vicinity of wetlands and populations of listed species.

Responses to noise can vary among individuals as a result of habituation where after a period of exposure to a stimulus, an animal stops responding to the stimulus. In general, a species can often habituate to human-generated noise when the noise is not followed by an adverse impact. Even when a species appears to be habituated to a noise, the noise may produce a metabolic or stress response (increased heart rate results in increased energy expenditure) though the response may or may not lead to changes in overall energy balance. Anthropogenic noise disturbance is known to alter animal behavioral patterns and lead to population declines (Barber et al. 2009, p. 181). Species that are commonly hunted often demonstrate behavioral (e.g., flushing, startle response) or physiological responses (e.g., increased heart rates, increased respiration rates) to gunshot sounds Larkin et al. (1996, p. 21-52). Incubating herring gulls (*Larus argentatus*) and great black-backed gulls (*L. marinus*) habituated to the continual presence of humans except when they perceived a human walking directly toward their nests (Burger and Gochfeld 1981, pp. 242-267). On Farallon de Medinilla, Micronesian megapodes flushed in response to humans (Lusk et al. 2000, p. 29). Upon flushing, the birds called and flew 30 to 50 m before dropping back into thick vegetation (Lusk et al. 2000, p. 29).

Continuous or repetitive very loud noise appears to cause stress and structural damage in the ear and could be harmful when animals are already under metabolic stress. Sound levels over 85 dBA are considered harmful to inner ear hair cells; 93 to 95 dBA is considered unsafe for prolonged periods; and extreme damage occurs as a result of brief exposure to 140 dBA (Hamby 2004 and reviewed in Dooling and Popper 2007, 74 pp.). Hearing loss in birds is difficult to characterize because birds, unlike mammals, regenerate inner ear hair cells, even after substantial loss (Corwin and Cotanche 1988, pp. 1,772-1,774; Stone and Rubel 2000, pp. 11,714-11,721). Mammal recovery from metabolic ear stress can often occur after ten hours post loud impulse noise, even before ear structures are fully recovered. Repeated trauma may prolong the course of hearing sensitivity recovery. Longer-term recovery from hearing loss is generally expected in birds due to cell regeneration; however, lifelong hearing loss (threshold shifts) can occur in birds.

Very loud noise, even if the noise is short in duration, can result in tympanum rupture, bone fracture, other damage to the ear, and deterioration of brain cells. These impulse noises can cause physical damage at lower intensity than continuous or rapidly-repeating noises due to the ear reflex mechanism. For example, common canaries (*Serinus canaria*) exposed to continuous loud noises experienced changes in hearing thresholds, especially at high frequencies (Larkin et al. 1996, p. 30, and references within). A study with budgerigars (*Melopsittacus undulates*) indicated that a permanent threshold shift (lifelong hearing loss) was experienced at low frequencies only and nearly absent at higher frequencies (Larkin et al. 1996, p. 30, and references within). Many birds appear to tolerate noise that can cause pain in humans, for example: seabirds at airports, wild turkeys (*Meleagris gallopavo*) near a rocket testing plant in Florida, and ospreys (*Pandion haliaetus*) at the Naval Surface Warfare Center, Dahlgren (Larkin et al. 1996, p. 31, and references within).

Noise from small arms is unlikely to affect animals in terms of hearing loss; however, those species that are commonly hunted will likely demonstrate behavioral (e.g., flushing, startle response) or physiological responses (e.g., increased heart rates, increased respiration rates). Blast noise from artillery and other detonations includes shock waves. Red-cockaded woodpeckers (*Picoides borealis*) successfully raised young near an active bombing range in

Mississippi; while other birds at other sites did not. Oahu elepaio (*Chasiempis sandwichensis ibidis*) did not respond in statistically significant or biologically meaningful ways to noise generated by training with 155 and 105 mm howitzers, 60 and 81 mm mortars, hand grenades, and demolition of unexploded ordinance (VanderWerf et al. 2000, pp. 18-19). Prairie falcons (*Falco mexicanus*) responded to blasts from ongoing civilian construction where the nests sites were not normally exposed to blasting; however, one northern harrier (*Circus cyaneus*) appeared to preferentially hunt near a location where 24-pound bombing occurred. Anecdotal observations indicate the burrowing owl (*Athene cunicularia floridana*) continues to be persistent at Eglin Air Force Base on a bombing range where a variety of ordnance (rockets, missiles, and bombs including the MOAB [a 21,700-pounds massive ordnance air blast bomb]) has been used over the last 24 years (Hagedorn 2009, pers. comm.).

Noise from helicopters is complex and wildlife response may depend on the model of the helicopter. Touch-and-go landings, bombing runs, helicopter sorties, and artillery practice are impulse activities that repeat at short enough intervals to constitute a continuous exposure. In a literature review of waterfowl response to aircraft, avian response to aircraft was (cautiously) generalized as more intense with helicopters than fixed-wing aircraft, and stronger with slower fixed-wing aircraft than fast fixed-wing aircraft (Plumpton 2006, p. 3-1, 3-2). Increasing horizontal distance resulted in lower response than increasing altitude (Plumpton 2006, p. 3-1, 3-2). Raptors have varied behaviors in response to helicopters and responded similarly to explosions: by remaining on a nest, flushing from an area, and attacking the helicopter. American black ducks (*Anas rubripes*) reacted to 39% of military aircraft overflights on their first day of exposure, but after two weeks they responded only 6% of the time (Conomy et al. 1998, pp. 1,135-1,142). However, wood ducks (*Aix sponsa*) in the same study continued to respond to aircraft noise (Conomy et al. 1998, pp. 1,135-1,142). Survival of captive black duck chicks was lower in a noisy area than control area; however adults were largely unaffected. Sandhill cranes (*Grus canadensis*) were noted to stay on their nests when helicopter activity was within 131 ft (40 m) above them and bald eagles remained on their nests until helicopters approached closely (distance not defined). On Farallon de Medinilla, adult birds (presumably various species of seabirds) flushed from their nests in response to helicopter landings; however, some returned to their nests within 15 minutes after the disturbance stopped (Lusk et al. 2000, p. 32).

Vehicles also differ from one another in sound and appearance. Vehicle noise impacts to wildlife are difficult to quantify as other factors (emissions, topography, and vegetation, etc.) generally confound analyses. Vegetation and topography can reduce vehicle traffic noise. In one study, when traffic increased, burrowing owls exhibited alert responses or moved, although these behaviors did not result in changes to nesting productivity. A study of sandhill cranes noted that the birds nested within 13 ft (4 m) of a road, while in a study of off-road vehicles, birds (species not defined) flushed and flew distances of 2.0 mi (3.2 km) at the sound of approaching vehicles. As summarized in Larkin et al. (1996, 107 pp.) other studies have noted species-specific decreases in breeding densities close to roads.

As described above, noise can produce a variety of physiological impacts and behavioral responses in wildlife. The response to noise not only affects an individual but can affect the overall population as well. Hearing impairment, both temporary and permanent, can decrease

viability or reproductive success particularly when mate attraction and territory protection depend on calling or singing. Hearing impairment can also decrease the ability to detect and warn others of predators. Behavioral responses (startle response, alert or alarm response, and flushing) to noise are often examined as these response actions result in: birds expending excess energy that is not directed towards reproduction; nest exposure increasing the risk of predation, nest cooling or nest heating which can result in egg and juvenile mortality; or accidently kicking eggs or juveniles out of the nest. Behavioral responses can also include lower breeding densities in suitable habitats that are subject to noise; therefore, suitable habitat may become otherwise unsuitable due to noise. Wildlife response to noise may also be more intense at night, if the species rely more on auditory cues than visual cues at night. Additionally, young animals may be more susceptible to hearing loss from noise exposure than adults; however, an experiment with common canaries did not show a differential response with age (Larkin et al. 1996, p. 25, 30 and references within).

Invasive Species

Implementation of the proposed project is likely to increase the risk of introducing or spreading non-native terrestrial and aquatic invasive species including plants, animals, and microbes. Pathways associated with anthropogenic activities have a relative risk of introducing and dispersing non-native invasive species. Hulme et al. (2008, 14 pp.) described three broad mechanisms for non-native species introductions: importation as a commodity (e.g., purposeful importation as biocontrol, pet trade), arrival via transport vector, and natural dispersal. Of these mechanisms, Hulme et al. (2008, 14 pp.) further described a framework for introductions that is supported by six principal pathways of which two could potentially occur via the implementation of JGPO: contaminant of a specific commodity and stowaway (independent of a commodity, like ballast water or airfreight). The pathways of contaminant and stowaway include, but are not limited to species transported via: construction equipment, personal protective equipment, delivery of supplies, materials, goods, foot traffic, vehicles or vessel traffic. Invasive species introduced as contaminants and stowaways could occur as a result of inadequate sanitation and inspection during and prior to movement. The repeated or routine movement of equipment and people increases the risk of introduction and establishment of a non-native invasive species.

The results that follow the introduction and spread of a non-native invasive species can be difficult to predict (Courchamp et al. 2003, 37 pp.); however, there is scientific documentation of the impacts to threatened and endangered species due to invasive species. Studies suggest that the threats and impacts related to invasive species are second only to the impacts from habitat destruction (Wilcove et al. 1998, p. 609). Non-native invasive species could have impacts that alter the existing terrestrial ecosystem and may then expand out into adjacent areas after the initial introduction. Impacts that have been documented for non-native invasive species generally include direct predation; habitat alteration; illness, injury, or death due to disease; and competition for resources. The types of impacts are determined by characteristics of the native species as well as the non-native species. Below we have provided examples of impacts from non-native invasive species (mammals, reptiles, invertebrates, and disease) introductions to avian and other species to highlight the risk and potential impacts from accidental invasive species introductions.

Introduced rats have affected island wildlife. During field trials on the uninhabited island of Surprise Island, New Caledonia, Caut et al. (2008, p. 434) documented predation by the black rat (*Rattus rattus*) on ground-nesting seabirds. The authors noted a dietary shift in the rats when seabird eggs and chicks were not present. As the abundance in seabird eggs and chicks declined, predation by black rats shifted to skinks, sea turtles, and insects (Caut et al. 2008, 10 pp).

On Guam, the non-native invasive brown treesnake has been documented as a predator on various species of vertebrates. Wiles et al. (2003, 11 pp.) examined bird data from Guam and stated that 22 out of 25 species of birds were affected by the brown treesnake. Of these species, 17 of the 18 native bird species were severely impacted, and 12 species have been extirpated from Guam. In addition, Wiles et al. (2003, pp. 1,355-1,356) provided reference to observations of Mariana swiftlet predation by brown treesnakes on Guam as a regular event. The brown treesnake has been linked to the extirpation or extinction of numerous bird, bat, and reptile species on Guam (Fritts and Rodda 1998, p. 114).

Another example of a non-native invasive species with documented impacts to avifauna is the red imported fire ant (*Solenopsis invicta*). The northern bobwhite quail (*Colinus virginianus*) is a ground-nesting and ground-foraging bird in North America. Allen et al. (1995, 8 pp.) describe impacts from red imported fire ant observed during field experiments with northern bobwhite quail in Texas. Red imported fire ant preyed upon pipping chicks. Other impacts to chicks included weight loss from exposure to red imported fire ant venom. Red imported fire ants also affect insect communities through competition which indirectly affected the diet of northern bobwhite quail resulting in lowered fitness of chicks and adult females (Allen et al. 1995, pp. 632, 636 and references within).

Mosquitoes have also been associated with the decline of biodiversity of species, especially birds. Specific accounts and historical documentation of the introduction and spread of mosquitoes and various bird diseases in the Hawaiian Islands was covered earlier in great detail by Warner (1968, 20 pp.), Benning et al. (2002, 4 pp.), and Atkinson and LaPointe (2009, 14 pp.). In particular, the vectors (differing mosquito species) and avian diseases are illustrated by authoritative accounts and field trials. Warner (1968, p. 116) discusses the ability for certain bird species to inhabit higher elevations (i.e., above 600 m) where it is mosquito-free and thus allows some bird species to persist. Juliano and Lounibos (2005, 24 pp. and references within) provide an overview of mosquito species, invasiveness, pathways for introduction, and associated impacts of these species on human and wildlife populations.

It is important to understand that the "risk" of introduction and establishment of invasive species is highly variable across taxa and habitats. Identifying and analyzing risk for all the species that could be moved via JGPO-related activities is not practicable. Instead, a more efficient approach is to address pathways where numerous species from different taxa may be inadvertently introduced and implement prescriptive measures to control risks from the pathways. A pathway risk assessment will provide a structure for assessing where the greatest "risk" for a non-native species introduction occurs and locations where managing ingress or egress of these species is most efficient for control. Pathways must be controlled because repetition of an action has a direct effect on propagule pressure which as stated above increases the likelihood of a species to become established.

Military Ports

Listed species and their habitats are subject to the risk of effects from the introduction and spread of existing and novel invasive species via the proposed action. To reduce the risk of introduction and spread of non-native, invasive species, the DoN has proposed to implement a variety of conservation measures for all training actions. In addition, the DoN has agreed to implement multiple conservation measures at all military ports to ensure that all vehicles (including automobiles, watercraft, and aircraft), cargo, equipment, and supplies are inspected and quarantined if storage is necessary prior to entering other areas on Guam and prior to leaving for any other ports under U.S. jurisdiction.

In particular, the DoN has targeted specific actions to prevent the spread of the brown treesnake from Guam to other islands including 100% inspection of outgoing vessels and aircraft, quarantine areas, research to enhance snake detection procedures, and environmental education of all personnel. The DoN will also require each individual service member (or other employee or contractor associated with range maintenance activities, biological surveys, etc.) to complete self-inspections (including equipment and gear) to avoid movement of invasive species between different islands and within different areas of the same island.

The DoN will also conduct a pathway analysis for each activity (or type of activity training, range maintenance, etc.) conducted under the proposed project to determine and implement appropriate risk avoidance procedures. The DoN will develop Standard Operating Procedures for each activity (or type of activity) that incorporate the appropriate risk avoidance procedures and will conduct after action reviews to assess and revise Standard Operating Procedures and avoidance procedures to ensure the risks from invasive species introductions are addressed.

Habitats used for training and those near construction areas will be monitored for incipient populations of invasive species. Biosecurity program teams will be established to eradicate incipient populations and implement control actions for previously established species. The DoN will actively seek agreements with other Federal and non-Federal agencies to implement rapid response and other control actions on their lands. Additionally, the DoN commits to implement a biosecurity program that will further reduce or eliminate risk of transporting invasive species via proposed project activities.
We anticipate that the above conservation measures proposed by the DoN will minimize the risk of introduction or spread of invasive species from military ports and adverse effects to listed species to the extent that incidental take of listed species is not likely to occur because these measures are comprehensive, are known to be effective, and they will be implemented to the degree that will avoid gaps in the interdiction program. Furthermore, many of the proposed conservation measures are designed to eliminate or control existing invasive species thereby improving the habitat for listed species.

Invasive Species Interdiction for Commercial Air Transport

Military and civilians associated with the proposed project (i.e., contractors, dependants, workers) and their cargos may be transported to and from Guam using commercial airlines. As described above, the transport of people and cargo is a pathway for the introduction and spread

of invasive species. Commercial flights from the A.B. Won Pat Guam International Airport serve multiple destinations from Guam. Of these destinations, only four destinations support listed species under the jurisdiction of the U.S.: Oahu, Saipan, Tinian, and Rota. Current airport biosecurity and inspections include: inspections of arrival passengers by Guam Customs and Quarantine Agency and outbound passengers to Honolulu go through customs inspection upon arrival in Honolulu by U.S. Customs and Border Protection. USDA APHIS Wildlife Services inspects outbound cargo (commercial and DoD) as prioritized by the agency for the presence of brown treesnakes (Vice and Engeman 2000, p. 106). In addition, all luggage containers are inspected upon arrival by customs officials and importation of plants, fruits, and animals are restricted without proper documentation from the point of origin (http://ns.gov.gu/cumstoms.html). The Hawaii Department of Agriculture and the CNMI Brown Treesnake Program have historically conducted canine and visual brown treesnake inspection of aircraft and cargo arriving in these locations. The Hawaii Department of Agriculture's canine inspection program is currently not in operation due to State funding shortfalls. The U.S. Department of Interior Office of Insular Affairs is providing funding to Hawaii Department of Agriculture to re-hire three canine inspector positions and purchase working dogs to ensure coverage of current level of commercial aircraft and air cargo arriving from Guam. The CNMI Brown Treesnake Program currently has an adequate number of inspectors and working dogs for current levels of commercial aircraft and air cargo arriving from Guam.

U.S. Department of Agriculture APHIS Plant Protection and Quarantine is authorized to prevent the introduction or dissemination of animal and plant diseases and pests on all ships, aircraft, and their cargo, and baggage arriving in the U.S. from any place outside, or moving from Hawaii, Guam, Puerto Rico, the Virgin Islands, or other territories and commonwealths of the U.S. to the Continental U.S. or between such areas. When inspection discloses items prohibited or restricted by USDA, quarantine regulations reveals a plant or animal pest, or there is reason to presume such a pest is present, the inspector will require action to prevent the dissemination of the pest or take action to dispose of the prohibited or restricted item.

Invasive Species Interdiction for Commercial Sea Transport

The Jose D. Leon Guerrero Commercial Port is administered by the Port Authority. The Port Authority is part of the Government of Guam and operates as a semi-public organization. Since its construction in 1969, the seaport has remained largely unchanged. With many areas near capacity or unusable, expansion of the seaport's facilities and equipment upgrades would create operational efficiencies and maximize Seaport capacity. Prior to the announcement of the proposed military relocation, seaport improvements and expansion were under consideration; however, the military relocation created an additional impetus to implement planning studies and improvements to service the anticipated construction work and additional population.

In August 2007, work began to update the seaport's master plan. The recommendations and updates address future expansion and development based on typical commercial growth, as well as the impending military buildup. A final draft seaport master plan was completed in April 2008 that updated the master plan and set the road map for upgrading the port facilities. The seaport master plan was approved by the Guam Legislature in December 2009. The master plan calls for nearly $200 million in capital improvement upgrades to the seaport facilities. The

modernization program would address both Guam's expected growth without the proposed action and the anticipated increase in cargo volume resulting from the proposed action.

The initial upgrades to the seaport include the demolition of older facilities, reconfiguration of laydown areas, and traffic and security improvements to accommodate increased cargo flow. Longer term improvements, including pier refurbishment, construction of new deep draft piers, and dredging to support such construction, have yet to be programmed. Any planned improvements would be required to comply with Guam and Federal environmental protection laws, including, but not limited to, the Endangered Species Act, Clean Water Act, and the National Environmental Policy Act.

The Port of Guam Master Plan (Port Authority of Guam, 2007) calls for development of new facilities to handle increased customs and agriculture inspection requirements. It is anticipated that increased customs and agricultural inspection requirements will be coordinated through both Guam and relevant Federal officials, including the USDA. The DoD will work with the Port and relevant Guam and Federal inspection authorities to address required inspection of cargo that pass through the Port. The increased inspection associated with civilian population growth will be a function of Port of Guam planning, implementation, and coordination with relevant Guam and Federal customs and inspection authorities.

Military personnel and civilians associated with the proposed project (i.e., contractors, dependants, workers) and their cargos may be transported to and from Guam using commercial seaport. As described above, the transport of passengers and cargo is a pathway for the introduction and spread of invasive species. Due to the Merchant Marine Act of 1920 (P.L. 66-261, as amended, also known as the Jones Act or Cargo Preference Act), international shippers are not authorized to leave the Port of Guam and move directly to other U.S. ports unless the ship is under a U.S. flag, constructed in the U.S., owned by U.S. citizens, and crewed wholly by U.S. citizens, or has an exemption (i.e., certain national emergencies, strategic interests) (see Merchant Marine Act of 1920). Generally, any shipping from Guam must go to another country prior to arriving in the U.S. Typical shipping routes from Guam travel to different ports in China or Taiwan and then travel to the mainland and on to Hawaii. Ships may go directly from Guam to Rota, Tinian, or Saipan. To our knowledge, only Matson meets the requirements of the Merchant Marine Act of 1920 and can ship from Guam to any U.S. shipping port.

Brown Treesnake

The proposed DoN action will increase the number of people on Guam. Both project-related construction and increased population will add to the volume of cargo and people traveling to and from Guam. Project-related increases to the populations of the CNMI are expected to be minor to modest. In addition to air travel directly related to people moving to Guam, there is also an anticipated increase in business and recreational travel from Guam to other regional destinations.

Guam's seaport is expecting an increase of up to 84% in cargo container traffic from 103,000 to 190,000 containers per year moving through the port during peak construction (Port Authority of Guam 2007). Containers are not retained on Guam, but are shipped out either with new cargo in

them (25%) or empty (75%). Much cargo is packed outside of the Port of Guam by freight forwarding or packaging facilities. Empty containers are stored both at the Port of Guam and at sites outside the Port. Shipping traffic via air and sea from Guam to Hawaii and the continental U.S. is assumed to increase proportionally to the overall rate of shipping to/from Guam due to the proposed action.

The primary commercial air route between Guam and the continental U.S. is via Honolulu, Hawaii. Regional commercial air traffic includes daily direct commercial airline service between Guam and Honolulu, and thrice-weekly service between Guam and Honolulu that stops at four to five islands along the way. Dedicated air cargo flights occur between Guam and Honolulu on an as-needed basis. The primary export on these flights is fish; however, additional space on the plane can be used for other cargo when needed. Commercial air service to the CNMI from Guam occurs through two regularly scheduled routes; a direct flight to Saipan, and a less frequent route that stops on the island of Rota prior to arriving on Saipan. Tinian receives regular air service from Saipan.

Increases in the rate of air and sea traffic between Guam and the CNMI are anticipated; however, data on this is limited. Cargo and containers arriving in the CNMI are shipped or transshipped from the Port of Guam. Cargo containers and vessels originating from Guam go through the Port of Saipan, however direct shipments to Tinian and Rota have occurred. Continental Micronesia, the dominant air carrier in the region, reported in 2008 that it was already seeing an increase in traffic due to the proposed action (Hensel 2008 p. 1-3).

Brown Treesnake Minimization Measures and Actions

Effective interdiction of brown treesnakes on Guam, the CNMI, and Hawaii is critical to preventing the spread of this species. The DoD has committed to fund the increase of current federally funded brown treesnake interdiction measures (in Guam, CNMI, and Hawaii) for the commercial sector where the increase is related to direct, indirect and induced-growth caused by the subject action. The timeframe of this commitment spans the construction phase as well as the post-construction phase of this project. Brown treesnake interdiction measures for the commercial sector include but are not limited to snake inspection, suppression and rapid response. The DoD has also committed to snake inspection (100% as a goal), snake suppression, construction of snake barriers and brown treesnake rapid response to support military training and non-training actions.
The DoD will utilize an iterative process of adaptive program management to determine the specific levels of brown treesnake interdiction required for the civilian sector. The DoD will convene a working group to identify a system of reporting, monitoring and threshold metrics that can be used to ensure current levels of brown treesnake interdiction are met. Perspective working group members include DOI Office of Insular Affairs, USDA APHIS Wildlife Services, Hawaii Department of Agriculture, the Government of Guam, the Commonwealth of the Northern Mariana Islands, the Service, and the U.S. Geological Service. During the construction phase of this action the working group will serve as a distinct subgroup of the Civil Military Coordination Council. Following the completion of construction, the federally-mandated Brown Tree Snake Working Group will serve the role of the Council.

The DoD's commitment to provide sustained brown treesnake research funding throughout the construction phase of this project will assist in the development of methods to eradicate or significantly suppress this pest island-wide. The refinement of existing control techniques and development of new ones will be required to successfully reintroduce listed species on Guam. Sustained, landscape-scale brown treesnake suppression on DoD and other lands is critical for the reintroduction of the Guam Micronesian kingfisher and Guam rail. This level of brown treesnake suppression would likely result in increased reproductive success and survival for the Mariana common moorhen and Mariana fruit bat on Guam. Measures developed by the DoD to eradicate or significantly suppress brown treesnakes on Guam can also be applied to reducing the risk of the brown treesnakes spreading to other locations.

Biosecurity Measures and Actions

The DOD has committed to establishment of a biosecurity program throughout the construction phase of the military build-up. This team, if adequately staffed, has the potential of reducing the risk of invasive species establishment and spread on DoD property within Guam and the CNMI. DoD has also committed to support opportunities for the biosecurity program to work collaboratively with local governments through Memorandums of Understanding or Memorandums of Agreement. This is critical because invasive species spread isn't limited by the human artifact of property or water body ownership.

Other Conservation Measures Associated with the Action

In addition to measures to minimize the risk of brown treesnake transfer from Guam, the proposed action also includes other measures that are intended to offset adverse project effects to listed species:

Reintroduction of Listed Species to DoN Lands

Recovery habitat remaining on DoN lands comprises a substantial percentage of the total habitat available for the recovery of the Guam Micronesian kingfisher, Guam rail, Mariana crow, and Mariana fruit bat. The DoD proposed conservation measures are intended to support re-introduction of native endangered or threatened species on DoD lands on Guam consistent with species recovery plans. In further support of such recovery efforts, the DoN intends to actively participate in recovery committees for endangered or threatened species on Guam. The DoN will work with the Service to develop a re-introduction plan and supporting programmatic biological opinion that ensures such re-introduction efforts are consistent with the species recovery plans and the military mission on Guam. The reintroduction plan will include mutually-agreed upon criteria for initiating the reintroduction of endangered and threatened species on DoN lands.

Development of Wild Populations to Complement Captive Programs

The DoN development and implementation of a Guam Micronesian kingfisher introduction plans for one to three islands in the CNMI (other than Guam) will facilitate the recovery of this species by enabling the maintenance of more natural breeding, feeding, and sheltering behaviors in

individuals to be reintroduced to Guam than would develop in captivity. Development of self-sustaining wild populations of this species will complement captive populations by buffering these populations against stochastic events. The DoN's goal is to develop three self-sustaining Guam Micronesian kingfisher. These breeding populations would become a source for future reintroductions to Guam. Implementation of introduction targets will ensure captive populations are not harmed by removing birds and that birds will be introduced in high enough numbers to contribute to self-sustaining populations. There is some uncertainty regarding the likelihood of success of the proposed project because approval from cooperating governments has not been secured.

Landscape-Scale Ungulate Management

The DoN's preparation and implementation of a Navy Joint Region Marianas ungulate management plan addressing the control and potential eradication of ungulates on DoD lands managed by Naval Facilities Engineering Command Marianas on Guam will minimize future degradation of forest habitat resulting from ungulates. The proposed action includes the development of an ungulate management plan as well as implementation of a long-term program and methods for a sustained reduction of ungulates on DoN lands. Eradication is the goal; however, if eradication is not feasible, ungulate control will be implemented with the goal of sustained suppression to levels that allow for forest regeneration and self-sustaining populations of native animals. The DoN will request the Service's review and comments regarding the draft ungulate management plan.

Ungulate removal will significantly benefit listed species on Guam. On Guam, feral pigs are distributed island wide, and densities may be as high as 238 pigs per square mi (110 pigs per square km). As has been documented in other locations, wallowing rooting, and trampling are common in most forested areas and can be locally severe (Conry 1988, p. 27). Ungulates cause severe damage to forests by directly affecting forest vegetation and by facilitating the establishment of invasive plants, which can impede forest regeneration by outcompeting native seedlings (USFWS 2009a, p. 27). As an example, Wiles (2005) documented a rapid decline in native breadfruit trees due to mortality of mature trees from typhoons and a lack of recruitment caused by deer and pig foraging on fallen fruit and seedlings.

Establishment and Management of Ecological Reserve Areas

Under the proposed action, four new ecological reserve areas, an additional conservation area, an outdoor recreation area, and wetland restoration areas (within which training will be limited), will be submitted to Chief of Naval Operations N45 for approval. Ecological Reserve Areas will be protected from development and, to varying extents, from training and recreational impacts. If the Ecological Reserve Areas do not come to fruition, alternate conservation projects will be developed in coordination with the Service to ensure conservation to listed species addressed in this Biological Opinion are equal to or greater than those we assessed in our preparation of this document.

The DoN will create the Ritidian Point Ecological Reserve Area to protect native limestone forest habitats in northern Guam that are recovery habitats for the Mariana crow, Guam

Micronesian kingfisher, and the Mariana fruit bat. The new Ritidian Point Ecological Reserve Area will be contiguous with and incorporate the areas protected under the ISR Strike Biological Opinion (USFWS 2006a, 73 pp.) and Northwest Field (USFWS 2006b, 7 pp.) consultations.

The DoN will submit a proposal to Chief of Naval Operations N45 to create the Pati Point Ecological Reserve Area to encompass native limestone forest habitats in northern Guam which are recovery habitats for the Mariana crow, Guam Micronesian kingfisher, and Mariana fruit bat (DoN 2010a, p. 125). The new Ecological Reserve Area will contain approximately 713 ac (289 ha) of habitat for listed species.

The DoN will coordinate with the Government of Guam to protect the limestone forest habitat on Government of Guam lands spanning from the area east of the proposed ranges on Route 15, north, to the Government of Guam's existing Anao Conservation Area. These lands contain recovery habitat for the Mariana crow, Guam Micronesian kingfisher, and Mariana fruit bat. The intention is to develop a continuous band of protected area from the Andersen Air Force Base at the Pati Point Ecological Reserve Area through Government of Guam's Anao Conservation Area south to the proposed Route 15 Range Complex. This will involve working with Government of Guam to designate the Anao Conservation Area as protected in perpetuity and then developing a Cooperative Agreement or Memorandum of Understanding on joint natural resources management to benefit listed species and their habitats in the entire area.

The DoN will submit a proposal to Chief of Naval Operations N45 to expand the existing Orote Ecological Reserve Area to encompass Orote Island (seabird nesting habitat), Adotgan Point, and the Spanish Steps area that supports sea turtle nesting (DoN 2010a, p. 125) on Naval Base Guam. The expansion will add approximately 32 ac (13 ha) of terrestrial habitat to the Orote Ecological Reserve Area.

No proposed action-related construction or training actions will occur at the Camp Covington wetlands. A restoration plan will be developed for the Camp Covington wetlands. This action is likely to attract Mariana common moorhen from Fena Reservoir, where habitat has declined in quality. If Camp Covington is deemed unsuitable for wetland enhancement or restoration, the Atantano wetlands will be evaluated for restoration potential.

The DoN will submit a proposal to Chief of Naval Operations N45 to create the Naval Munitions Site Ecological Reserve Area to protect native limestone forest habitats in southern Guam which are recovery habitats for the Mariana crow, Guam Micronesian kingfisher, and Mariana fruit bat (DoN 2010a, p. 125).

The DoN will implement forest enhancement and restoration in the Naval Munitions Site. A minimum of 8.9 ac (3.6 ha) will be restored. Enhancement and restoration will occur in areas contiguous with existing recovery habitats (instead of within) to increase the overall baseline of recovery habitat within southern Guam. Forest enhancement prescriptions and plans will be prepared by a qualified forester/plant ecologist who has knowledge of Guam's forest ecosystems. The goal of the forest enhancement is to increase the habitat suitability for native wildlife species. In savanna areas, forest restoration will include non-native species eradication or control and will establish greenbelts of *Acacia* spp. (e.g., *Acacia confusa*) to fix soil nitrogen,

build soil quality, and limit impact of grass fires to forest areas, extend greenbelts to become continuous forest areas with recovery habitats, under-plant *Acacia* spp. with native species; and reduce *Acacia* spp. after native species are established. In existing native or mixed native forests, enhancement and restoration will incorporate removal of non-native feral mammals (cats, dogs, and ungulates) with the goal of eradication. If eradication is not feasible, control of these animals will be implemented with the goal of suppressing non-native mammals to levels that allow for forest regeneration and self-sustaining populations of native animals. Forest restoration will facilitate recovery of the Guam Micronesian kingfisher, Mariana crow, and the Mariana fruit bat.

The DoN will investigate the feasibility of restoring habitat within the Bolanos Conservation Area. If habitat restoration is determined to be feasible, the DoN may choose to restore habitat such that over the long-term it is restored into recovery habitat. If the DoN decides to implement restoration, they will work with the Service to develop a recovery crediting program (or similar assurances) for the site. These actions, if implemented, will benefit the Mariana common moorhen.

Modification to the Boundary of the FAA Mitigation Area on Tinian

On Tinian, under the proposed action, the DoN proposes to alter the boundaries of the existing FAA Mitigation Area to include some of the largest tracts of limestone forest remaining on the island, and to develop and implement a plan to enhance the native forest within the Mitigation Area. Approximately one half of the original FAA Mitigation Area will be exposed to training-related noise louder than 93 dB as a result of the proposed action.

Two DoN Biologists to Conserve Guam National Wildlife Refuge

Under the proposed action, the DoN will hire two additional DoN biologists to implement conservation and recovery actions on Guam National Wildlife Refuge Overlay lands and ensure conformance with requirements described in this Biological Opinion. The DoN will meet with the Service (Ecological Services and Refuges) at the beginning of the fourth quarter of each fiscal year to review progress and mutually identify priorities and specific actions for the coming fiscal year. This action will contribute significantly to the completion of conservation measures in the Integrated Natural Resources Management Plans, recovery plans, five-year status reviews, Comprehensive Conservation Plans, State Wildlife Plans, or other actions identified as priorities for natural resources management. These actions will facilitate the recovery of the Guam Micronesian kingfisher, Guam rail, Mariana common moorhen, and the Mariana fruit bat.

Funding for Two Service Biologists on Rota

DoN will ensure funding for two biologists on Rota for a 12-year period, beginning in FY11 to conserve the Mariana crow and the Mariana fruit bat. Initially the two biologists will be DoN contractors and as soon as possible DoN will work with Office of Management and Budget to ensure a budget-based transfer is completed to enable the Service to fund two Senior Fish and Wildlife Biologists for the remainder of the 12-year period. Actions will be targeted to on-the-ground recovery actions (or steps needed to prepare for on-the-ground actions). These actions

will strive to reverse recent declines in Mariana crow and Mariana fruit bat numbers on Rota to facilitate the recovery of these species. Conservation of the Mariana crow population on Rota would facilitate future reintroductions of this species to Guam.

Law Enforcement Officers

Under the proposed action, the DoN will hire two DoN Conservation Law Enforcement Officers to increase security on DoN lands and prevent poaching. The DoN will sign a Memorandum of Agreement such that these law enforcement officers can assist Service law enforcement officers (on Guam and all islands within the CNMI) with violations under the Federal, Lacey Act, Migratory Bird Treaty Act, and Convention on International Trade in Endangered Species (CITES). The efforts of these two Conservation Law Enforcement Officers is expected to prevent future impacts of poaching on Mariana fruit bats on DoD lands.

Roving security in the Naval Munitions Site will reduce the likelihood of illegal events (e.g., poaching and illegal fires) occurring on the installation. This action will result in significant reductions in the rate of forest conversion to savanna in the Naval Munitions Site. Conservation of limestone and ravine forest in southern Guam is necessary to ensure the recovery of the Guam Micronesian kingfisher and the Mariana crow.

Research and Monitoring

Under the proposed action, the DoN will fund research to collect demographic information on the Mariana fruit bat in the Marianas Archipelago, including data on age at sexual maturity, survivorship, longevity, frequency of inter-island movements using DNA testing, and evaluate the status of Mariana fruit bat subspecies throughout the species' range. This action will benefit the Mariana fruit bat by filling gaps in our knowledge of fruit bat demography, movements, and phylogeography.

Species-Specific Effects of the Action

Effects of the Action – Guam Micronesian Kingfisher

The Guam Micronesian kingfisher is endemic to Guam and is believed to have been extirpated from the wild in 1988 (Wiles et al. 2003, p. 1354). Currently the captive population consists of approximately 101 individuals in 19 captive rearing facilities (Bahner 2010, pers. comm.). Low productivity in the captive population, incremental habitat loss due to development and wildfires, habitat degradation from feral ungulate browsing and trampling, and predation risk from the brown treesnake are all limiting the re-establishment and recovery of this species in the wild (USFWS 2008a, pp. 16-26).

Habitat Loss and Degradation Due to Project Impacts

As described under Status and Baseline there are approximately 15,822 ac (6,403 ha) and 13,488 ac (5,458 ha) of recovery habitat in northern and southern Guam, respectively, for the Guam Micronesian kingfisher (Figure 18). Approximately 1,520 ac (615 ha) of this recovery habitat in northern Guam and 4 ac (2 ha) in southern Guam will be cleared as a direct result of the proposed action. In addition, approximately 353 ac (143 ha) in northern Guam and 6 ac (2 ha) in southern Guam are expected to be removed due to indirect or induced development impacts of the proposed action. A total of approximately 1,883 ac (762 ha) of Guam Micronesian recovery habiatat will be permanently lost due to the proposed action which will reduce the available habitat for recovery of this species to only 1,158 ac (469 ha) above the minimum required to allow for potential recovery (see Table 10). The proposed action will result in the permanent loss of habitat that could have supported approximately 188 Guam Micronesian kingfisher territorial pairs once other threats are controlled.

To meet recovery goals for the Guam Micronesian kingfisher on Guam, a minimum of 13,134 ac (5,315 ha) are needed in northern Guam and 13,134 ac (5,315 ha) are needed in southern Guam (refer to the Status and Baseline section for additional details). Therefore, after implementation of the proposed project (including interrelated and interdependent effects) we expect there to be enough potential recovery habitat remaining on Guam to support recovery of the Guam Micronesian kingfisher. However, only an estimated 815 ac (330 ha) in northern Guam and 343 ac (139 ha) will remain in southern Guam once project actions are considered. Recovery goals for the Guam Micronesian kingfisher are subject to revision as the recovery plan is being revised currently.

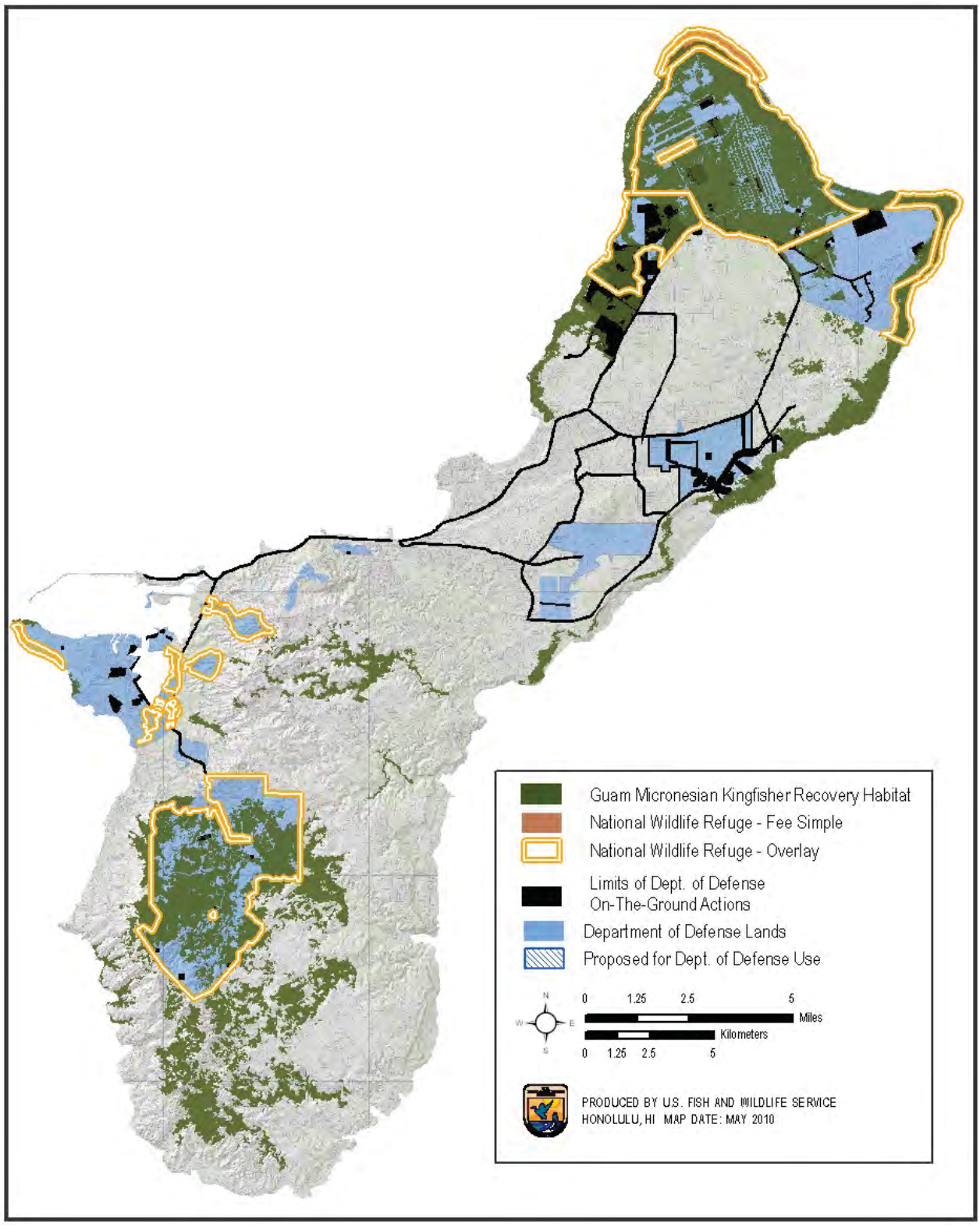

Figure 18. Distribution of recovery habitat for the Guam Micronesian kingfisher.

Impacts of Proposed Action-Related Fires

Because the DoN's fire management plan will be developed to provide guidance and direction to ensure fires do not encroach into recovery habitat for the Guam Micronesian kingfisher, we anticipate that no additional recovery habitat will be lost due to wildfires igniting as a result of project training. Although the DoN's fire management plan may also minimize fire impacts by instituting fire prevention, detection, and suppression programs as well as implementing landscape-level fuel modifications in the Naval Munitions Site, the beneficial effects of this DoN action are difficult to assess because these projects have not been adopted by DoN at this time. DoN helicopters, known to be of great assistance on wildfires elsewhere in the Pacific, may help minimize fire impacts to forest areas and substantially reduce the estimated 37 ac (15 ha) annual rate of recovery habitat loss in southern Guam (detailed in the general Status and Environmental Baseline section above).

Conservation Measures to Benefit the Guam Micronesian Kingfisher

Recovery habitat remaining on DoD lands composes a substantial percentage of the total habitat available for the recovery of the Guam Micronesian kingfisher. The DoN's conservation measures are intended to support reintroduction of native endangered or threatened species on DoD lands on Guam consistent with species recovery plans. In further support of such recovery efforts, the DoN intends to actively participate in recovery committees for endangered or threatened species on Guam. The DoN will work with the Service to develop a reintroduction plan and supporting programmatic biological opinion that ensures such reintroduction efforts are consistent with the species recovery plans and the military mission on Guam. The reintroduction plan will include long-term criteria for initiating the reintroduction of endangered and threatened species on DoN lands.

Under the proposed action the DoN has committed to provide sustained funding for the development of methods to eradicate or significantly suppress brown treesnakes island-wide to facilitate the recovery of listed species on Guam (see General Effects section). If successful, landscape-level implementation of brown treesnake suppression on DoN and other lands will facilitate reintroduction of the Guam Micronesian kingfisher by reducing brown treesnake numbers. This in turn is expected to reduce nest predation and mortality of juveniles and adult kingfishers which is essential to the successful reestablishment of the Guam Micronesian kingfisher on Guam.

In addition, the DoN has proposed the following habitat management and protection measures (see General Effects section): (1) create four Ecological Reserve Areas; (2) enhance forests on the Naval Munitions Site using ungulate suppression and *Acacia* spp. greenbelts; (3) prepare and implement an ungulate management plan for DoN-managed lands; and (4) create unidentified conservation areas that adjoin conservation areas identified for protection by the Air Force under the ISR Strike Biological Opinion (DoN 2010a, pp. 125-131). The Ecological Reserve Areas include potential Guam Micronesian kingfisher habitat and may provide some protection to these areas. The expanded Anao Conservation Area includes potential recovery habitat for the Guam Micronesian kingfisher and, if protected and managed, could provide some benefit to the species. The additional conservation areas on Andersen Air Force Base could be beneficial; however,

their location and management objectives have not been identified so potential benefit to the kingfisher cannot be assessed at this time. Finally, the enhancement of forests and conversion of savannah areas to *Acacia* on the Naval Munitions Site may provide some benefit to the kingfisher by reducing fire impacts to remaining recovery habitat and moving toward restoration of recovery habitat for this species. The DoN has proposed to restore or enhance a minimum of 8.9 ac (3.6 ha) of forest within the Naval Munitions Site. However, the full extent of this benefit cannot be assessed because the DoN has not identified the additional amount of forest to be managed. We therefore conclude that there may be some benefit to existing kingfisher habitat through these conservation measures but we cannot assess the extent to which new habitat will be created.

Finally, the DoN will also fund the development and implementation of a Guam Micronesian kingfisher introduction plan(s) to islands other than Guam (see General Effects). The overall goal of the action is to develop self-sustaining wild population(s) that will complement captive populations currently in zoological institutions, and buffer captive and other wild populations against stochastic events in the interim and allow for "wild" individuals to be reintroduced to Guam if and when native ecosystems on Guam are restored to support a viable population. If successful (i.e., appropriate islands are identified, associated governments approve of the release, and the releases are successful), this action is expected to improve the status of the species and bring it closer to recovery.

Summary

The Guam Micronesian kingfisher is currently extirpated from the wild, therefore no take is expected as a result of the action. However, we have determined that the proposed project will adversely affect the Guam Micronesian kingfisher by removing areas of recovery habitat which, in the absence of the project, would have remained intact to provide for the feeding, breeding, and sheltering of this species. The amount of habitat remaining after completion of the proposed project will be above the minimum threshold currently estimated to be necessary for the recovery of the species on Guam.

The DoN's proposed habitat management and protection measures will help protect and enhance some of the available Guam Micronesian kingfisher habitat on DoD and Government of Guam lands. The DoN's development and implementation of landscape-level brown treesnake eradication/control measures will be beneficial to the Guam Micronesian kingfisher because in the absence of this action, the recovery habitat is not in a suitable condition to support the reintroduction and survival of the species because of the abundance of the brown treesnake.

Once the DoN develops and implements landscape-level brown treesnake suppression, and works with the Service to develop a reintroduction plan, the substantial percentage of Guam Micronesian kingfisher recovery habitat remaining on Navy lands will be available for the reintroduction of the Guam Micronesian kingfisher. Additionally, the establishment of a wild kingfisher population outside of Guam will help safeguard the species and provide wild kingfishers for release on Guam.

Effects of the Action – Guam Rail

The Guam rail was once distributed throughout Guam, but significant population declines, resulting primarily from habitat loss and predation by the brown treesnake and feral cats, resulted in their extirpation from Guam by 1987 (Wiles et al. 1995, p. 38). The Guam rail is now found only in captivity and in one experimental population on Rota consisting of between 60 to 80 birds (Wenninger 2008, pers. comm.). The Rota population is a designated non-essential experimental population under section 10 of the Act. As of June 2008, there were approximately 158 Guam rail in captivity on Guam and in mainland zoological institutions (USFWS 2008b, p. 5). Because the Guam rail is extirpated from the wild on Guam, no adverse effects to individual rails are expected to be caused by the proposed action.

Recovery of the species on Guam will depend on the re-establishment of a wild population on Guam and sufficient habitat to support a recovered population, as summarized in the Status and Baseline section. Project impacts to recovery habitat, effects of brown treesnake introduction to Rota, and beneficial effects of project conservation measures are detailed below.

Habitat Loss and Degradation Caused by the Proposed Action

There are approximately 24,698 ac (9,995 ha) and 24,886 ac (10,063 ha) of recovery habitat in northern and southern Guam, respectively, for the Guam rail. Approximately 1,219 ac (493 ha) of potential recovery habitat in northern Guam and 98 ac (40 ha) in southern Guam will be developed within the project vegetation clearing footprint as a direct result of the proposed action (Figure 19).

In addition, approximately 1,795 ac (726 ha) of Guam rail recovery habitat in northern Guam and 550 ac (223 ha) in southern Guam are expected to be cleared through indirect or induced development impacts of the action. Therefore, there will be 21,684 ac (8,775 ha) of potential recovery habitat in northern Guam and 24,218 ac (9,801 ha) in southern Guam remaining after implementation of the proposed project. As detailed in the Status and Baseline for the Guam rail, it is estimated that 8,236 ac (3,333 ha) of recovery habitat is necessary on Guam to support Guam rail populations needed to meet downlisting criteria and an estimated minimum of 41,184 ac (16,668 ha) of recovery habitat must be conserved on Guam to enable the recovery of the Guam rail. After implementation of development directly and indirectly related to the proposed project, there will be 4,718 ac (1,908 ha) of recovery habitat on Guam beyond that which is minimally necessary to support the minimum Guam rail population size required to meet recovery goals. Therefore, after implementation of the proposed project (including interrelated and interdependent actions) there will be enough potential recovery habitat remaining on Guam to support recovery of the Guam rail. Recovery goals for the Guam rail are subject to revision as the recovery plan is being revised currently.

Because the Guam rail utilizes shrubby vegetation and edges, fires caused by training in the vicinity of the Andersen South and Route 15 Range Complex and other training areas are not expected to result in loss of habitat for the Guam rail.

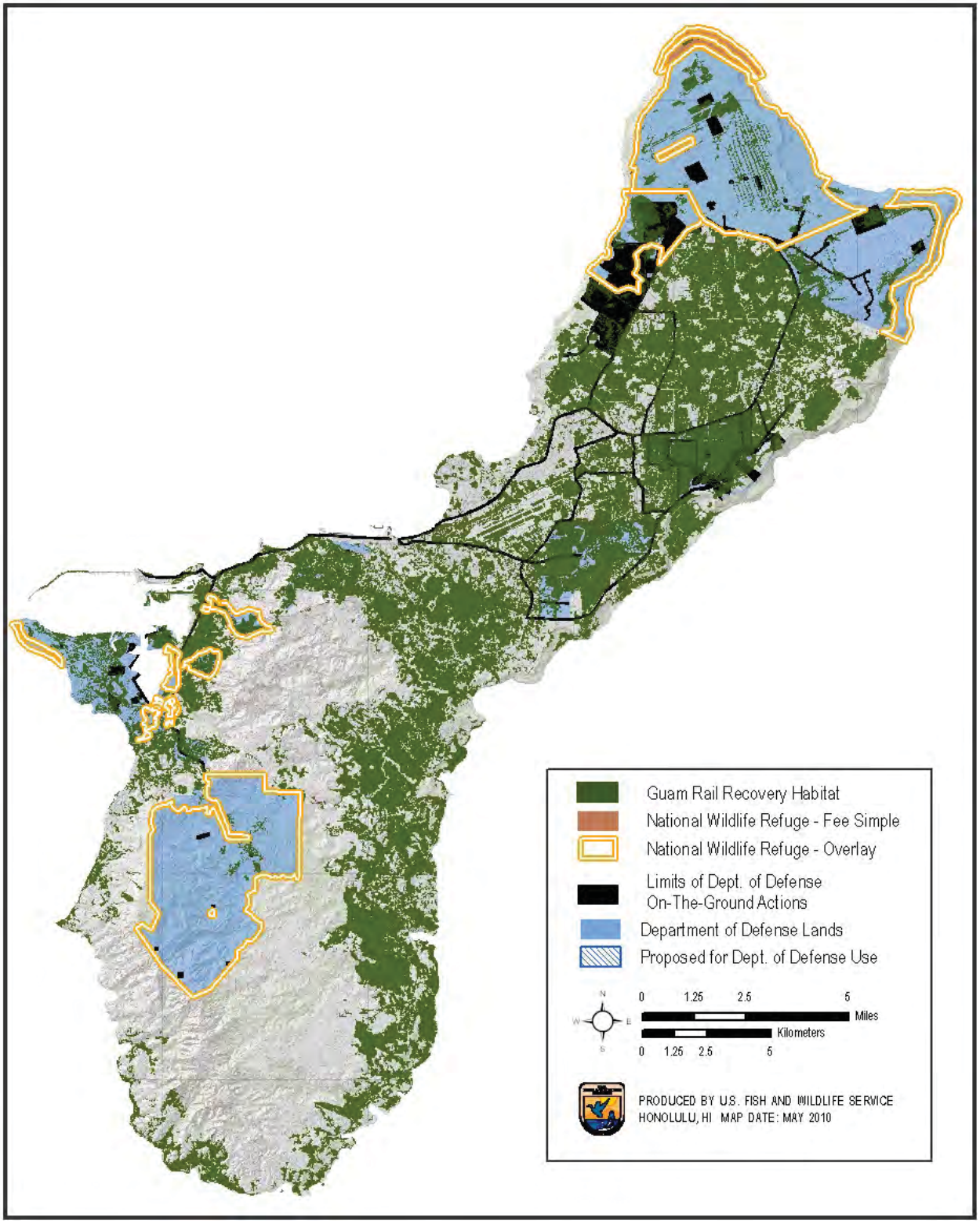

Figure 19. Distribution of Guam rail recovery habitat.

Conservation Measures to Benefit the Guam Rail

Recovery habitat remaining on DoD lands comprises a substantial percentage of the total habitat available for the recovery of the Guam rail. The DoN's proposed conservation measures are intended to support reintroduction of native endangered or threatened species on DoD lands on Guam consistent with species recovery plans. In further support of such recovery efforts, the DoN intends to actively participate in recovery committees for endangered or threatened species on Guam.

The DoN has committed to provide sustained funding throughout the construction phase of the project for the development of methods to eradicate or significantly suppress brown treesnakes island-wide to facilitate the recovery of listed species on Guam. If successful, landscape-level implementation of brown treesnake suppression on DoD and other lands will facilitate reintroduction of the Guam rail. This in turn is expected to reduce the rate of nest predation and adult bird mortality.

In addition, the DoN has proposed the following habitat management and protection measures under the proposed project: (1) submission of proposals to create four Ecological Reserve Areas; (2) finalize and implement an ungulate management plan for DoN-managed lands; and (3) hire two additional Overlay Refuge biologists to implement conservation and recovery actions on Guam National Wildlife Refuge Overlay lands in addition to two Conservation Law Enforcement Officers to increase security on DoN lands and prevent poaching. The Ecological Reserve Areas include potential Guam rail habitat and may provide some benefit to the species. The objective of the Ungulate Management Plan (in progress) is to improve habitat quality for special status species including the Guam rail. Improvement of Guam rail habitat will have long-term benefits for this species.

Summary

Although the proposed action will result in a permanent loss of available habitat for Guam rails on Guam, there will still remain an adequate amount of habitat to provide for recovery of the species. The DoN's proposed increased ungulate management, habitat management and protection of 2,929 acres (four Ecological Reserve Areas and a cooperative conservation agreement with the Government of Guam at Anao) of native vegetation may help protect and enhance some of the available Guam rail habitat on DoD and Government of Guam lands. The proposed conservation facilities at Finegayan will increase public awareness of the conservation needs of this species and will therefore provide a conservation benefit to the Guam rail and its habitat. In addition, the two additional Overlay Refuge biologists funded by DoN will implement conservation and recovery actions on Guam National Wildlife Refuge Overlay lands and the two Conservation Law Enforcement Officers hired by DoN will increase security on DoN lands and prevent poaching. The DoN's development and implementation of brown treesnake eradication and control measures coupled with their biosecurity program to eradicate incipient populations of invasive species will facilitate the potential reintroduction of the Guam rail to DoD and non-DoD lands on Guam.

Effects of the Action - Mariana Common Moorhen

Most recent survey information indicates there are approximately 90 Mariana common moorhens on Guam, 154 birds on Saipan, 41 individuals on Tinian, and only two individuals on Rota (Takano and Haig 2004a, p. 247). The number of Mariana common moorhens has declined at Fena Reservoir on Guam since these surveys were conducted due to habitat degradation resulting from eutrophication thought to have resulted from a typhoon (A. Brooke, pers. comm., U.S. Navy, 2007). The number of Mariana common moorhens at Lake Hagoi on Tinian has varied (Vogt 2008, p. 3), but the number of birds at that site appears to be declining (Engbring et al. 1986, pp. 121-122, Stinson et al. 1991, p. 41, Takano 2003, p. 70, Takano and Haig 2004a, pp. 246-247). All Mariana common moorhen populations are threatened by habitat loss and degradation, predation by introduced predators, human disturbance, and stochastic disturbances. Recovery of the species will require wetland restoration, predator control, and implementation of other coordinated conservation measures.

Habitat Loss and Degradation Caused by the Proposed Action

Under the proposed action, conservation measures will be implemented to minimize the impacts of project construction and training to wetlands on Guam and Tinian. To minimize the likelihood the proposed action will result in the introduction and establishment of invasive species, which may further reduce the quality of Mariana common moorhen habitat, the DoN will implement the Micronesia Biosecurity Plan, invasive species monitoring, and rapid response efforts.

Conservation measures have also been incorporated into construction actions to minimize impacts to wetlands. Although road and bridge improvements will occur in the vicinity of the Atantano wetlands, which serve as secondary recovery habitat for the Mariana common moorhen, preconstruction surveys by a qualified biologist will be completed to ensure impacts to nesting Mariana common moorhen are avoided. Road and bridge work (see Figure 1) will also be designed such that permanent impacts that would make the habitat unsuitable for recovery of the Mariana common moorhen do not occur up- or downstream of the road and bridge work. No construction or training actions related to the proposed project will occur at the Camp Covington wetlands. The DoN has committed to designing project-related retention ponds and stormwater collection areas to ensure these water bodies do not attract Mariana common moorhen. None of the other construction project areas associated with the proposed action on Guam currently support wetland habitat used by the Mariana common moorhen. Civilian development may result in reductions in the distribution and quality of wetlands in the CNMI used by this species. Changes in hydrology resulting from future increases in Guam's human population may reduce water levels in wetlands utilized by the Mariana common moorhen. Runoff from developed areas may result in decreases in the abundance of food for the Mariana common moorhen.

The vegetation clearing project footprint on Tinian does not overlap with Lake Hagoi or Magpo. However, the proposed construction, operation, and maintenance of the platoon battle course will occur near the Bateha wetland system, which is known to support the Mariana common moorhen (DoN 2010a, p. 180). The Bateha Wetland was surveyed nine times between August 1994 and May 1995. A single moorhen was visually recorded in October, and a total of three audio

detections were recording during two separate surveys in November. In December, one subadult was also recorded at this wetland. Based on these surveys, the Service conservatively estimated the number of moorhens using the Bateha Wetland to be no more than four birds (USFWS 1996, p. 6). Surveys conducted in 2003 did not detect Mariana common moorhen at the Bateha Wetland (USGS 2003, p. 66). The DoN has proposed to either build the range during the dry season to avoid disturbance to nesting Mariana common moorhens at the Bateha wetlands or, if nesting Mariana common moorhen are present, to postpone clearing and construction until the chicks have fledged. The Biological Assessment for the proposed action indicates that 0.3 ac (0.1 ha) of the platoon battle coarse will be constructed in an area previously mapped as a wetland. After additional investigation, the depressions were determined to be sinks rather than seasonal wetlands and no wetland vegetation or soils were present. The DoN will work with planners to avoid sighting the footprint of the platoon battle course within wetland areas. Range construction will entail clearing and grubbing and these depressions be filled. No Mariana common moorhen habitat will occur within the range footprints after construction. The range footprint areas will be mowed, herbicided, or otherwise treated and will be unsuitable for Mariana common moorhen use. Earthen backstops around the firing ranges and targets will minimize the introduction of lead and other ammunition components into waterbird habitat. Range maintenance will include sifting soil to remove lead and other contaminants.

The DoN will terminate cattle grazing leases within the footprint of the new range complex on Tinian and will work with CNMI representatives to minimize relocation of the leases into areas serving as habitat for listed species.

Noise Impacts Associated with Increased Training Activities

New aviation training, including low-level helicopter flights will occur at the Naval Munitions Site, south of Fena Reservoir, Talafofo, and Ugum River basins. As detailed in the General Effects section above, noise from helicopter and fixed-wing overflights may mask predator approaches and mating calls or startle birds and cause them to flush. Overflights at low-levels may also result in bird aircraft strike impacts. To avoid noise impacts and aircraft strike risks to the Mariana common moorhen, all aviation training will be conducted such that flights approach the southern portion of the Naval Munitions Site over the Talafofo River watershed and Fena Reservoir at heights of 1,000 ft (305 m) or greater above ground level. Flights may go up the Ugum River at altitudes of 1,000 ft (305 m) or greater above ground level until they reach 9,843 ft (3,000 m) from the mouth of the river at Highway 4 and south of this point flights may conduct low-level terrain flights. Low-level training flights (DoN 2010a, p. 54) will be restricted to the southernmost portion of the Naval Munitions Site (DoN 2010a, p. 35) where the Mariana common moorhen is not commonly present.

On Tinian, noise levels over Lake Hagoi resulting from small arms training are not expected to exceed 60 dB (see Figure 17 in the General Effects section), however, portions of the Bateha wetlands system are close enough to the training ranges that they will be exposed to noise louder than 60 dB. This noise from firing range training may mask Mariana common moorhen mating calls and may startle or alarm the birds and cause them to minimize their use of the sinks in the training range vicinity. Birds exposed to training-related noise would be likely to shelter in dense vegetation or disperse to less disturbed areas such as Lake Hagoi. Mariana common

moorhens have been documented to halt vocalizations during routine overflights (estimated height of 800 to 1000 ft; 244 to 305 m above ground level) of small airplanes above Lake Hagoi (USFWS 1996, p. 9). Conversely, the moorhens have increased vocalizations, including loud shrieks and honks in response to gun shots (USFWS 1996, p. 9). Neither of these responses appears to have resulted in changes to breeding or alteration of predation rates (Vogt 2008, pp. 2-5). Furthermore, breeding has not been observed in the small wetlands adjacent to the proposed firing range location, so we do not anticipate breeding would be affected by the proposed action. Because the number of Mariana common moorhen on Tinian is low, habitat is not currently limiting their reproductive success or survival on the island. However, because they are seasonal wetlands lacking fish, the Bateha wetlands have a higher quality and quantity of food than Lake Hagoi. Because the noise associated with the proposed action will result in reduced Mariana common moorhen use of the high quality foraging area, the effects of the project constitute a significant disruption of their feeding.

Conservation Measures on Guam

Ungulates severely degrade wetland habitat and brown treesnake predation reduces reproductive success of the Mariana common moorhen so measures to reduce ungulate access to wetlands and measures to suppress the brown treesnake will benefit the Mariana moorhen. DoD's preparation and implementation of a Navy Joint Region Marianas ungulate management plan for the control and potential eradication of ungulates on lands managed by Naval Facilities Marianas on Guam and DoN development and implementation of installation- and landscape-level brown treesnake suppression on Guam will be beneficial to the Mariana common moorhen. To further benefit the Mariana common moorhen, the DoN will enhance or restore habitats at the Camp Covington wetlands and may restore habitat at the Atantano wetlands as well.

Summary

The DoN has incorporated measures to minimize project construction and training impacts to Mariana common moorhen habitat on Guam and Tinian. DoD measures to minimize the spread of invasive species and to control ungulates will result in improvements to the quality of Mariana common moorhen habitat on Guam. DoD efforts to minimize ungulate impacts and to develop measures to complete landscape-level brown treesnake suppression will also be beneficial to the Mariana common moorhen on Guam. Construction and live-fire training at Tinian ranges will expose the Bateha wetlands system to noise levels above 60 dB. The Bateha wetlands are richer in food sources than Tinain's Lake Hagoi because the seasonal wetlands lack fish, which compete with the moorhen for food. Although surveys indicate only four or fewer Mariana common moorhen are found at the Bateha wetlands, the noise associated with the proposed action will result in reduced Mariana common moorhen use of the high quality foraging area, constituting a significant disruption of their feeding. Mariana common moorhen is not known to breed in these seasonal wetlands. Changes in reproduction and survival of the Mariana common moorhen are not expected to result due to implementation of the proposed action.

Effects of the Action – Mariana Crow

Historically, Mariana crows were considered relatively common and widely distributed on Rota (Pratt et al. 1979, p. 234) and Guam (Baker 1951, p. 246). Currently, as a result of habitat loss, hunting, and predator impacts, only approximately 60 breeding pairs and 24 non-breeding individuals occur on Rota and two male individuals remain on Guam (refer to the Status and Baseline section). Recovery goals include the establishment of at least three stable populations consisting of a minimum of 75 territorial pairs at each of three sites: Rota, northern Guam, and southern Guam.

The populations are threatened by habitat loss and degradation (caused by humans, cyclones, and wildfire, and other disturbances), predation by introduced species, human persecution, and stochastic and genetic affects caused by a small population. On Guam, the Mariana crow is threatened by brown treesnake predation, habitat loss and degradation, and the inability of the remaining crows to find mates and reproduce. Juvenile crows are particularly susceptible to the brown tree snake because they feed on the forest floor. In addition, recovery of the species on Guam requires that additional individuals be re-introduced to the island, and that sufficient habitat (with no brown treesnakes) is available to support a recovered population. The ability to translocate Mariana crows on military land in the future is essential for the recovery and survival of the species.

<u>Habitat Loss and Degradation Caused by the Proposed Action</u>

Guam's two remaining Mariana crows are likely to forage within areas mapped for project footprint development (Schwagerl pers. comm. 2010). The DoN will conduct surveys for listed species one week prior to the clearing of vegetation to ensure no crows are in the area. Because the crow population is so low, adequate habitat for these two birds occurs outside the project footprint (as detailed below). Therefore, the loss of foraging habitat within their home range is not expected to adversely affect these individuals.

As described in the Status and Baseline section above, there is approximately 26,650 ac (10,785 ha) of recovery habitat on Guam for the Mariana crow. Approximately 14,831 ac (6,002 ha) of Mariana crow recovery habitat remains in northern Guam and 11,819 ac (4783 ha) of recovery habitat occurs in southern Guam. The proposed project footprint will result in the clearing of 1,518 ac (614 ha) of Mariana crow recovery habitat in northern Guam and 4 ac (2 ha) in southern Guam, for a total of 1,522 ac (616 ha) of recovery habitat loss (Figure 20, see Table 10). Indirect development resulting from the proposed project will result in the permanent loss of 313 ac (127 ha) of recovery habitat in northern Guam and 6 ac (2 ha) in southern Guam.

We calculate there will be 13,001 ac (5,261 ha) in northern Guam and 11,810 ac (4,779 ha) in southern Guam for a total of 24,802 ac (10,037 ha) of Mariana crow recovery habitat remaining on Guam after implementation of the proposed action and the civilian development occurring as a result of the action (see Table 10). The project will have resulted in the permanent loss of approximately approximately 12% of current Mariana crow recovery habitat in northern Guam and less than one percent in southern Guam. The acreage lost as a result of the project will total

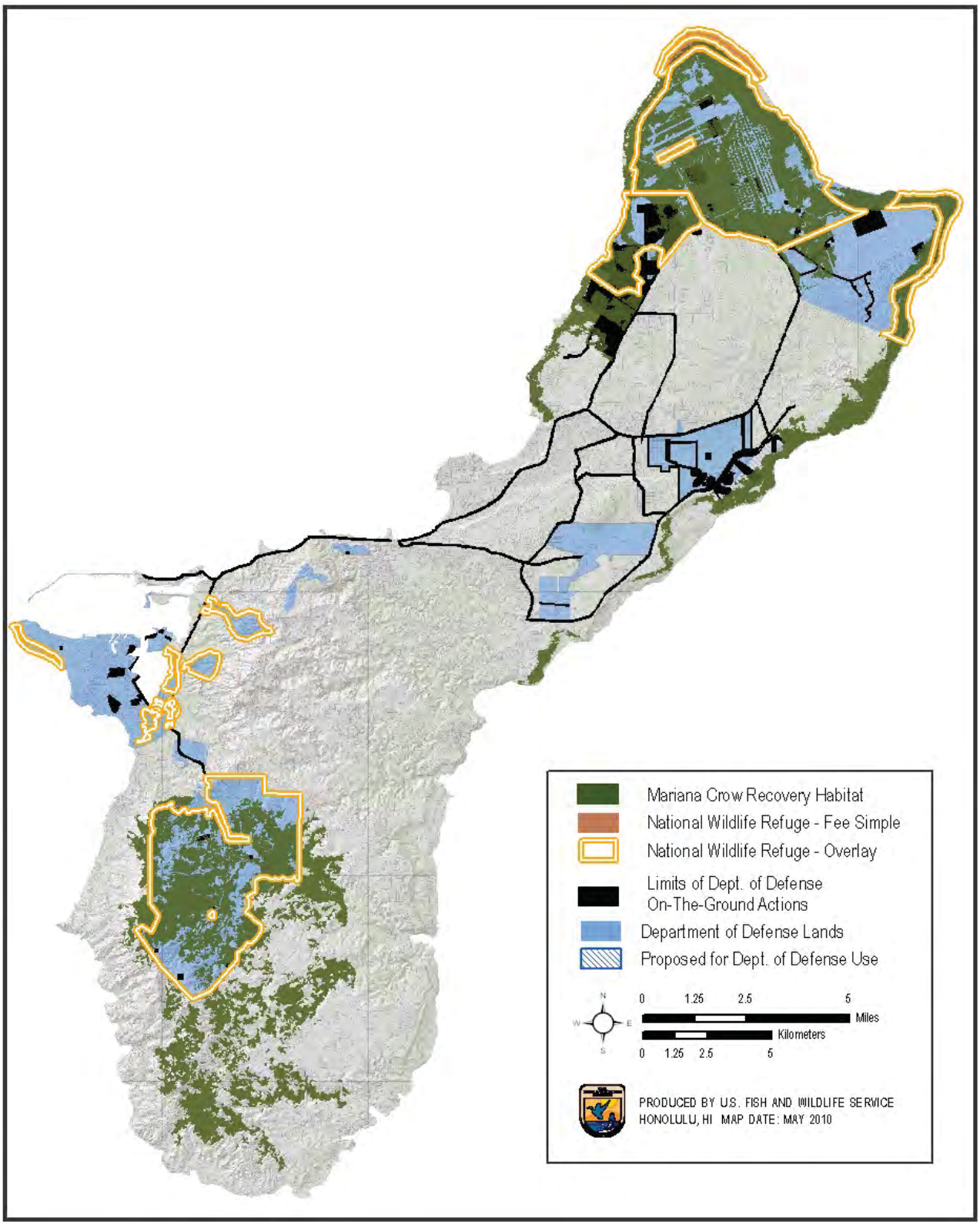

Figure 20. Distribution of Mariana crow recovery habitat on Guam.

approximately 1,841 ac (745 ha) of recovery habitat that could have supported approximately 50 territorial Mariana crow pairs. This action will reduce the available habitat for recovery of the species to only 9,885 ac (4,000 ha) above the minimum required to allow for potential recovery. After project-related development is completed, there will be only 5,538 ac (2,241 ha) of recovery habitat remaining in northern Guam above that necessary to support the minimum number of Mariana crows needed to recovery the species. In southern Guam, completion of project-related development will result in only approximately 4,347 ac (1,759 ha) of available recovery habitat above the minimum needed to support the population size required just to meet recovery goals. Recovery goals for the Mariana crow are subject to revision as the recovery plan is being revised currently.

Noise Impacts Associated with Increased Training Activities on Guam

Noise associated with baseline aircraft operations at Andersen Air Force Base currently extends over areas that contain suitable nesting and foraging habitat for the Mariana crow. Under the proposed action, the total area of Mariana crow habitat on Guam would be subjected to an approximately 30% increase in the frequency of noise levels greater than 60 dB. The majority of this increase would occur within the 60-70 dB noise contours and it would be generated by Marine Corps F/A-18D jet aircraft in the vicinity of Andersen Air Force Base runways.

A general description of physiological and behavioral impacts of noise to wildlife is presented in the "General Effects" section above. Morton (1996, p. 81) conducted a study on the potential impact of aircraft overflights on Mariana crows from 1994 to 1995. He found no evidence that aircraft overflights contributed directly to nest abandonment or nest failure during the study. In fact, one nest was constructed within 1 km (0.6 mi) of the north runway during a large aircraft training exercise (Tandem Thrust). However, Morton (1996, p. 61) did report three observations of Mariana crows reacting to aircraft. One observation was of alarm calling and an increase in vigilant, alert, and standing behavior from an adult attending a nest after an unknown aircraft (76-92 dBA, > 1,000 ft (305 m) above ground level) flew over the nest. Another observation was of a Mariana crow returning to a nest while an unidentified cargo aircraft flew overhead. The adult remained standing at the nest and alarm calling for the duration of the overflight (approximately two minutes). No sound levels or altitude was reported for the aircraft. The final observation was of a pair of Mariana crows responding to six F-16s and four KC-135s (≤ 86 dBA, no altitude reported) departing the base. The pair was observed alarm calling and flying for 12 minutes after the overflights. In addition to these observations, Morton (1996, pp. 60-61) also summarized previous observations of Mariana crow and aircraft interactions by other biologists on Guam. The most severe of these interactions was a pair leaving their nest several times in response to a helicopter flying less than or equal to 400 ft (120 m) above the ground. Other observations also included adults flushing from the nest and leaving eggs unattended. In general, the observations of Mariana crows flushing from nests were all due to aircraft below 1,000 ft (305 m) above the ground (Morton 1996, p. 61). Mariana crows reacting to aircraft by alarm calling and other minor behaviors occurred when aircraft were above this elevation. Recent studies on reproductive success of the Mariana crow on Rota indicate that noise and human disturbance may play a more prominent role in nest failure and therefore the decline of the species than these previous studies indicated (J. Ha, pers. comm. 2010).

The DoD's proposed conservation measures require that no helicopter or fixed-wing aircraft fly below 1,000 ft (305 m) above Munitions Storage Area 1 and that no helicopters fly below 1,000 ft (305 m) above the ground over the areas north of the south runway at Northwest Field of Andersen Air Force Base. The proposed action will increase the frequency and duration of aircraft noise on Guam and the increased noise may affect the behaviors of Mariana crows in the area. However, we do not expect that these affects will significantly affect the reproductive success or survival of the two male crows in the action area. We do not expect these male crows to breed. Therefore, avoidance behaviors and alarm calling associated with low flying aircraft are not expected within the areas currently utilized by crows. Alarm behaviors were noted for aircraft above 1,000 ft (305 m), however, we expect that these behaviors will only have temporary impacts on the foraging, roosting, and sheltering behaviors and will not result in harm for the two male crows. At this time, we do not have enough information regarding noise impacts to the Mariana crow to assess noise impacts to the suitability of Mariana crow recovery habitat.

Fire Impacts to Mariana Crow Habitat on Guam

Because the Fire Management Plan will be developed to provide guidance and direction to ensure fires do not encroach into recovery habitat for the Mariana crow, we anticipate that no additional recovery habitat will be lost due to wildfires igniting as a result of project training. Although the DoN's fire management plan may also minimize fire impacts by instituting fire prevention, detection, and suppression programs as well as implementing landscape-level fuel modifications in the Naval Munitions Site, the beneficial effects of this DoN action are difficult to assess because these projects have not been adopted by DoN at this time. Landscape-level DoN actions (such as fire suppression support by large DoN helicopters) may substantially reduce the estimated 37 ac (15 ha) annual rate of recovery habitat loss in southern Guam (see "General Effects" section above).

Project Conservation Measures to Benefit the Mariana Crow

The DoN's proposed increased ungulate management, forest habitat restoration and protection of 2,929 acres (four Ecological Reserve Areas and a cooperative conservation agreement with the Government of Guam at Anao) of native vegetation will help protect and enhance some of the available Mariana crow habitat on DoD and Government of Guam lands. The proposed conservation facilities at Finegayan will increase public awareness of the species and will help minimize human impacts to the Mariana crow and its habitat. In addition, DoN is proposing to hire two additional Overlay Refuge biologists to implement conservation and recovery actions on Guam National Wildlife Refuge Overlay lands and two Conservation Law Enforcement Officers to increase security on DoN lands and prevent poaching. The DoN's development and implementation of brown treesnake eradication and control measures coupled with a biosecurity program to suppress/eradicate incipient populations of invasive species as well as respond to new invasions will facilitate the potential reintroduction of the Mariana crow to DoD lands on Guam. In addition, by assuring 12-years of funding for two biologists on Rota the DoN's action will be very beneficial to the Mariana crow on Rota in addition to increasing the likelihood this population will be conserved to serve as a source for future reintroductions of this species to Guam.

Summary

The proposed action will adversely affect the Mariana crow by permanently clearing areas of recovery habitat which, in the absence of the project, would have remained intact to provide for the feeding, breeding, and sheltering of this species. Following completion of the proposed action, there will be a minimally adequate amount of habitat remaining for the recovery of the species on Guam. The best available information indicates project-related noise will not further reduce the amount of recovery habitat suitable for this species' breeding, feeding and sheltering. The DoN's proposed habitat management and protection measures could help protect and enhance some of the available Mariana crow habitat on DoD and Government of Guam lands. The DoN's development and implementation of landscape-level brown treesnake eradication/control measures will be beneficial to the Mariana crow because in the absence of this action, the recovery habitat is not in a suitable condition to support the survival of the species due to current snake abundance on Guam. Once the DoN develops and implements landscape-level brown treesnake suppression program, and works with the Service to develop a reintroduction plan, a substantial percentage of recovery habitat remaining on DoN lands will be available for the reintroduction of the Mariana crow on Guam. By ensuring 12 years of funding for two biologists on Rota, the DoN will contribute to the conservation of an important Mariana crow population.

Effects of the Action – Mariana Fruit Bat

Of the estimated 6,610 to 6,930 total Mariana fruit bat individuals, fewer than 20 occur on Guam (Brooke, 2010 pers. comm.; Boland 2009, pers. comm.; Brooke 2008, p. 1 and references cited therein; Brooke 2009, p. 1; CNMI Division of Fish and Wildlife 2000b, p. 4; CNMI Division of Fish and Wildlife 2000c, p. 35; Johnson 2001, p. 19; DoN 2009, p. 89; Wiles and Johnson 2004, p. 585). The low and declining number of bats on Guam are threatened by brown treesnake predation on non-volant juveniles, habitat loss and degradation of native forests, hunting, and noise and other human disturbance (USFWS 2009b).

The island of Tinian, albeit seldom used by fruit bats currently, provides roosting and foraging habitat important for connectivity of fruit bat populations among the southern islands in the Marianas. The chief threats to Mariana fruit bats on Tinian are the loss and degradation of native forests (on which transient bats depend for roosting and foraging), hunting, and military training and other human activities that could harass bats roosting on the island or preclude them from roosting (USFWS 2009b).

The recovery criteria in the "Draft Revised Recovery Plan for the Mariana Fruit Bat or Fanihi" (USFWS 2009b) indicate that recovery of the Mariana fruit bat will require development and maintenance of subpopulations of sufficient size to avoid genetic and demographic risks associated with small populations. Two of the criteria for achieving recovery goals are (1) that three of the five southern islands (Saipan, Tinian, Aguiguan, Rota, and Guam) support stable or increasing subpopulations of Mariana fruit bat (USFWS 2009b, pp. 40-41), and (2) that habitat sufficient to support these populations must be restored or protected on these the islands. Refer to the discussion in "Relationships of the Action Area to the Survival and Recovery of the

Mariana Fruit Bat" in the Environmental Baseline section above, for a full explanation of the importance of Guam and all of the southern Mariana Islands in meeting the recovery criterion for distribution of the Mariana fruit bat. Re-establishing and maintaining a widely distributed, robust metapopulation of Mariana fruit bat in the Mariana Islands is critical to the long-term persistence of the species. The strategy for achieving the distribution and long-term population stability involves several broad categories of actions: unlawful hunting of Mariana fruit bat must be effectively controlled throughout the archipelago; habitat on islands where Mariana fruit bats occur must be protected and enhanced, and habitat where Mariana fruit bats do not currently or regularly occur must be protected or restored to facilitate movement of bats among islands and address existing or incipient disjunctions in the Mariana fruit bat's distribution; and brown treesnakes must be controlled on Guam and Saipan, and most importantly, must be prevented from dispersing to other islands.

Preconstruction surveys will be implemented to ensure no bats are occupying the vegetation to be removed. The proposed action will result in the loss of Mariana fruit bat habitat and increases in noise levels within portions of fruit bat habitat, which will adversely affect the Mariana fruit bat as described in the following section.

Habitat Loss and Degradation Caused by the Proposed Action

Approximately 1,520 ac (615 ha) of Mariana fruit bat recovery habitat is within the limits of DoN construction in northern Guam and an additional 4 ac (2 ha) are within the project areas in southern Guam. An additional 353 ac (143 ha) of recovery habitat is likely to be cleared as a result of indirect/induced civilian development in northern Guam and 6 ac (2 ha) will be impacted by such development in southern Guam (see Table 10). We cannot provide a quantitative estimate of recovery habitat necessary to support Mariana fruit bat recovery because we do not have sufficient data to quantify the relationship between sustainable population size and areal extent of habitat suitable for breeding, roosting, and foraging. We do know, however, that Mariana fruit bats and other species in the genus *Pteropus* often make transits of several to many mi (km) each night from their roosts to forage on resources that are distributed patchily in space and time, such as fruit and flowers (Nelson 2003, pp. 81-82; Mildenstein et al. 2005, p. 98; Janeke 2006, p. 51). In addition, although most Mariana fruit bats occupy colonial roosts, some bats roost (always or intermittently) alone or in small groups away from colonial roosts (Wiles and Johnson 2004, Janeke 2006, pp. 31-37). Therefore, Mariana fruit bats rely on forest areas much larger than colonial roost sites to meet their requirements for survival and reproduction, and all of the remaining native forest on Guam may be used by the Mariana fruit bat.

Guam

As described in the "Status of the Species" section, we assume the same amount of recovery habitat calculated for the Guam Micronesian kingfisher for the Mariana fruit bat because both species rely on forest types dominated by a variety of native trees, including native primary and secondary limestone forest, volcanic (or ravine) forest, and old coconut plantations. We do not have sufficient information to quantify the relationship between a sustainable population size and the aerial extent of habitat suitable for breeding, roosting, and foraging to determine the extent of habitat necessary to conserve the Mariana fruit bat. The amount of recovery habitat currently

available for the kingfisher and fruit bat was determined using high resolution landcover data (Liu and Fischer 2006) that yielded a refined identification and delineation of cover types than data available when critical habitat was proposed for these species (USFWS 2002).

As described in the "Status of the Species" section, there are approximately 29,308 ac (11,860 ha) of recovery habitat available on Guam for the Mariana fruit bat (Figure 21). Approximately 1,520 ac (615 ha) of potential recovery habitat in northern Guam and 5 ac (2 ha) in southern Guam will be cleared within the project vegetation clearing footprint as a direct result of the proposed action. Preconstruction surveys will be implemented to ensure no bats are occupying the vegetation to be removed. Once facilities are constructed, fruit bats are expected to avoid the developed areas because they will not contain suitable habitat.

In addition, approximately 204 ac (83 ha) of recovery habitat in northern Guam and 3.0 ac (1.2 ha) in southern Guam are expected to be cleared through indirect or induced development impacts of the proposed action. Therefore, there will be 13,853 ac (5,606 ha) of potential recovery habitat in northern Guam and 13,722 ac (5,553 ha) in southern Guam remaining after implementation of the proposed project (see Table 10). Landscape-level DoN actions to minimize fire impacts to forest areas may substantially reduce the estimated 37 ac (15 ha) annual rate of recovery habitat loss in southern Guam (refer to "General Effects" section above).

As noted in the species status and baseline discussion above, we do not know enough about fruit bat habitat use or carrying capacity to estimate how many fruit bats can be supported by the amount of recovery habitat remaining after implementation of the proposed action. Based on the information we have regarding these aspects of the species' biology, sufficient habitat likely will remain to support a self-sustaining subpopulation of fruit bats after the project is completed on Guam.

Tinian

The proposed new training ranges will not be constructed in native limestone forest habitats within the Tinian action area, and bats are unlikely to use the non-native tangantangan habitat that will be removed. Preconstruction surveys will be implemented to ensure no bats are occupying the vegetation to be removed. Once ranges are constructed, fruit bats are expected to avoid the training areas because they would contain no suitable habitat.

No effects that cause a significant disruption of Mariana fruit bat feeding, roosting, or breeding behavior on Tinian are anticipated because bats are transient on Tinian and will be avoided if present during construction. Native limestone forest, preferred by fruit bats, will be avoided, albeit not in the areas where fruit bats have been observed on the island (DoN 2009). The DoN has proposed conservation measures to work with the CNMI to situate the leases outside of habitat for listed species.

Noise Impacts Associated with Increased Training Activities

On Guam, the Marine Corps-related training and construction activities at the Naval Munitions Site, Andersen South, or Route 15 Range complex will produce loud noise. Any individual bats

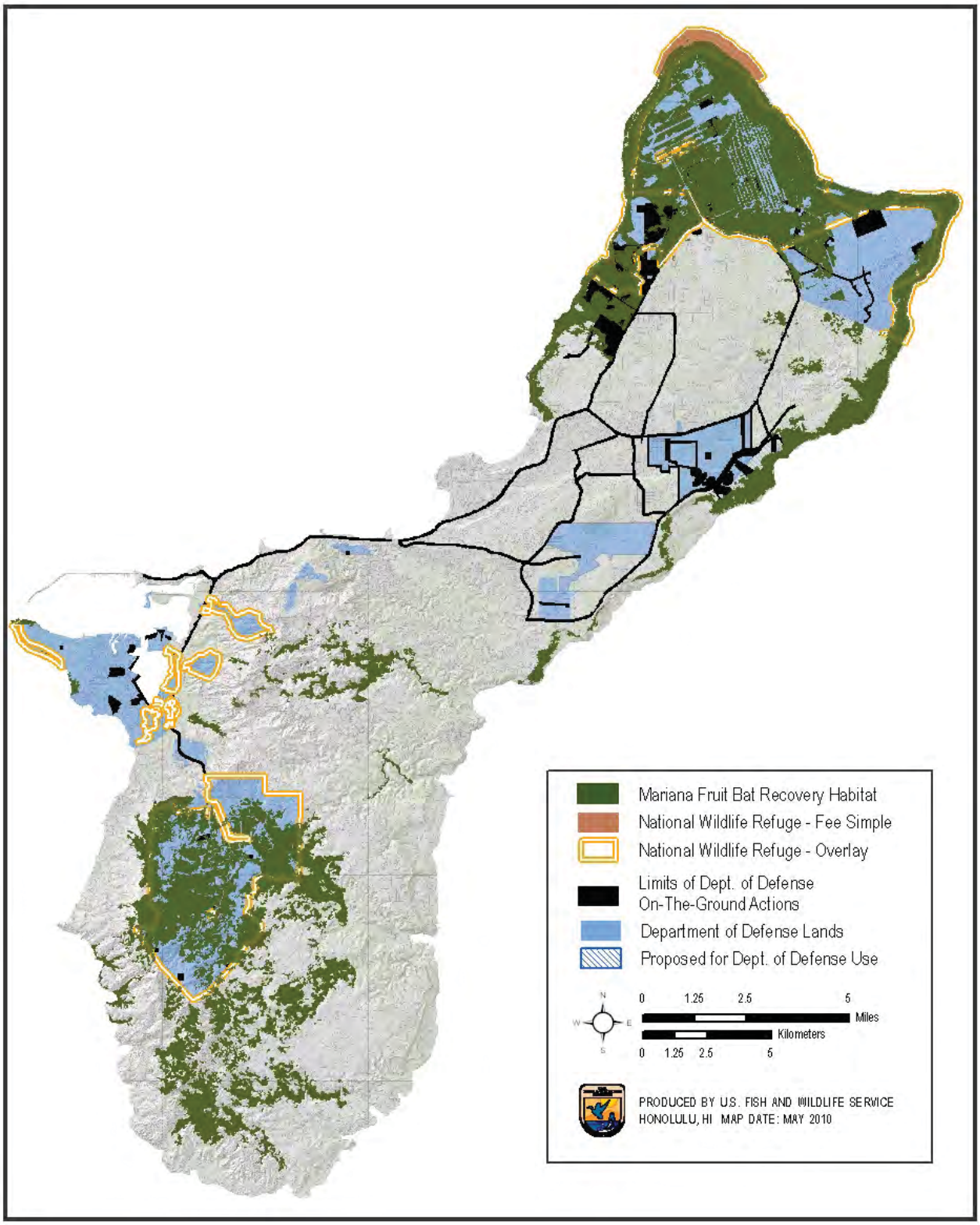

Figure 21. Distribution of recovery habitat for the Mariana fruit bat on Guam.

flushed from roosts in these areas are likely to be capable of flying to another area outside the disturbance zone. Solitary bats flushed as a result of project noise may travel to another area where the likelihood of poaching or harassment is greater overall than it is on DoD lands. Flight restrictions will limit low-level flights over much of the Naval Munitions Site and this will minimize adverse noise impacts to the bat in this area.

The adverse impacts of noise caused by the proposed action on the Mariana fruit bat at Pati Point on Andersen Air Force Base are expected to be substantial. Based on the documented effects of noise on wildlife (described above in the "General Effects" section) and the best available information about the response of Mariana fruit bats to aircraft noise and about the previous abandonment of fruit bat roosts on Guam (see analysis in Service 2006a, pp. 35-39 and references cited therein), we believe the current roost site in the Natural Area at Pati Point on Andersen Air Force Base will likely be abandoned by the few bats remaining there as a result of the proposed action.

Noise effects were reviewed under the ISR Strike Biological Opinion (USFWS 2006a) and were determined to adversely affect the Mariana fruit bat to the extent that the remaining colony site would be abandoned. Ongoing and anticipated noise resulting from jet aircraft and helicopter use of the main runways at Andersen Air Force Base (actions analyzed in the ISR Strike Biological Opinion) was expected to result in the incidental take of the remaining bats on Guam, due to harassment from aircraft noise (USFWS 2006a, p. 49). In addition, harassed bats moving to less protected areas were expected to be lost to opportunistic hunting (USFWS 2006a).

The proposed JGPO project will increase jet traffic by approximately 25% and will approximately double the number of (relatively quieter) helicopter operations. These training flights will adversely affect the Mariana fruit bat. Any remaining bats at the Pati Point-area colony are likely to abandon that site as a result of project-related noise. This is because: (a) the increase in aircraft operations will further reduce the quality of the current site for normal roosting by further increasing bat activity levels throughout the day; (b) alternate sites of sufficient quality are available to the west and northwest of Pati Point and on the Island of Rota; and (c) the current colony site, and other roost sites, have been abandoned in the past because of human disturbance and other factors. Because noise from the ISR Strike Biological Opinion and this Biological Opinion will occur contemporaneously, it would not be possible to attribute the take to a single project.

This abandonment will, in turn, have several adverse impacts on Guam's fruit bats. First, we believe the bats at the current site will likely move to alternate roost sites. The records of abandonment of Mariana fruit bats from Guam indicate that the bats have always moved to alternate sites on Guam, usually along the northern cliffline. Therefore, we expect the bats to remain on Guam and not migrate to Rota. Next, because the cliffline areas to the west and northwest of Pati Point are near public hunting areas and roads, we believe these areas are more accessible to humans and bats roosting in these areas would be vulnerable to illegal hunting. This illegal hunting would likely result in loss of individuals and cause the new roost site to eventually be abandoned. This impact may also be cumulative; roost sites established subsequently in the same general region may also be susceptible to illegal hunting. Finally, in addition to illegal hunting, juvenile bats may be left behind at abandoned roost sites because they

are too heavy for their mother to carry. These abandoned juveniles are likely to die of starvation or predation by brown treesnakes. This sequence of events is expected to have cumulative adverse impacts to the bat population if each new roost site is abandoned.

Mariana fruit bats are known to migrate from Rota to Guam periodically following typhoons because illegal hunting of bats often increases to exploit the bats' vulnerability on these occasions (refer to "Environmental Baseline" section above). We believe these temporary migrants to Guam also will be disturbed by the project-related increased aircraft activities at Pati Point and this will cause them to return to Rota prematurely (less than one month after a storm). We believe these bats will be exposed to illegal hunting and/or poor habitat conditions upon their return Rota. We expect that these circumstances will occur only after a severe storm on Rota and when aircraft operations have increased on Guam. We also expect this to occur only while the Pati Point roost site in the Natural Area is occupied by bats from Guam because fruit bats are gregarious and bats from Rota have previously been noted to be present in existing colonies of bats from Guam.

On Tinian, loud noise resulting from training will impact approximately one-third of the forested FAA mitigation site, reducing the suitability of this area for Mariana fruit bat roosting (see Figure 17 in the General Effects section above). However, we do not expect the noise to result in reduced reproductive success or other significant impacts to individuals on Tinian because bats are transient on Tinian and are not known to breed there.

Conservation Measures to Benefit the Mariana Fruit Bat

The DoN has proposed several conservation actions to benefit the Mariana fruit bat. The DoN's commitment to develop measures to control brown treesnake on a landscape level and to implement these measures on DoD installations and island-wide on Guam will provide protected areas for the Mariana fruit bat population to increase. Of the bat recovery habitat remaining on Guam after implementation of the proposed project, the majority is owned by DoD, and the DoN has proposed to restore or enhance (through ungulate removal and reforestation if necessary) a minimum of 8.9 ac (3.6 ha) that will benefit the bat on DoD lands

The DoN's increased ungulate management, forest habitat restoration, and protection four Ecological Reserve Areas and a cooperative conservation agreement with the Government of Guam at Anao will help protect and enhance some of the available Mariana fruit bat habitat on DoD and Government of Guam lands.

The DoN will hire two DoN Conservation Law Enforcement Officers to increase security on DoN lands and prevent poaching. The increase in conservation law enforcement on Guam is expected be very beneficial to the Mariana fruit bat.

And in order to benefit the fruit bat throughout its range, the DoN will also fund research to fill gaps in our knowledge of fruit bat demography, movements, and phylogeography and will ensure funding for two additional biologists to conduct fruit bat management and conservation activities on Rota. The long-term goal is to develop guidelines to be used in recovery and sustainable management of fruit bats on different islands. Research may include but is not

limited to demographic information used in population viability analysis (age of sexual maturity, timing and frequency of births, survivorship, longevity, adult and juvenile dispersal and frequency of inter-island movements); carrying capacity (quantification of habitat quality, density by habitat type, and habitat availability); island-wide population surveys throughout the range; estimates of predation by brown treesnakes and hunters; identification of any other population-limiting factors (DoN 2010a, p. 135).

The proposed funding of two biologists to be stationed on Rota should help implement conservation actions on that island for the bat. These actions are expected to be very beneficial for the Mariana fruit bat.

The proposed conservation facilities at Finegayan will increase educational awareness of the species and provide a conservation benefit to the Mariana fruit bat and its habitat.

On Tinian, the DoN has proposed to alter the boundaries of the existing FAA Mitigation Area to include some of the largest tracts of limestone forest remaining on the island, and to develop and implement a plan to enhance the native forest within the Mitigation Area. These actions will improve the extent and quality of native forest on Tinian, which will benefit fruit bats if they establish permanent residence on the island in the future.

Summary

The proposed action is likely to adversely affect the Mariana fruit bat on Guam. Roughly 12% of the remaining recovery habitat on the island will be lost or degraded directly or indirectly as a result of the proposed action (see Table 10), and although this loss will not preclude the recovery or survival of the fruit bat, it will reduce the total number of bats the island can support. The abandonment of the Pati Point's Natural Area Mariana fruit bat colony on northern Guam is likely to occur as a result of noise and disturbance from increased aircraft overflights associated with training activities. These bats compose the entire population of the Mariana fruit bat on Guam. The bats abandoning the Pati Point colony are likely to move to areas where they will be exposed to illegal hunting activities. Increases in conservation law enforcement provided by DoN will minimize the likelihood these bats will be killed by hunters. By ensuring 12 years of funding for two biologists on Rota, the DoN will contribute to the conservation of an important Mariana fruit bat population.

2.5 CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, tribal, local or private actions that are reasonably certain to occur in the action area considered in this Biological Opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

The extent to which future development is addressed as a cumulative effect in the following analysis excludes any such future development that is expected to be interdependent with or interrelated to construction of federally-funded roads or is likely to be caused by other Federal actions that will be addressed in future section 7 consultations.

Overview of Cumulative Effects

Civilian development, human-caused wildfires and the transport of non-JGPO-related items through Ports may reduce the geographic extent and quality of habitat for the species addressed in this consultation.

Civilian Development Activities

Urbanization, agriculture, and other forms of development on are likely to result in the loss, fragmentation, or degradation of forest and wetland habitat within the action area. Development is likely to result in increased noise and predator densities in the vicinity of sites occupied by listed species. Changes in water quality and water level in freshwater wetlands may occur as a result of civilian development activities. Increases in population will result in increased human noise disturbance in urban areas as well as in outdoor recreation areas.

Guam

The DoN provided a list of known future projects lacking a Federal nexux on Guam in their Final EIS for the proposed JGPO action (DoN 2010b and Pepi 2010, pers. comm.) of known future projects lacking a Federal nexus on Guam. The DoN reviewed all known future non-Federal projects to determine if any of the projects will potentially be located within recovery habitat for the Mariana fruit bat, Guam Micronesian kingfisher, and the Mariana crow. Only one project is proposed within that recovery habitat: 4.5-acre (1.8-ha), 236-unit condominium complex. This project obtained approval from the Guam Land Use Commission in November 2007, and construction is planned for 2010 through 2012.

Human population increases unrelated to the proposed JGPO action that exceed the capacity of the currently planned civilian development described above are reasonably certain to occur. The DoN's Final EIS (DoN 2010b, vol. 2, p. 16-3) reported an annual rate of increase in Guam's population of 1.6% during the 2000 through 2008 period and that, in the absence of the proposed JGPO action, that rate would be 1.2% from 2010 through 2020, and would drop to 0.9% for the 2020 through 2030 period. Guam's 2008, population was 175,877 (U.S. Census Bureau 2008, as cited in DoN 2010b, vol. 2, p. 16-3).

Guam's land use planning maps (Government of Guam 2009, p. 2-14) indicate housing and industrial development will be targeted to minimize impacts to recovery habitat areas. Significant areas of recovery habitat are zoned for development as tourist/resort (Government of Guam 2009, p. 2-14). It is our understanding that development of many of the tourist/resort areas will entail creation of federally-funded roadways and infrastructure; therefore these projects will be addressed, pursuant to the Act, in separate section 7 consultations.

Project-related development of housing for construction workers, as well as development by civilians indirectly related to the proposed action during the construction period, is likely to result in an abundance of housing which may be left occupied after the construction period (Table 11). Housing for approximately 11,000 new non-project-related Guam residents will be developed during the project construction period. The availability of vacant project-related housing during the post-JGPO construction period is likely to reduce the level of other new civilian development. Our calculations indicate construction-worker housing is likely to constitute approximately 50% of total housing becoming available after the buildup period. Although the construction worker housing may not be of the size and development density sought by home-buyers during the post-construction period, availability of project-related housing is not likely to offset all future development pressure. During the construction period, non-project-related population increases on Guam may result in increased civilian development.

Table 11. Anticipated population growth and availability of housing on Guam during and following the JGPO construction period.

Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Non-Project-Related Population Increase (Based on Navy 2009, vol. 2 p. 16-3)											
Population Size	180,123	182,285	184,472	186,686	188,926	191,193	193,488	195,809	198,159	200,537	202,944
Cumulative Population Increase Unrelated to Project - During Construction Period	2,136	4,297	6,485	8,698	10,939						
Cumulative Population Increase Unrelated to Project - During Period when Vacant Project-Related Housing will be Available						2,267	4,561	6,883	9,233	11,611	14,017
Project-Related Population Increase (Navy 2009, vol. 1, p. ES – 7)											
Construction Worker Housing Capacity In Use by Project	4,400	10,785	18,017	21,798	23,095	14,972	4,832				
Project-Related Civilian Indirect/Induced Population	5,592	14,199	23,433	27,926	36,480	28,814	15,955	12,299	12,299	12,476	12,476
Total Project-Related Civilian Population	9,992	24,984	41,450	49,724	59,575	43,786	20,787	12,299	12,299	12,476	12,476
Cumulative Project-Related Housing Capacity Vacated						15,789	38,788	47,276	47,276	47,099	47,099

For a period after the peak period of construction, non-construction worker and construction worker housing vacancy rates will be high enough to absorb ongoing non-project related

increases in population for some time. Our calculations indicate future rates of civilian development are expected to be significantly reduced as a result of the increased housing supply resulting from the proposed JGPO action.

Tinian

Urbanization, agriculture, and other forms of development on are likely to result in the loss, fragmentation, or degradation of forest and wetland habitat on Tinian. Development is likely to result in increased noise and predator densities in the vicinity of sites occupied by listed species.

Wildfire Impacts to Recovery Habitat

Guam

Over a three-year period from 2000 through 2003, 2,020 arson fires were reported to have burned approximately 6,000 ac (2,428 ha) in Guam. Of the approximately 750 wildfires burning each year on Guam, approximately 80% are caused by arson (Wildland Fire Prevention and Education Team Final Report, 2003, as cited in Neill and Rea 2004, p. 6-7). The number of fires reported on non-DoN land increased from an average of 612 per year during the 1979 through 1989 period to an average of 786 per year during the 1991 through 2002 period; this change represents an increase of approximately 27% although improvements in fire reporting may account for some of this increase. However, the average annual total reported area burned by wildfires dropped by approximately 35% (2,000 ac) in the 1991 through 2002 period, compared with the 1979 through 1989 period. We anticipate the area burned by wildfires will continue to decline as a result of efforts by the U.S. Forest Service, Federal Emergency Management Agency, and the DoI Office of Insular Affairs. The U.S. Forest Service, for instance, anticipates providing funds to develop a robust fire suppression force led by a skilled fire management officer on Guam (Mahoney 2010, pers. comm.).

Although there is ongoing debate regarding the origin of savanna areas in Guam (Hunter-Andersen 2009 and Athens and Ward 2004), savanna areas are enlarging into previously forested areas as a result of human-caused wildfires. To estimate the rate of historical forest conversion to savanna, Greenlee (2010) delineated areas which appeared to be dominated by forest vegetation in 1975 aerial photographs and which are no longer forested in recent infrared imagery, and estimated that 1,119 ac (453 ha) of forest have been converted to savanna in southern Guam since 1975 (see Figure 15 in the General Effects section above). This estimate indicates the average rate of forest loss in southern Guam is approximately 37 ac/year (15 ha/year).

Transport of Non-JGPO-Related Items through Ports

Guam's human population will continue to grow even in the absence of the proposed action. Historically, Guam's population growth has shown annual rates of population growth that range from 1.2% to 2.4%. Currently, Guam is in a low growth phase. Annual population growth, without the proposed action, is projected to be 1.2% during the decade of 2010-2020 and 0.9% for the decade 2020-2030 (DoN 2010b, vol. 2 p. 16-3). This translates to a total of 25,000 new

Guam residents during the period 2010-2020. The proposed action is not expected to compensate for these increases in population and resultant risks to endangered species. While less than the growth attributable to the proposed action, this non-project growth is still important from a biosecurity perspective. Currently, the DoI Office of Insular Affairs funds brown treesnake interdiction, control, and research efforts that complement DoD funding for many of these same efforts. The DoI Office of Insular Affairs program includes the following measures in Guam, CNMI, and Hawaii:

Guam

1. 100% canine inspection of civilian sea cargo, civilian air cargo, and air passenger flights leaving Guam.
2. Establishment of snake-free quarantine areas for packing and storing cargo prior to transport.
3. Snake suppression in and around the snake-free cargo quarantine areas.
4. Snake control for natural resource protection.
5. Support for the brown treesnake rapid response efforts to ensure incidents outside Guam are adequately staffed and equipped.

CNMI: Interdiction support on three main islands (Saipan,Tinian, and Rota) includes:

1. Canine inspections of incoming cargo and aircraft (Saipan and Tinian established; funding has been provided for Rota).
2. Establishment of quarantine areas (Saipan and Tinian established; funding has been provided for facility at Port of Rota).
3. Rapid Response/Biosecurity Training (all islands).

Hawaii: Interdiction support in Hawaii includes:

1. Canine inspections of incoming cargo and aircraft.
2. Rapid Response/Biosecurity Training.

Interdiction efforts during 2009, appeared to be adequate for the volumes of aircraft and surface cargo shipped out of Guam. For example, canine inspections were completed for 99.8% of military aircraft, 96.6% of commercial aircraft, 94.6% of military household goods, and 98.6% of civilian household goods (Table 12). The DoI Office of Insular Affairs also funds brown treesnake suppression efforts for natural resource benefits, research on brown treesnake control, the implementation of brown treesnake barriers, and overall brown treesnake coordination efforts.

While the current brown treesnake inspection efforts are good (e.g., discussed above), there is still a risk of brown treesnake slipping through the system and establishing on other islands. Perry and Vice (2009) modeled brown treesnake risk of establishment associated with specific, existing shipping and transportation pathways and found an extremely high risk of brown treesnake establishment on Saipan, a very high risk for Rota, and a high risk for Tinian. Hawaii

Table 12. USDA-Wildlife Services canine inspection results for fiscal year 2009.

	AIR FORCE INSPECTIONS					NAVY INSPECTIONS					COMMERCIAL INSPECTIONS				
FY09	**A/C[1]**	**Hses[2]**	**Vehs[3]**	**Whses[4]**	**Pallets[5]**	**A/C**	**Hses**	**Vehs**	**Whses**	**Pallets**	**A/C**	**Hses**	**Vehs**	**Whses**	**Pallets**
Qtr 1	390	101	132	295	8051	254	309	483	515	26718	634	3	789	576	11091
Qtr 2	378	155	133	474	6272	318	306	911	520	23381	687	33	364	856	10357
Qtr 3	333	225	221	617	7563	313	318	425	461	22840	757	22	480	990	12435
Qtr 4	430	151	190	601	4552	287	292	304	520	22367	648	13	632	907	13605
No. Inspected	1531	632	676	1987	26438	1172	1225	2123	2016	95306	2726	71	2265	3329	47488
No. Missed (% Missed)	1 (> 1%)	47 (6.92%)	0 (0.00%)	0 (0.00%)	5 (0.02%)	3 (0.26%)	60 (4.67%)	0 (0.00%)	0 (0.00%)	3 (0.00%)	95 (3.37%)	1 (1.39%)	0 (0.00%)	0 (0.00%)	**34 (0.07%)**
% +/- FY08	-5.6%	-10.4%	76.5%	51.9%	0.0%	-2.2%	-36.6%	47.1%	-7.3%	6.6%	-2.8%	-7.7%	26.2%	23.0%	-8.0%
Total Movements	1532	679	676	1987	26443	1175	1285	2123	2016	95309	2821	72	2265	3329	47522

was also considered to be at a high risk of brown treesnake establishment. These risks are mitigated by effective interdiction. The loss of interdiction capacity or effectiveness would increase the likelihood of brown treesnake establishing in CNMI. There is no indication that DoI Office of Insular Affairs will reduce funding to brown treesnake interdiction in Guam or CNMI or that it will not provide program increases to keep up with the baseline growth of Guam's population and resultant risks associated with increased air transportation and sea shipping. Therefore, the risk of the transport of the brown treesnake from Guam to other locations in the Pacific will remain low.

The brown treesnake could also be introduced to the islands of the CNMI as a result of shipments originating from its native range in Australia, New Guinea, Indonesia, and the Solomon Islands. Rodda and Savidge (2007) state that "at the current time the risk of brown treesnake introductions to the Pacific from the snake's native range is considered to be relatively minor for two reasons: (1) the density of brown tree snakes is generally much lower in the snake's native range than it is in Guam, and (2) little cargo destined for tropical and subtropical areas originates in the snake's native range (e.g., Port Moresby, Honiara, Darwin, Halmahera).

Species-Specific Cumulative Effects

Guam Micronesian Kingfisher

As described in the Overview of Cumulative Effects section above, the effects of future development to Guam Micronesian kingfisher recovery habitat are expected to be insignificant. If the number and size of human-caused wildfires burning in southern Guam continues at historical rates, the amount of Guam Micronesian kingfisher recovery habitat remaining in southern Guam will be reduced below the threshold necessary for recovery within approximately nine years. However, the trend in annual area burned has been declining and we anticipate it will continue to decline as a result of ongoing and future Federal support of the development of local fire suppression resources. Therefore, we do not expect the recovery of the Guam Micronesian kingfisher will become habitat limited in southern Guam as a result of cumulative effects.

Guam Rail

Because the Guam rail utilizes edge habitat and shrubby areas, the effects of future development and human-caused wildfire (which increase the amount of edge habitat and shrubby areas) to the Guam rail on Guam are expected to be insignificant.

Mariana Common Moorhen

Increases in Guam and Tinian populations may result in reductions in the distribution and quality of wetlands used by this species. Changes in hydrology resulting from increased human use of ground water may reduce water levels in wetlands utilized by the Mariana common moorhen. Runoff from developed areas may result in decreases in the abundance of food for the Mariana common moorhen.

Mariana Fruit Bat

As described in the Overview of Cumulative Effects section above, the effects of future non-project-related development to Mariana fruit bat recovery habitat are expected to be insignificant; wildfire conversion of forest to grassland, however, is expected to continue. The effects of non-project-related development to Mariana fruit bat recovery habitat are expected to be insignificant. The trend in annual area burned has been declining and we anticipate it will continue to decline as a result of ongoing and future Federal support of the development of local fire suppression resources. Therefore, we do not expect the recovery of the Mariana fruit bat will become habitat-limited in southern Guam.

Mariana Crow

The two male Mariana crows on Guam will continue to be exposed to human persecution and predation by introduced predators. As described in the Overview of Cumulative Effects section above, the effects of future development to Mariana crow recovery habitat are expected to be insignificant. Although wildfires resulting from ongoing civilian actions in southern Guam are likely to continue to convert Mariana crow recovery habitat to savannah, the trend in annual area burned has been declining and we anticipate it will continue to decline as a result of ongoing and future Federal support of the development of local fire suppression resources. We do not expect the recovery of the Mariana crow will become habitat limited in southern Guam as a result of cumulative effects.

2.6 CONCLUSION

After reviewing the current status of the listed species identified in Table 1, the environmental baseline, the effects of the proposed action and the cumulative effects, it is the Service's biological opinion that the action, as proposed: is not likely to jeopardize the continued existence of the Guam Micronesian kingfisher, Guam rail, Mariana common moorhen, Mariana crow, and Mariana fruit bat. The Service reached these conclusions based on the following findings, the basis for which is presented in the preceding sections of this document.

Guam Micronesian Kingfisher

The Guam Micronesian kingfisher is currently extirpated from the wild; therefore, direct impacts to individuals will not occur as a result of the subject action. However, we have determined that the proposed project will adversely affect the Guam Micronesian kingfisher by removing areas of recovery habitat which, in the absence of the project, would have remained intact to provide for the feeding, breeding, and sheltering of this species once it is reintroduced. After implementation of the proposed project (including interrelated and interdependent effects) there is expected to be enough potential recovery habitat remaining on Guam to not preclude recovery of the Guam Micronesian kingfisher. However, only an estimated 815 ac (330 ha) in northern Guam and 343 ac (139 ha) will remain in southern Guam once project actions are considered.

Future cumulative effects of development to kingfisher recovery habitat are expected to be insignificant because housing developed during construction will be available for habitation by future Guam residents. If the number and size of wildfires burning in southern Guam continues at historical rates, the amount of Guam Micronesian kingfisher recovery habitat remaining in southern Guam will be reduced below the minimum threshold necessary for recovery within approximately nine years. Because the trend in annual area burned has been declining and we anticipate it will continue to decline as a result of ongoing and future Federal support of the development of local fire suppression resources, we do not expect the recovery of the Guam Micronesian kingfisher will become habitat-limited on Guam.

The DoN's proposed habitat management and protection measures will help protect and enhance some of the available Guam Micronesian kingfisher habitat on DoD and Government of Guam lands. The DoN's development and implementation of brown treesnake eradication and control measures and reintroduction planning will facilitate the successful reintroduction of the Guam Micronesian kingfisher to DoN lands on Guam. Additionally, the establishment of a wild kingfisher population outside of Guam will help safeguard the species and provide wild kingfishers for release on Guam.

On the basis of these findings, the Service concludes that the effects of the subject action, taken together with cumulative effects, are not likely to appreciably reduce the likelihood of both the survival and recovery of the Guam Micronesian kingfisher in the wild.

Guam Rail

Although the proposed action will result in a loss of habitat for Guam rails, there will still remain an adequate amount of habitat to provide for recovery of the species. The DoN's proposed habitat management and protection measures may help protect and enhance some of the

available Guam rail habitat on DoD and Government of Guam lands. The DoN's development and implementation of brown treesnake eradication and control measures and DoN's reintroduction planning will facilitate the reintroduction of the Guam rail to DoN lands on Guam. On the basis of these findings, the Service concludes that the effects of the proposed action, taken together with cumulative effects, are not likely to appreciably reduce the likelihood of both the survival and recovery of the Guam rail in the wild.

Mariana Common Moorhen

Most recent survey information indicates there are approximately 90 Mariana common moorhen on Guam, 154 of these birds on Saipan, 41 individuals on Tinian, and only two individuals on Rota (Takano and Haig 2004a, p. 247). The DoN's development and implementation of brown treesnake eradication and control measures, if successfully implemented in wetland areas, will result in future increases in Mariana common moorhen numbers on Guam. Because the quality of waterbird habitat in many of Guam's wetlands is poor, the DoN's implementation of wetland restoration in central Guam will benefit the Mariana common moorhen. Construction and live-fire training at Tinian ranges will expose the Bateha wetlands system to noise levels above 60 dB. The Bateha wetlands are richer in food sources than Tinain's Lake Hagoi. Although surveys indicate only four or fewer Mariana common moorhen are found at the Bateha wetlands, the noise associated with the proposed action will result in reduced Mariana common moorhen use of the high quality foraging area, constituting a significant disruption of their feeding. Mariana common moorhen is not known to breed in these seasonal wetlands.

Cumulative effects, including civilian development may result in reductions in the extent of wetland habitat in the CNMI. Coastal wetlands in the vicinity of Naval Base Guam could be affected by increased storm impacts and sea level rise resulting from climate change. Changes in precipitation resulting from climate change may affect the abundance and water levels in seasonal and permanent wetlands. Because wetland habitat degradation such as Fena Lake's eutrophication is thought to have resulted from a typhoon (Brooke 2007, pers. comm.), changes in typhoon frequency and severity resulting from climate change would affect the Mariana common moorhen.

Overall, the effects of the proposed action are not likely to appreciably reduce the likelihood of both the survival and recovery of the Mariana common moorhen in the wild because sufficient habitat and populations are likely to persist throughout its range at levels that retain the potential for recovery of this species.

Mariana Crow

The Mariana crow is known historically only from the islands of Rota and Guam (Baker 1951, p. 245). Currently, the only remaining Mariana crows known to occur in the wild are the approximately 60 breeding pairs and 24 non-breeding individuals on Rota and the two male individuals (previously introduced from the Rota population) on Guam. Both individuals are located on Andersen Air Force Base and are not within areas proposed for development (DoN 2010a, p. 237).

The proposed action will adversely affect the Mariana crow on Guam by removing areas of recovery habitat which, in the absence of the action, would have remained intact to provide for the feeding, breeding, and sheltering of this species. The acreage lost as a result of the project will total approximately 1,841 ac (745 ha) of recovery habitat that could have supported approximately 50 territorial Mariana crow pairs. This action will reduce the available habitat for recovery of the species to only 9,885 ac (4,000 ha) above the minimum required to allow for potential recovery. The future effects of non-project-related civilian development to crow recovery habitat are expected to be insignificant. We anticipate annual area burned by wildfires in southern Guam will continue to decline as a result of ongoing and future Federal support of local fire suppression resources such that the amount of recovery habitat remaining will be adequate to support the recovery of the Mariana crow.

The DoN's proposed habitat management and protection measures will help protect and enhance some of the available Mariana crow habitat on DoD and Government of Guam lands on Guam. The DoN's development and implementation of brown treesnake eradication and control measures, Mariana crow monitoring and research, and increased conservation law enforcement action, and ungulate control actions are likely to result in future increases in the survival and reproductive success of the Mariana crow on Guam. In order to benefit the Mariana crow throughout its range, the DoN will also ensure funding for two biologists to be based on the island of Rota. These biologists will facilitate conservation of a significant population of Mariana crows by implementing conservation actions to contribute to halting and reversing declines in the largest remaining wild population of the species. For these reasons, it is our opinion that the proposed action is not likely to appreciably reduce the likelihood of the survival and recovery of the Mariana crow in the wild.

Mariana Fruit Bat

Most recent survey information indicates there are fewer than 20 Mariana fruit bats on Guam, the bats are transient on Tinian, approximately 50 individuals occur on Saipan, Rota supports a population of between 1,200 and 1,400 individuals, and more than 5,000 Mariana fruit bats occur on nine other islands in the CNMI (Brooke, 2010, Boland 2009, pers. comm.; Brooke 2008, p. 1 and references cited therein; Brooke 2009, p. 1; CNMI Division of Fish and Wildlife 2000b, p. 4; CNMI Division of Fish and Wildlife 2000c, p. 35; Johnson 2001, p. 19; Navy 2009, p. 89; Wiles and Johnson 2004, p. 585).

The proposed action will adversely affect the Mariana fruit bat on Guam. Roughly 11% of the remaining recovery habitat on the island will be lost or degraded directly or indirectly as a result of the proposed action, and although this loss will not preclude the recovery of the fruit bat, it will reduce the total number of bats that the island can support. The abandonment of the Pati Point Natural Area's Mariana fruit bat colony on northern Guam is likely to occur as a result of noise and disturbance from increased aircraft overflights associated with training activities. The bats abandoning the Pati Point Natural Area's colony may move to areas where they will be exposed to illegal hunting impacts on Guam and Rota. The two conservation law enforcement staff funded by DoN will minimize the likelihood that Mariana fruit bats occurring on DoD lands will be impacted by hunting. DoN's proposed public education program will also better ensure future hunting impacts to this species on Guam are minimized. The DoD's funding of two

biologists on Rota for a period of 12 years may result in decreased hunting of the Mariana fruit bat on that island; thus potentially increasing the Rota bat population to the point where some Rota bats can recolonze Guam.

The DoN's proposed habitat management and protection measures may help protect and enhance some of the available Mariana fruit bat habitat on DoD and Government of Guam lands on Guam. The DoN's development and implementation of brown treesnake eradication and control measures, Mariana fruit bat monitoring and research, and increased conservation law enforcement actions are likely to result in future increases in the survival and reproductive success of the Mariana fruit bat. DoN's funding for two biologists on Rota will contribute significantly to halting and reversing the declines in that significant Mariana fruit bat population. On the basis of these findings, the Service concludes that the effects of the subject action, taken together with cumulative effects, are not likely to appreciably reduce the likelihood of both the survival and recovery of the Mariana fruit bat in the wild because sufficient habitat and populations are likely to persist throughout its range at levels that retain the potential for recovery of this species.

2.7 INCIDENTAL TAKE STATEMENT

Section 9 of the Act and Federal regulations pursuant to section 4(d) of the Act prohibit the take of endangered or threatened species, respectively, without special exemption. Take is defined as harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct. Harm is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including, breeding, feeding, or sheltering. Harass is defined by the Service as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering.

Incidental take is defined as take that is incidental to, and not the purpose of, carrying out an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered a prohibited taking under the Act provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The measures described below are non-discretionary, and must be undertaken by DoN so that they become binding conditions to the applicant for the exemption in section 7(o)(2) to apply. The DoN has a continuing duty to regulate the activity covered by this incidental take statement. If DoN (1) fails to assume and implement the terms and conditions or (2) fails to require contractors to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to contract documents, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, DoN must report the progress of the action and its impact on the species to the Service as specified in this incidental take statement [50 CFR 402.14(i)(3)].

Amount or Extent of Take Anticipated

Based on our analysis presented in this Biological Opinion, the Service anticipates the following take may occur as a result of the proposed action:

1) Four Mariana common moorhens may be incidentally taken in the form of harassment on days when construction and live-fire exercises occur at the proposed Tinian firing ranges. Loud noise associated with the proposed action will result in reduced Mariana common moorhen use of the high quality foraging area, constituting a significant disruption of their feeding.

2) The Service anticipates that up to ten remaining Mariana fruit bats at the Pati Point natural area colony will be taken in the form of harassment due to loud aircraft noise resulting from the proposed action.

The Service will not refer the incidental take of any listed endangered or threatened migratory bird for prosecution under the Migratory Bird Treaty Act of 1918, as amended (16 U.S.C. §703-712), if such take is in compliance with the terms and conditions specified herein.

Effect of the Take

In the accompanying Biological Opinion, the Service determined that this level of anticipated take is not likely result in jeopardy to the Mariana common moorhen or the Mariana fruit bat.

2.8 REASONABLE AND PRUDENT MEASURES

Reasonable and prudent measures serve to minimize impacts on the individuals or habitats affected by the action. The Service believes the following reasonable and prudent measures are necessary and appropriate to minimize impacts of incidental take of the Mariana common moorhen and the Mariana fruit bat:

1) The DoN will implement the Conservation Measures set forth in the Project Description in this Biological Opinion.

2) The DoN will report on the progress of project implementation.

3) The DoN will minimize the level of incidental take of the Mariana fruit bat occurring as a result of aircraft operations on Guam.

4) The DoN will minimize the level of incidental take of the Mariana common moorhen occurring as a result of training activities on Tinian.

2.9 TERMS AND CONDITIONS

In order to be exempt from the prohibitions of section 9 of the Act, DoN must comply with the following terms and conditions, which implement the reasonable and prudent measures described above and specify reporting requirements. These terms and conditions are non-discretionary.

In order to implement the reasonable and prudent measure above, the following terms and conditions apply:

1) DoN shall implement the Conservation Measures in the Project Description of this Biological Opinion. We reiterate this requirement here for convenience and clarity. If there is any deviation from these conditions the Service shall be notified one (1) month prior to modifications of the Conservation Measures.

2) The DoN will:
   a) Submit annual reports detailing the implementation of the Conservation Measures, the other aforementioned Terms and Conditions, minimization measures and best management practices used to minimize impacts, and summaries of biological monitor reports. The first report will be due at the end of Fiscal Year 2011 (September). Reporting will be required until the Conservation Measures are fully implemented.

b) With assistance from the Service, develop and implement a methodology (e.g., spreadsheet, database) for tracking project actions as described in the Project Description including the timing and implementation of the conservation measures and the aforementioned Terms and Conditions. This project and mitigation tracking system should be completed within six (6) months from the date of this Opinion. The DoN will coordinate with the Service so that the tracking methodology is readily usable for both agencies in order to facilitate our joint monitoring (and DoN implementation) of the mitigation objectives outlined in this Opinion.

3) To determine the level of take DoN will:
   a) Monitor, a minimum of once a week, the number of Mariana fruit bats occupying all known roost sites on Andersen Air Force Base from one year prior to and one year after the proposed overflight increases are fully implemented. The monitoring methodology should, at a minimum, include direct counts of Mariana fruit bats utilizing a spotting scope at an appropriate distance to avoid disturbance impacts to the bats.
   b) Reports summarizing the methods and results of the above monitoring efforts shall be sent to the Service's Pacific Islands Fish and Wildlife Office (300 Ala Moana Blvd., Room 3-122, Box 50088, Honolulu, Hawaii 96850) every six (6) months until the monitoring is completed. Results for the bat monitoring will include a table of count results, bat behavior during training events, and weekly summary of the number of aircraft operations (by aircraft type) over occupied roost sites.

4) To determine the level of take DoN will:

   a) Develop and implement a program to monitor the effects of project noise on the numbers of Mariana common moorhen occupying the Bateha wetlands. The program will include surveying the Bateha wetlands within one week prior to and following a subset of periods of construction and training to determine the number of individuals and active nests present before and after training events. These surveys should only be conducted during the wet season as moorhens are not known to use the wetlands during the dry season.
   b) Write reports summarizing the methods and results of the above monitoring efforts shall be sent to the Service's Pacific Islands Fish and Wildlife Office (300 Ala Moana Blvd., Room 3-122, Box 50088, Honolulu, Hawaii 96850) every six (6) months when training is occurring on Tinian. Results for the moorhen monitoring will include a table of count results and summary of the activities occurring at the site associated with the survey (e.g., construction, live-fire training, etc.).

Reporting Requirements

The DoN shall inform the Field Supervisor of the Service's Pacific Islands Fish and Wildlife Office in Honolulu, Hawaii, in writing of take of any federally listed species within three (3) working days. The depository designated to receive specimens of any threatened or endangered species killed is the B.P. Bishop Museum, 1525 Bernice Street, Honolulu, Hawaii, 96817 (telephone: 808/547-3511). If the B.P. Bishop Museum does not wish accession to the

specimens, the permittee should contact the Service's Division Office of Law Enforcement in Honolulu, Hawaii (telephone: 808/861-8525; fax: 808/861-8515) for instructions on disposition. The Service's Pacific Islands Fish and Wildlife office (telephone: 808/792-9400) will also be informed within three (3) working days of any injured threatened or endangered species found and the actions taken.

2.10 CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Federal (Act) directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species, to help implement recovery plans, or to develop information. The recommendations provided relate only to the proposed action and do not necessarily represent complete fulfillment of the Army's section 7(a)(1) responsibilities for the species. In order for the Service to be kept informed of actions minimizing or avoiding adverse effects or benefiting listed species or their habitats, the Service requests notification of the implementation of any conservation recommendations.

1) The DoD should replace the proposed project footprint with a project footprint such as the ones described in "Alternative 1" or "Alternative 8" in the Final EIS (DoN 2010b) to minimize project development within areas of Guam Micronesian kingfisher, Mariana crow, and Mariana fruit bat recovery habitat.

2) The DoD should restore limestone forest or ravine forest on 1,525 ac (617 ha) currently mapped by the U.S. Forest Service (2002) as "Scrub Forest, Leucaena Stand, Other Shrub/Grass, or Savanna Complex" to offset impacts to Guam Micronesian kingfisher, Mariana crow, and Mariana fruit bat recovery habitat within the project footprint. DoD should restore an additional 208 ac (84 ha) of limestone forest or ravine forest to offset anticipated impacts of civilian development to recovery habitat expected to occur as a result of the project.

3) In addition to ensuring project-related fires do not impact recovery habitat for listed species, the DoN should incorporate the following measures into fire management operations: (1) establish and maintain cooperative agreements with Government of Guam and local jurisdictions to ensure DoD fire suppression resources are able to assist with fire suppression efforts, as necessary, to protect remaining limestone forest and ravine forest from fire; (2) to facilitate fire management planning and implementation of daily fire suppression staffing, immediately establish remote automated weather stations on Guam and Tinian and maintain weather and fire danger data in the interagency weather information management system; (3) complete landscape-level forest restoration to convert grasslands in the Naval Munitions Site back to limestone forest or ravine forest; (4) restore any areas of forest burned on DoD lands, regardless of fire cause; (5) control public access at the Naval Munitions Site to minimize ignition of fires caused by the public.

4) In addition to incipient weed control the DoD should enhance limestone forest and ravine forest areas on DoD land currently mapped as recovery habitat for the Guam Micronesian kingfisher, Mariana crow, and Mariana fruit bat by implementing landscape-scale measures to control invasive plants.

5) The DoD should manage Fena Reservoir vegetation and water quality for recovery of the Mariana common moorhen.

6) The DoD should fund a study that examines the effects of noise on behavior and reproduction of the endangered Mariana crow. Of particular potential concern is disturbance to Mariana crows resulting from noise related to training on Guam; however, other sources of noise should also be investigated.

7) The DoD should provide assistance for implementation of a conservation incentive program for the Mariana crow on Rota, which is currently under development.

8) In addition to funding two conservation personnel to develop measures to benefit the Mariana crow and Mariana fruit bat, DoD funding for implementation of projects developed by these staff on Rota would provide even more substantial benefits to these species. We recommend that DoD develop the following specific projects to benefit the Mariana fruit bat:

    a. Socioeconomic research to shed light on the best methods for reducing illegal hunting of Mariana fruit bats (i.e., development of a conservation incentives program that can be implemented throughout the archipelago).

    b. Ecological and life history research to determine for example (i) the fruit bat's specific habitat requirements – habitat structure, composition, and habiat needs, (ii) refined estimates of rates of reproduction and survival, (iii) population-level impacts of illegal hunting and direct and indirect effecs of typhoons, and (iv) the best means to reestablish self-sustaining numbers of Mariana fruit bats on Guam.

    c. Other research and conservation actions as described and prioritized in the Draft Revised Recovery Plan for the Mariana Fruit Bat or Fanihi (USFWS 2009b).

9) DoD should fund or provide training and other support for local law enforcement and conservation officers to facilitate their conduction of patrols for and prosecutions of illegal hunting and other "take" of Mariana crows on Rota and Mariana fruit bats on Guam, Rota, and Saipan.

10) An anti-terrorism fence has been proposed to secure Andersen Air Force Base from intrusion of unauthorized people. Recent discussions between the DoN and the Service indicate that the DoN is proposing to build a fence that will effectively enclose the northern portion of Guam including Guam National Wildlife Refuge land. The fence would then not only serve as a protective fence for Andersen Air Force Base, it would also be an effective barrier for ungulates. We recommend this ungulate exclusionary fence be included in the DoN's Ungulate Management Plan.

11) The DoN should ensure National Wildlife Refuge staff are provided with unescorted access to Guam National Wildlife Overlay Refuge sites on DoD lands to increase implementation of recovery actions.

2.11 REINITIATION – CLOSING STATEMENT

If cargo originating from Guam is implicated in the transport of a brown treesnake to the CNMI, Hawaii, or continental U.S., the Service shall assess the ongoing risk of brown treesnake transport and will determine if additional brown treesnake interdiction measures or other actions are necessary to ensure the effects of the action are minimized.

This concludes formal consultation on this action. As required in 50 CFR §402.16, reinitiation of consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is met, any operation causing such take must cease pending reinitiation.

If you have any questions concerning this Biological Opinion, please contact me at the letterhead address or by telephone at (808) 792-9400.

Sincerely,

Loyal Mehrhoff
Field Supervisor

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APPENDIX A

SUMMARY OF BEST MANAGEMENT PRACTICES

GUAM AND TINIAN

(DoN 2010b, vol. 7, pp 2-4 – 2-23)

Item	BMP	Description	Activities			Resources				
			Design	Construction	Operation	Geological & Soil	Water	Terrestrial Biological	Marine Biological	Hazardous Materials
1	Erosion Control	A range of BMPs would control erosion during construction and operations to eliminate and/or minimize nonpoint source pollution in surface waters due to sediment. Erosion control BMPs include, but are not limited to, the following practices and procedures. **Construction:** • Erosion control through site approval process (whereby the Navy reviews each proposed project for its erosion potential, and involves the designated installation Natural Resource Specialist in the process). • Topsoil removed from the site would be placed in the immediate area and reused for re-compaction purposes (if appropriate, in accordance with geotechnical recommendations). • Soil exposed near water as part of the project would be protected from erosion with erosion control blankets (organic or synthetic fibers held together with net to cover disturbed areas) after exposure, and stabilized as soon as practicable (with vegetation matting, hydroseeding, etc.). • Flatten landfill slopes for increased soil stability. • Silt-containment (silt fences and other physical barriers that intercept runoff from drainage areas). • Re-vegetate as soon as possible after any ground disturbance or grading. • Minimize construction and grading during times of inclement weather. • Soil piles and exposed slopes covered during times of inclement weather. • Stockpiling of excavated materials behind impermeable berms and away from the influence of river waters and runoff. • Implement a re-vegetation program to ensure graded benches are fully vegetated as landfills mature. • Vegetation/mulch stabilization (applying coarse plant residue to cover soil surface. The vegetation/mulch should be free of invasive species viable reproductive parts, such as rhizomes, seeds, and plants). • Level spreader (non-erosive outlet for runoff to disperse flow uniformly across slope). • Rock outlet protection (rock protection placed at end of culverts). • Sediment basin (barrier that retains sediment from runoff).		X	X	X	X	X	X	X

Item	*BMP*	*Description*	*Activities*			*Resources*				
			Design	*Construction*	*Operation*	*Geological & Soil*	*Water*	*Terrestrial Biological*	*Marine Biological*	*Hazardous Materials*
		Operation: • Restrict vehicles in training areas (ensure that all training areas, including transit routes necessary to reach training areas, are clearly identified or marked. Restrict vehicular activities to designated/previously identified areas).								
2	Stormwater Management under the Clean Water Act (CWA): Stormwater Management Plan (SWMP)	In compliance with the federal CWA under Section 401, the proposed actions would require a SWMP. A SWMP is a document that describes the minimal procedures and practices used to reduce the surface flow and subsequent discharge of pollutants to storm drainage systems. Elements of a SWMP include structural and non-structural practices such as: • Check dams (small temporary stone dam across drainage). • Diversion dike/swale (berm or ditch that channels water to desired location). • Lined waterway (lined outlet for drainage). • Stormdrain inlet protection (permeable barrier around inlets reducing sediment let into storm drain). • Stormwater ponds and wetlands. • Infiltration practices (capture/temporarily store water before infiltrating into the soil). • Use of groundwater recharge wells and infiltration basins, where applicable. • Filtering practices (capture/temporarily store water and pass through filter beds of sand, organic matter, soil, or other media).	X	X	X	X	X	X	X	X

Item	*BMP*	*Description*	*Activities*			*Resources*				
			Design	*Construction*	*Operation*	*Geological & Soil*	*Water*	*Terrestrial Biological*	*Marine Biological*	*Hazardous Materials*
3	Stormwater Management under the CWA: Stormwater Pollution Prevention Plan (SWPPP)	Stormwater Management Pollution Prevention Plan (SWPPP). A SWPPP is a self-implementing plan for compliance with an installation's stormwater permit. • Facilities would be required to comply with the SWPPP during construction and then during day-to-day operations to ensure that stormwater remains free of contaminants. • The SWPPP requires development of pollution prevention measures to reduce and control pollutants in stormwater discharge. • Where applicable, provisions of any Construction General Permit(s) would be fully implemented on non-DoD properties. • Where applicable, consistency with CNMI and/or Guam Stormwater Management Manuals. • A site-specific SWPPP tailors the plan to the facility and associated activities most likely to have a negative impact on stormwater. Applicable SWPPPs would manage stormwater and erosion at each training location.		X	X	X	X	X	X	X
4	Water Quality Monitoring Plan (WQMP)	Development of Water Quality Monitoring Plan (WQMP). WQMPs evaluate the effectiveness of environmental permits and/or performance standards. Monitoring plans identify ambient or control conditions at a particular site and capture deviations from those conditions resulting from a project or operations of a facility. WQMPs may range in complexity from visual inspections for sedimentation and protection measure failure to laboratory or field analysis of chemical and biological effects on water quality or organisms (acute/chronic bioassay), dependent on a given water resource.		X	X	X	X	X	X	X

Item	*BMP*	*Description*	*Activities*			*Resources*				
			Design	*Construction*	*Operation*	*Geological & Soil*	*Water*	*Terrestrial Biological*	*Marine Biological*	*Hazardous Materials*
5	Leadership in Energy and Environmental Design (LEED) Certification	Current Navy/Marine Corps policy supports Leadership in Energy and Environmental Design (LEED). The policies support and facilitate Silver certification for bases. LEED is a voluntary point system tool that measures the degree of sustainability features incorporated into a development. Some LEED requirements include: • Reduction of electrical energy use in buildings by 10% to save power. • Construction materials: use of local sources. Navy guidance and qualification for LEED Silver points requires that 50% non-hazardous waste and demolition debris are recycled. • Increased water efficiency. • Renewable energy. The sustainability/LEED initiatives would help reduce potable water use and should have a positive effect on demand for wastewater treatment.	X	X	X	X	X	X	X	X
6	Low Impact Development (LID)	The Navy would implement Low Impact Development (LID) design technology to make use of innovative methods to capture stormwater. Recommendations of a Comprehensive Drainage and LID Implementation Study would also be implemented. Examples of LID design include: • Grassed channel (channel stabilized by vegetation to convey water down a slope). • Grassed vegetation maintained on berms. • Integrated pest management, including proper handling of construction waste (cans, tires, drums, etc.) to avoid stagnant water collection that could harbor mosquitoes and other vectors. • Native plant landscaping. • Avoidance of pesticides and fertilizers. • Bio-retention strips. • Watershed-based management. A watershed protection management approach could consider: • Participating in the development of a watershed management plan. • Implementing and adopting specific watershed protection strategies. • Designing land use planning techniques that reduce or shift impervious cover and enhance percolation. • Work towards achieving important water resource goals.	X	X	X	X	X	X	X	X

Item	BMP	Description	Activities			Resources				
			Design	Construction	Operation	Geological & Soil	Water	Terrestrial Biological	Marine Biological	Hazardous Materials
		On Tinian, LID would include the use of ecologically, leach field friendly chemicals for treatment of wastewater.								
7	Energy Policy Act of 2005 (EPACT)	Energy Policy Act (EPACT) compliance includes analysis and life-cycle cost analysis using a simulated model and the following energy conservation measures: • Buildings achieve an energy consumption level that is 30% below the level achieved by ASHRAE Standard 90.1. • Use low energy consuming products that are either Energy Star-qualified or Federal Energy Management Program-recommended. • Optimize building orientation to reduce cooling loads or energy loads to cool the buildings. • Optimize building insulation. • Seal building envelope for air tightness. • Incorporate "cool roof" building designs. • Use motion detectors to reduce lighting and to setback cooling in unoccupied buildings. • Natural lighting.	X	X	X	X	X	X		X

Item	*BMP*	*Description*	*Activities*			*Resources*				
			Design	*Construction*	*Operation*	*Geological & Soil*	*Water*	*Terrestrial Biological*	*Marine Biological*	*Hazardous Materials*
8	Water Conservation Plan	Water Conservation Plans include as the use of: • Low-flow faucets. • Ultra-low-consumption toilets/urinals with electric flush sensors. • Low-flow showerheads. • Lower flow commercial-type "Energy Star" washing machines in housing units. • Energy and water-saving dishwashers (Energy Star). • Water softeners only as needed. • wastewater recycling in industrial washing and rinsing of aircraft and vehicles. • Water-efficient cooling systems. • Minimal landscape irrigation and no irrigation at housing. • Rainwater collection and reuse. • Meters installed at all facilities and key locations within the water distribution system that can significantly improve the ability to quickly identify leaks and take corrective action. In addition, educate the military population regarding practices that would conserve water (including full-load clothes washing).	X	X	X		X			
9	Hazardous Materials Management Plans (HMMP)	HMMPs describe implementation procedures for the transportation, storage, use, and disposal of hazardous materials. HMMPs would also include waste minimization plans that provide protocols designed to encourage and promote the efficient use of hazardous materials, substitute products that are less toxic whenever feasible, minimization of their use, and promote recycling and reuse of hazardous materials. HMMPs would contain procedures such as: • Hazardous materials spill/release control (use of secondary containment and leak detection methods in operations involving liquid hazardous substances). • Construction materials and all construction-related materials should be free of leachable pollutants. • Train personnel (DoD personnel and contractors are trained in proper labeling, container, storage, staging, and transportation requirements for hazardous substances. Also, they are trained in accordance with spill prevention, control, and cleanup methods).		X	X	X	X		X	X

Item	BMP	Description	Activities			Resources				
			Design	Construction	Operation	Geological & Soil	Water	Terrestrial Biological	Marine Biological	Hazardous Materials
		• Perform all vehicle maintenance activities at existing DoD maintenance shops. • Ensure that all personnel and contractors store, handle, and dispose of all POL per all applicable local and federal laws, regulations, and requirements. • As necessary, expand Defense Reutilization Marketing Offices (DRMO) hazardous materials storage, transportation, and disposal capacity prior to any expected increases. Note that a Joint Military Master Plan provides specific details regarding several new facilities. These new facilities would be required to store, handle, and dispose of the estimated increases in hazardous substances that would occur from the potential DoD unit transfers to Guam. • Contaminated topsoil removed from the site should be properly disposed of in an approved landfill in accordance with applicable regulatory requirements • Ensure that sediments to be dredged and soils to be excavated are well characterized, properly handled, and disposed of to minimize dispersal of any contaminants that may be present. • Temporary equipment laydown or construction staging areas would be located in previously disturbed (e.g., paved) areas. • Minimize the use of contaminated sites for new construction. When new construction occurs on sites where contamination and/or munitions and explosives of concern have been identified, ensure that the risk of human/ecological risk and exposure is minimized via the use of site-specific health and safety plans, engineering and administrative controls, and PPE. These site-specific health and safety plans must specifically address how these controls would be implemented to ensure the protection of human health and the environment. In addition, as appropriate conduct Phase I and II Environmental Site Assessments prior to construction activities and ensure that designs consider and address contaminated sites as appropriate.								

Item	BMP	Description	Activities			Resources				
			Design	Construction	Operation	Geological & Soil	Water	Terrestrial Biological	Marine Biological	Hazardous Materials
10	Hazardous Waste Management Program (HWMP)	HWMPs include waste minimization plans that provide protocols designed to encourage and promote the efficient use of hazardous waste, substitute products that are less toxic whenever feasible, minimize their use, and promote recycling and reuse of hazardous waste. HWMPs include the following recommendations: • Update and implement the existing HWMP to include procedures for the transportation, storage, use, handling, and disposal of hazardous waste. Also, modify project-specific hazardous waste disposal protocol as appropriate. • Ensure personnel and contractor training regarding project- and facility-specific hazardous waste plans. • The use of spill/release control (use of secondary containment and leak detection methods in operations involving liquid hazardous substances). • Ensure all DoD personnel and contractors are trained in accordance with the Guam public law (PL) 29-26 regarding the importation, handling, use, and application of pesticides (e.g., during maintenance, pre and post construction, and general operations activities). • Ensure appropriate housekeeping protocol (improving overall hazardous waste housekeeping practices, keeping area swept, wiping up spills, etc.). • Perform all maintenance activities at existing DoD maintenance shops. • Ensure that DRMO has sufficient hazardous waste storage, transportation, and disposal capacity prior to any expected increases. Note that a Joint Military Master Plan provides specific details regarding several new facilities. These new facilities would be required to store, handle, and dispose of the estimated increases in hazardous substances that would occur from the potential DoD unit transfers to Guam. • Ensure all federal, local, and DoD laws and regulations are being observed via inspections/audits/surveillances and implement corrective actions as necessary. Also ensure that all personnel and contractors manage, store, handle, transport, and dispose of hazardous wastes in accordance with applicable local (Guam EPA or CNMI Department of Environmental Quality (DEQ), USEPA, RCRA, and HSWA requirements. • Ensure that contaminated topsoil removed from sites is properly disposed		X	X	X	X			X

Item	BMP	Description	Activities			Resources				
			Design	Construction	Operation	Geological & Soil	Water	Terrestrial Biological	Marine Biological	Hazardous Materials
		of in accordance with applicable regulatory requirements. • Ensure that sediments to be dredged and soils to be excavated are well characterized, properly handled, and disposed of to minimize dispersal of any contaminants that may be present. • Temporary equipment laydown or construction staging areas would be located in previously disturbed (e.g., paved) areas. • Minimize the use of contaminated sites for new construction. When new construction occurs on sites where contamination and/or MEC has been identified, ensure that the risk of human/ecological risk and exposure is minimized via the use of site-specific health and safety plans, engineering and administrative controls, and PPE in accordance with CFR 29 1910.120 (hazardous waste operations and emergency response operations). These site-specific health and safety plans must specifically address how these controls would be implemented to ensure the protection of human health and the environment. In addition, as appropriate conduct Phase I and II Environmental Site Assessments prior to construction activities and ensure that designs consider and address contaminated sites as appropriate.								

Item	BMP	Description	Activities			Resources				
			Design	Construction	Operation	Geological & Soil	Water	Terrestrial Biological	Marine Biological	Hazardous Materials
11	Spill Prevention, Control and Counter-measures Plans (SPCC) and Facility Response Plans (FRPs)	• Update and implement existing SPCC plan to assess and respond to hazardous substance spills and/or releases. • Update and implement existing FRPs for responding to releases, leaks, or spills of hazardous substances. • Ensure DoD personnel are trained as to proper labeling, container, storage, staging, and transportation requirements for hazardous substances. Also, ensure they are trained in accordance with spill prevention, control, and cleanup methods. • Ensure petroleum, oil and lubricants (POL)/fuel transfers kept away from water bodies and a response/contingency plan is in place in the event of any releases, leaks, or spills. • Ensure proper labeling of all hazardous substance containers to prevent inappropriate storage or use. • Contaminant migration control (e.g., reducing contaminant migration pathways by preventing releases to drains, pipelines, and sewers and the use of absorbent pads and materials to prevent and control spills and releases). • Ensure that contaminants (e.g., oils, greases, lubrication fluids for heavy equipment) are properly stored at work sites and temporary construction staging areas to avoid spills, releases, and leaks. • Ensure that emergency response plans are in place for responding to releases, leaks, or spills of hazardous substances. • Minimize the risk of uncontrolled leaks, spills, and releases through industry and Navy accepted methods for spill prevention, containment, control, and abatement. • Minimize the risk of human exposure to contaminated media through the use of a site-specific health and safety plan, engineering and administrative controls, and appropriate personal protective equipment (PPE) (e.g., indicating where eye-wash stations, fire extinguishers, etc., are located).		X	X	X	X	X	X	X

Item	BMP	Description	Activities			Resources				
			Design	Construction	Operation	Geological & Soil	Water	Terrestrial Biological	Marine Biological	Hazardous Materials
12	Integrated Pest Management Plan (IPMP)	• DoD would develop and implement a comprehensive IPMP. This IPMP would encompass all activities regarding the importation, handling, storage, use, and application of pesticides as well as address prevention of the introduction of potential invasive species to Guam. • DoD personnel and contractors would be trained in accordance with Guam public law (PL) 29-26 regarding the importation, handling, use, and application of pesticides (e.g., during maintenance, pre and post construction, and general operations activities).		X	X					X
13	Munitions and Explosives of Concern (MEC)	• Comply with all applicable MEC protocol, procedures, and guidance including, but not limited to the Naval Ordnance Safety and Security Activity (NOSSA) Instruction 8020.15B Explosives Safety Review, Oversight, and Verification of Munitions Responses prior to any construction/demolition or other site activities. • Reduce the potential exposure to unexploded ordnance (UXO) through surveys or other means to identify and remedy this hazard prior to building upon a site. Work would be conducted by qualified UXO specialists. • Implement routine firing range clearance operations (e.g., annually or as needed), perform sampling and analysis as deemed necessary, and implement all applicable DoD MEC operations guidance to minimize or eliminate potential MEC explosion hazards and other adverse impacts (including depositions with potential to leach into the subsurface). • Implement land use controls, signage, periodic inspections, and other means to ensure no unauthorized access to firing ranges, MEC, and/or hazardous substances. • Train construction crews on identifying and responding to MECs encountered in the field. UXO personnel would be available to monitor earthmoving activities.		X	X		X		X	X

Item	BMP	Description	Activities			Resources				
			Design	Construction	Operation	Geological & Soil	Water	Terrestrial Biological	Marine Biological	Hazardous Materials
14	Land Use Planning and Project Design	Land Use Planning and Project Design BMPs include: • Minimize impacts through design, and incorporating site plans that attempt maximum land use efficiency. Place future industrial use sites in the vicinity of similar DoD industrial uses. • Use the community development planning process to minimize impacts to land use. • Maintain a perimeter buffer within DoD property boundaries. • Reduce seismic, liquefaction and ground shaking by following Unified Facility Code 3-310-04 Seismic Design for Buildings (USACE 2007). • Construction planning would avoid locating new buildings over unstable karst features to prevent collapse and reduce unnecessary compaction. • Avoid locating new building construction in flood hazard areas, or if necessary, fortify or elevate them above base flood elevation where possible. • Minimize land acquisitions. • Install utilities in existing corridors to the extent possible. • Avoid the acquisition of public facilities, such as park land, to the extent practical (FHWA).	X	X		X	X	X		
15	Natural Resource Management (Terrestrial Focused)	Various measures are currently used to minimize impacts to the terrestrial environment from project-related activities such as: • No-Training Areas within a 328-ft (100-m) radius around Mariana swiftlet caves at Naval Munitions Site (NMS). • No-Training Areas around wetlands with known Mariana common moorhen nesting activity. • Implement Brown Tree Snake (BTS) Control and Interdiction or Management Plans (COMNAV Instruction 5090.10A, dated February 2005; Andersen AFB 36 WG Instruction 32-7004 dated March 2006). • Prevent the spread of invasive species by implementing a training SOP; troops would receive awareness training and would inspect all gear and clothing (e.g., boots, bags, weapons, pants) for soil accumulations, seeds, invertebrates, and possible inconspicuous stow away BTS. • Trap BTS at swiftlet caves. The Navy has been contracting with USDA Wildlife Services to trap BTS at the swiftlet caves and in housing areas.		X	X		X	X		X

Item	BMP	Description	Activities			Resources				
			Design	Construction	Operation	Geological & Soil	Water	Terrestrial Biological	Marine Biological	Hazardous Materials
16	Natural Resource Management (Marine Focused)	Minimize contamination of the marine environment from project-related activities through actions such as: • Contractors are required to have and to implement a contingency plan to control and contain toxic spills, including petroleum products. Appropriate materials to contain and clean potential spills would be maintained and readily available at the work site. • All construction project-related materials and equipment placed in the water would be free of pollutants. The project manager and heavy equipment operators would perform daily pre-work equipment inspections for cleanliness and leaks. All heavy equipment operations would be postponed or halted should a leak be detected, and would not proceed until the leak is repaired and equipment cleaned. This information is written into the construction contract conditions. • Fueling of construction project-related vehicles and equipment would take place at least 50 feet away from the water, preferably over an impervious surface. With respect to construction equipment (dredging barges) that cannot be fueled out of the water, spill prevention booms would be employed to contain any potential spills. Any fuel spilled would be cleaned up immediately. • A plan would be developed and implemented to prevent construction debris from entering or remaining in the marine environment during the project.		X	X		X		X	X

Item	BMP	Description	Activities			Resources				
			Design	Construction	Operation	Geological & Soil	Water	Terrestrial Biological	Marine Biological	Hazardous Materials
17	Public Outreach/ Education	Develop and implement a Public Outreach Program to: • Inform residents, businesses, and service providers about the project schedule and other relevant information. • Implement public awareness education seminars and workshops regarding the dangers of munitions and explosives of concern (MEC) the importance of staying off firing ranges, and what to do if MEC is suspected or observed. • Promote public meeting announcements by posting ads and placing public notices in multiple places and on the internet. • Provide public meeting written materials translated in Chamorro and Filipino, supply an interpreter at public meetings. Mail announcements of public meetings to areas that may be disproportionately impacted by proposed actions (i.e., residents of Dededo, Yigo, Barrigada, Mangilao, Piti, Santa Rita, Agat, and Talofofo). • Mail announcements of public meetings to more rural areas in the south (i.e., Agat and Talofofo). • Hold public meetings in areas accessible to public transportation and in the southern region in locations accessible to as many people in that region as possible noting that public transportation may not be available in all rural areas.		X		X		X	X	X
18	Army Corps of Engineers (USACE)	USACE permit conditions and BMPs from recent Apra Harbor projects (that minimize degradation of water quality and impacts to fish and wildlife resources) provide the following recommendations (the project–specific permit may have additional conditions and protective measures): • All project-related materials and equipment (dredges, barges, etc.) placed in the water should be clear of pollutants prior to use; i.e., no project-related materials (fill, revetment rock, etc.) should be stockpiled in the water (intertidal zones, reef flats, etc.). • All debris removed from the marine/aquatic environment should be disposed at an approved upland or ocean-dumping site. • No contamination (trash or debris disposal, alien species introductions, etc.) of adjacent marine/aquatic environments (reef flats, channels, open ocean areas, stream channels, etc.) should result from project-related		X	X	X	X	X	X	

Item	BMP	Description	Activities			Resources				
			Design	Construction	Operation	Geological & Soil	Water	Terrestrial Biological	Marine Biological	Hazardous Materials
		activities. • Fueling of project-related vehicles and equipment should take place away from the water. • A contingency plan to control petroleum products accidentally spilled during the project should be developed. • Absorbent pads and containment booms should be stored on-site to facilitate the clean-up of accidental petroleum releases. • Any under-layer fills used should be protected from erosion with stones (or concrete cover layer units) as soon after placement as practicable. • Dredged material dewatering areas should be constructed and operated in accordance with all permit requirements. (Where applicable, a dewatering plan would be submitted to the GEPA prior to placing dredged material in upland placement sites.) • Whenever possible, dredged material would be reused. Where applicable, prior to disposal of dredge materials, a sampling and analysis plan would be submitted to the GEPA. • Provide advanced public notice of dredging activities to minimize conflicts with commercial shipping, recreational boating and other recreational activities. • Additional ship traffic should be addressed through scheduling and communications between Port Operations and contractors. In addition, USACE 404 and 401 permits require compliance with conditions and measures to protect water quality such as: • The installation of silt curtains in nearshore, shallow water areas to control turbidity. • Dredging operations may be suspended during inclement weather to prevent accidental release of dredged material and to ensure the integrity of silt curtains or other containment barriers, if utilized. • Water quality monitoring. • Adjustments resulting from water quality monitoring such as slowing or stopping operations.								
19	Transportation Federal Highway	Roadway project construction BMPs include the following recommendations: • Individual roadway projects should be designed and constructed in		X		X	X	X		X

Item	BMP	Description	Activities			Resources				
			Design	Construction	Operation	Geological & Soil	Water	Terrestrial Biological	Marine Biological	Hazardous Materials
	Administration-(FHWA) specific	accordance with the Safe, Accountable, Flexible, and Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) objectives. • Final roadway designs should avoid contaminated sites where possible. • Temporary equipment laydown or construction staging areas should be located in previously disturbed (e.g., paved) areas. • Material from demolition of existing road pavements should be stored in previously disturbed areas whenever possible. • Final roadway designs should include coordination with the responsible party to ensure that roadway construction does not interfere with ongoing remediation activities. • A Phase II environmental site assessment should be conducted for roadway projects with Right-of Way (ROW) acquisitions of non-residential property. • Individual roadway projects should be designed and constructed in accordance with recommendations of the project- and site-specific geotechnical investigation, and applicable geotechnical code requirements. • In accordance with Section 10106 (*General Requirements: Erosion and Sediment Control Plans*) of the GSESCR, an Erosion and Sediment Control Plan for roadway construction/work should be prepared, submitted to the GEPA for review and approval, and implemented in construction plans and practices to the maximum extent practicable. • Prevent leaks or spills of contaminants by ensuring all temporary equipment laydown or construction staging areas are constructed with secondary containment for storage of any hazardous or petroleum products (FHWA). • Locate temporary equipment laydown or construction staging areas in previously disturbed (e.g., paved) areas (FHWA).								

Item	BMP	Description	Activities			Resources				
			Design	Construction	Operation	Geological & Soil	Water	Terrestrial Biological	Marine Biological	Hazardous Materials
20	Noise Abatement	BMPs to abate noise from roadway construction include the following: • Ensure that all equipment items have the manufacturers' recommended noise abatement measures, such as mufflers, engine enclosures, and engine vibration isolators, intact and operational. • Inspect all construction equipment at periodic intervals to ensure proper maintenance and presence of noise control devices (e.g., mufflers and shrouding). • Turn off idling equipment. • Implement a construction noise monitoring program to limit the impacts. • Plan noisier operations during times least sensitive to receptors. • Avoid scheduling construction during nighttime hours (10:00 p.m. to 7:00 a.m.) and on weekends. • Keep noise levels relatively uniform and avoid impulsive noises. • Maintain good public relations with the community to minimize objections to the unavoidable construction impacts. • Provide frequent activity updates of all construction activities.		X	X			X		
21	Utilities	For roadway projects, planning and continued coordination with utility providers during the preliminary engineering and final design, and construction stages of the project should minimize or eliminate interruption in utility service to customers. • Where feasible, utility relocations should be undertaken prior to roadway construction activities.		X						
22	Cultural Resources	• Archaeological monitoring of medium probability areas during construction in consultation with the State Historic Preservation Officer. • For post review discoveries, an assessment would be made for National Register of Historic Places eligibility in consultation with the State Historic Preservation Office. • For areas or properties that have not been inventoried for historic properties, the DoD would follow Standard Operating Procedures as outlined in the Integrated Cultural Resources Management Plan and Section 106 consultation.		X	X	X				
23	Range Training Area Management	Update the existing training area management plans to include the new ranges. There are many management practices addressed in the plan including the following:			X	X	X	X	X	X

Item	BMP	Description	Activities			Resources				
			Design	Construction	Operation	Geological & Soil	Water	Terrestrial Biological	Marine Biological	Hazardous Materials
	Plan	• Remove expended rounds from the ranges periodically and transporting them to an appropriate recycling contractor or smelter in accordance with appropriate regulations. • Develop and implement a Range Safety Program to conduct or coordinate training area safety, emergency response (medical and fire), Explosive Ordnance Disposal, Training Mishap Investigations, safety training, and range inspections. • Develop and implement a Fire Management Plan. • Implement all applicable DoD Range Management procedures and protocol. • Adhere to protective measures established in natural and cultural resource management plans. • Controls for training area airspace in accordance with Federal Aviation Administration regulations and agreements, with an objective of use by multiple agencies with minimal interference and maximum safety. • Manage of movement and access into and within the training area by monitoring and controlling use of surface roads, shorelines and adjacent water areas, and airspace above the Range Training Area. • Publication of advanced notice for periods of range use to airman, mariners, and the general public as required for safe training area operations. • Comply with water protection measures and Military Handbook 1027/3B to minimize the potential for groundwater leachate to affect the production wells, proposed range maintenance activities and training operations would be in compliance with • Implement Military Handbook 1027/3B contains procedures for reducing potential impacts from ranges. These include adding soil amendments to maintain the soil pH between 6 and 8, maintaining vegetation on berms and drainage ways and turf on the range, contaminant monitoring, and reclamation and recycling of spent ammunition. • Implement a monitoring program to identify any early indications of lead movement so that action could be taken to address any potential water quality impacts.								

Item	BMP	Description	Activities			Resources				
			Design	Construction	Operation	Geological & Soil	Water	Terrestrial Biological	Marine Biological	Hazardous Materials
24	Environmental Protection Plan (EPP)	An Environmental Protection Plan (EPP) is required for projects at the discretion of the GEPA Administrator. EPPs are specifically identified in 22 Guam Annotated Regulations, Division II, Chapter 10, Section 10103.C.5 (d). EPPs would include nonpoint source control management measures including erosion and sedimentation control, vegetation, wildlife resource protection measures, fugitive dust control, solid and hazardous waste management and disposal procedures, nutrient management plan, integrated pest management strategy/plan, confined animal facilities management plan, irrigation water management plan, personnel safety procedures, work site maintenance, and typhoon contingency plans, as necessary, depending on the work, project, activity and facility function.		X	X	X	X	X	X	X
25	Seismic Design for Buildings (SD4B)	During project design and construction, hazards associated with earthquakes and fault rupture would be minimized by adherence to UFC 3-310-04 Seismic Design for Buildings (USACE 2007).	X	X		X				
26	Armed Forces Ballast Water Management Program	Ships must strictly comply with fuel transfer and ballasting procedures to ensure ballast water does not become contaminated with oil or any other waste. Ships using self-compensating fuel tanks are required to ensure adequate margin is preserved to prevent inadvertent discharges of oil with the compensating water. Navy ships must prevent the introduction of non-native organisms into natural ecosystems. Ship Ballast Water and Anchor System Sediment Control provide measures to prevent introductions of aquatic species.			X				X	
27	Awareness Training	Increase awareness training regarding the consequences of drug and alcohol use.		X	X					
28	Domestic Animal Control (MCO 11000.22)	Limits the number and type of household pets allowed per military family and requires microchip identification of pets.		X	X			X		

Item	BMP	Description	Activities			Resources				
			Design	Construction	Operation	Geological & Soil	Water	Terrestrial Biological	Marine Biological	Hazardous Materials
29	US Army Corps of Engineers (USACE)	Compliance with USACE 404 and 401 permit conditions such as: • The installation of silt curtains in nearshore shallow water areas to control turbidity. • Dredging operations may be suspended during inclement weather to prevent accidental release of dredged material and to ensure the integrity of silt curtains or other containment barriers, if utilized. • Water quality monitoring. • Adjustments resulting from water quality monitoring such as slowing or stopping operations.		X			X		X	

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F1G USFWS, BO for the DON's Relocation of the U.S. Marine Corps from Okinawa to Guam and Associated Activities on Guam (July 2015)

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United States Department of the Interior

FISH AND WILDLIFE SERVICE
Pacific Islands Fish and Wildlife Office
300 Ala Moana Boulevard, Room 3-122,
Honolulu, Hawaii 96850

In Reply Refer To:
01EPIF00-2015-F-0025

JUL 3 1 2015

Captain Joseph A. Campbell
Deputy Director, Joint Guam Program Office
Office of the Assistant Secretary of the Navy (EI&E)
Joint Guam Program Office, ASN (EI&E)
201 12th Street South, Suite 700
Arlington, Virginia 22202

Subject: Biological Opinion for the Department of Navy's Relocation of the U.S. Marine Corps from Okinawa to Guam and Associated Activities on Guam

Dear Captain Campbell:

This document transmits the U.S. Fish and Wildlife Service's (Service) Biological Opinion (Opinion) addressing the effects of the subject action as proposed by the Department of the Navy (DON) to the threatened Mariana fruit bat (*Pteropus mariannus mariannus*), and the endangered Mariana crow (*Corvus kubaryi*), Guam Micronesian kingfisher (*Todiramphus cinnamominus cinnamominus*), Guam rail (*Gallirallus owstoni*), and *Serianthes nelsonii*. The Opinion also addresses adverse effects to critical habitat for the Mariana fruit bat, Mariana crow, and Guam Micronesian kingfisher. The Opinion was prepared in accordance with the requirements of section 7 of the Endangered Species Act (ESA) of 1973 as amended (16 U.S.C. 1531 *et seq.*). The DON is the designated lead Federal agency for this consultation. This Opinion completely supercedes and replaces the 2010 DON Biological Opinion (2010-F-0122).

In addition, pursuant to the requirements identified in the Cooperative Agreement between the U.S. Air Force, DON, and the Service for the establishment and management of the Guam National Wildlife Refuge, we have provided coordination regarding potential impacts to the Guam National Wildlife Refuge Overlay from the proposed project. This consultation reviews anticipated effects to the listed species and their terrestrial habitats, including listed species habitat, on Guam. In this consultation, habitat is defined as the habitat that is currently suitable to support the survival and recovery of listed species.

Your October 1, 2014 letter, requested our concurrence with your determination that the subject action is not likely to adversely affect the endangered Mariana swiftlet (*Aerodramus bartschi*),

threatened green sea turtle (*Chelonia mydas*), and endangered hawksbill sea turtle (*Eretmochelys imbricata*) pursuant to section 7 of the ESA. Our assessments of project effects to these species are addressed in Appendix A.

This Opinion is based on information provided in your October 1, 2014, letter and biological assessment; updates to the biological assessment; email correspondence and discussions between the Service and DON; and our files. A complete project file for this consultation is in the Pacific Islands Fish and Wildlife Office (PIFWO) in Honolulu.

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A. CONSULTATION HISTORY

September 8, 2010. The Service issued the Biological Opinion (BO) for the Joint Guam Program Office (JGPO) Relocation of the U.S. Marine Corps (USMC) from Okinawa to Guam and Associated Activities on Guam and Tinian (2010-F-01222; hereafter, 2010 DON BO) to the DON.

March 13, 2012. The DON informed the Service that they were proposing changes to the project as described in the 2010 DON BO. The DON discussed that the proposed live-fire training range complex (LFTRC) may be located along Route 15 or within the Naval Munitions Site (NMS) on Guam. The DON explained that they were in the process of preparing a draft supplemental environmental impact statement (Draft SEIS) that would include potential locations for the LFTRC on Guam.

September 17, 2012. The DON submitted their annual report on the implementation of conservation measures for the 2010 DON BO. The DON explained to the Service the implications of the 2012 National Defense Authorization Act (2012 NDAA) on the 2010 DON BO. The DON stated there would be a reduced force and number of dependents moving to Guam; and that the 2012 NDAA did not affect the existing awards for military construction but affected all future military construction projects, including some of the conservation measures in the 2010 DON BO. The DON provided a draft letter requesting an amendment to the 2010 DON BO.

September 20, 2012. The DON provided the Service with a draft conservation measure tracking sheet which showed the project activities (as described in the 2010 DON BO) that were affected by the 2012 NDAA.

October 11, 2012. The DON modified its Draft SEIS to accommodate changes to the proposed force structure and number of dependents being relocated to Guam, and the proposed alternatives for the LFTRC changed from information provided in March 2012 to include the LFTRC at Northwest Field (NWF) located on Andersen Air Force Base (AAFB).

October 12, 2012. The Service and DON discussed the proposed changes to the project and whether the changes constituted an amendment or a reinitiation of the 2010 DON BO. The Service stated that the 2010 DON BO would need to be reintiated due to substantive changes in the scope of the action.

January 30, 2013. The DON, the Service's Pacific Regional Office (RO), and the Regional Solicitor's Office via a conference call discussed the subjects of extirpated species consultation and the need to reinitiate versus amend the 2010 DON BO for the DON's " interim actions" that would occur between 2013 and 2015.

April 3, 2013. The Service received DON's request to reinitiate the 2010 DON BO and received the *Biological Assessment for the Reinitiation of Consultation for the Proposed Military Relocation to Guam; Fiscal Years 2010–2015*. The DON determined that the only federally listed species affected by the DON activities between fiscal years 2010 and 2015 was

the Mariana fruit bat. The DON determined that the project "may affect, but is not likely to adversely affect" the Mariana fruit bat.

April 9, 2013. The DON and the Service met to discuss DON's request to reinitiate the 2010 DON BO. The DON delivered a presentation on the proposed adjustments to the project, which included the relocation of approximately 5,000 USMC personnel and 1,300 dependents and the LFTRC alternative located at NWF, AAFB on Guam. The DON requested the reinitiated consultation only address the project activities that would be conducted between 2010-2015. The discussion focused on how to best address the "interim actions" that would occur between 2013 and 2015; the inclusion of the extirpated species, the Guam Micronesian kingfisher, Guam rail, and the Mariana crow, in the consultation; the status and implementation of conservation measures; and brown treesnake interdiction measures.

May 3, 2013. The Service acknowledged the receipt of the DON's request to reinitiate the 2010 DON BO. The Service determined that there was insufficient information to initiate consultation. The Service questioned the need to determine if reinitiation of consultation or an amendment would be the best mechanism to address DON's changes in the proposed action. The Service requested a table with a list of project activities and their associated or linked conservation measures that would mitigate impacts to the listed species. The Service also requested that the brown treesnake control and interdiction measures in the 2010 DON BO remain in the consultation.

May 7, 2013. The Service provided a draft table that tracked the conservations measures that should have or have been implemented as required by the 2010 DON BO.

May 30, 2013. The DON responded to the Service's letter of May 3, 2013, and provided the requested table (hereinafter "crosswalk table"). The crosswalk table listed project activities and linked conservation measures that avoid, minimize, and compensate for the impacts associated with the interim actions. DON also provided a color coding of all the conservation measures included in the 2010 DON BO to delineate which conservation measures have been implemented and those measures which have not been triggered or will not be implemented based on the proposed adjustments to the action.

June 13, 2013. The DON requested a meeting to discuss the crosswalk table and for the Service to provide the rationale to support including the Guam Micronesian kingfisher, Mariana crow, and Guam rail in the consultation.

July 8, 2013. The Service and DON met to discuss the following: 1) The Service discussed staffing workload and recommended a programmatic approach to the Marianas related DoD consultations being submitted to the Service office in the next 18 months; 2) The Service requested that the Guam Micronesian kingfisher, Mariana crow and Guam rail be included in the consultation. The DON requested the legal rationale requiring section 7 consultation on extirpated species. The Service stated they had a draft white paper in development that would address DON's request; 3) Standardized language for brown treesnake interdiction and rapid response efforts; 4) The Service acknowledged that they requested a reinitiation of the 2010 DON BO, which resulted in DON's April submittal of a reinitiation request; however the Service

thought an amendment may be more appropriate considering the interim actions are within the scope of the consultation; and 5) Both parties agreed further clarification and discussion on the crosswalk table were needed.

August 19, 2013. The Service provided rationale to the DON regarding the requirement under the ESA to consult on project impacts to the Guam Micronesian kingfisher, Mariana crow, and Guam rail.

August 22-23, 2013. The Service submitted comments on the crosswalk table to DON. Email correspondence was exchanged between the Service and DON on the crosswalk table.

August 28, 2013. The DON provided their reasons why they disagreed with the Service's August 19, 2013, rationale.

September 10, 2013. The DON requested a species list for this consultation, the DON Relocation of the USMC from Okinawa to Guam and Associated Activities on Guam (proposed project). The DON also provided the Service with the preliminary drafts of chapters 1 and 2 of the Draft SEIS.

September 11, 2013. During a conference call between DON and the Service, the participants agreed that the extirpated species issue required elevation to the Service's RO and Regional Office of the Solicitor.

September 30, 2013. The Service provided the DON with a species list of federally listed species and information on critical habitat for the proposed project.

October 1, 2013. The Service notified the DON that the Service completed their review of the August 28, 2013, correspondence from the DON. The Service determined that both agencies were at an impasse regarding the issue on consulting on project affects to the Guam Micronesian kingfisher, Mariana crow, and Guam rail. The Service informed the DON that this issue would be elevated to the Service's RO.

December 3, 2013. The DON and the Service discussed the development of the biological assessment for the proposed project and the initial approach on the conservation measures.

December 2013. The DON's Assistant General Counsel for Energy, Installations, and Environment reconfirmed the Service's RO position in discussions with the Department of the Interior's Deputy Solicitor for Fish, Wildlife, and Parks. The date of "December 2013" and meeting description are referenced in a January 30, 2014, letter from the DON to the Service.

January 30, 2014. The DON requested to terminate their request for reinitiation of the 2010 JPGO BO for their interim actions as described in their April 3, 2013, biological assessment.

February 24, 2014. The Service replied that they would consider the January 30, 2014, request from the DON; however before a decision could be made, the Service requested assurances that

key conservation measures outlined in the Service's letter would be implemented per the requirements of the 2010 DON BO.

March 21, 2014. The DON acknowledged receipt of the Service's February 24, 2014, response and requested a meeting to discuss issues outlined per the January 20, 2014, and February 24, 2014, correspondences.

April 15, 2014. The Service and DON met and discussed the following: The DON will reinitiate the 2010 DON consultation by submitting one consolidated biological assessment for the entire relocation to include 2010-2015 interim actions identified in the DON's request to consult, dated April 3, 2013, and the changes to the project (the reduction in USMC relocating to Guam and the proposed LFTRC and NWF). The DON will assess impacts and proposed conservation measures for all project activities and actions associated with the project.

May 6, 2014. A teleconference occurred between DON and the Service as a follow up to the April 15, 2014, meeting. Items discussed included the Service's review of completed and ongoing mitigation to assess interim legal compliance and the Service's and DON's points of contacts for the consultation.

May 15, 2014. The Service and DON discussed the twenty-three species located on Guam and the U.S. Commonwealth of the Northern Mariana Islands (CNMI) that were under consideration for listing as either threatened or endangered under the ESA. The Service also mentioned they are considering designating critical habitat for these species (if listed) and revising critical habitat for currently listed species on Guam and the CNMI.

May 23, 2014. The Service and DON met to discuss the development of the biological assessment, including preliminary thoughts on mitigation for habitat loss.

June 26, 2014. The DON discussed including mitigation in the consultation for the demolition and related function of the ungulate management fence at NWF, AAFB. The ungulate management fence is a conservation measure and requirement of the Intelligence, Surveillance, Reconnaissance, and Strike Capability (ISR) Biological Opinion that was issued to the Air Force.

July 22, 2014. The Service and DON discussed the status of this consultation and related briefings to regional and headquarters Service and DON counterparts; the status of the predictive modeling for the U.S. Department of Agriculture, Wildlife Service's (USDA) brown treesnake interdiction costs; and future coordination between the Service and DON on the proposed project's biological assessment.

September 16, 2014. The DON provided a presentation of the general contents of the biological assessment that would be submitted to the Service on October 1, 2014. During the meeting, the DON explained the main differences between the project as described in the 2010 Final EIS and the Draft SEIS. Other topics that were discussed were the species that would be included in the consultation and potential project impacts to their habitat, project construction chronology, training activities at the NMS, conservation measures, and proposed project activities on critical

habitat on Guam.

September 24 and 26, and October 15, 2014. The Service and DON discussed and corresponded via email regarding available sea turtle literature and information.

October 1, 2014. The DON transmitted a letter, dated September 30, 2014, requesting formal consultation on the potential adverse effects of the proposed DON military relocation to Guam to the Guam Micronesian kingfisher, Mariana fruit bat, Mariana crow, and Guam rail. The DON also requested informal consultation on the Mariana gray swiftlet, green sea turtle, hawksbill sea turtle, and the *Serianthes nelsonii*. The DON's letter included an enclosed biological assessment for the proposed action: the *Biological Assessment for the Re-Initiation of Consultation regarding the Proposed Military Relocation to Guam*, dated October 1, 2014 (hereafter, referred to as the BA).

October 2, 2014. The DON requested a map of the proposed listed species locations on Guam from the Service.

October 22, 2014. In response to the DON's request, the Service provided a map of the proposed threatened and endangered species' locations on Guam.

October 31, 2014. The Service acknowledged the receipt of the September 30, 2014, DON letter and BA for the proposed DON military relocation to Guam. The Service determined that the information in the 2014 DON BA was insufficient to reinitiate consultation and requested additional information from the DON on the proposed action necessary to initiate and complete this consultation. The Service outlined the requested information in a letter.

November 11, 2014. The DON transmitted a letter, dated November 7, 2014, and enclosure in response to the Service's October 31, 2014, request for additional information needed to reinitiate the formal consultation.

December 4, 15, and 19, 2014. The Service and DON corresponded via emails to further clarify the project description, and met to discuss mitigation for the loss of habitat on Guam as a result of the proposed project. During the December 19 meeting, the Service provided the DON with the *Framework for Mitigating the Impacts of Listed Species Habitat Loss on Guam*, dated December 19, 2014 (hereafter, referred to as the Mitigation Framework), and delivered a presentation on the Mitigation Framework.

December 19, 2014. The Service provided the DON with the updated Geographic Information System (GIS) layers for the recovery habitat for the Guam Micronesian kingfisher and Mariana crow.

December 19, 2014. The Service acknowledged receipt of the November 7, 2014, DON letter and enclosure and the December 19, 2014, DON email and table with the additional information necessary to initiate consultation. In these correspondences, the DON stated that the information on the peak noise levels for the proposed LFTRC would be provided to the Service on January 8, 2015. The Service also recognized the ongoing dialogue between the agencies on the project

impacts to the *Serianthes nelsonii* at NWF; however the Service did not concur with DON's determination that the proposed action "may affect, but is not likely to adversely affect" the *S. nelsonii*. The Service recommended that the DON request formal consultation on the project effects to *S. nelsonii*. The Service agreed to initiate the consultation on January 8, 2015 in good faith that above issues would be resolved by this date.

January 8, 2015. The Service and DON, met at the Marine Corps Base Hawaii on Oahu. The DON and USMC presented information on noise levels associated with the machine gun range they proposed to build and operate at the LFTRC at NWF, AAFB on Guam. The Service agreed that the requested information on noise levels was received during this meeting. The DON agreed to change their determination from a "not likely to adversely affect" to "may affect, likely to adversely affect" for project impacts to *S. nelsonii*. The DON and Service also agreed to communicate more effectively regarding issues related to the project consultation.

January 16, 2015. The Service and DON met to discuss the status of the consultation and additional clarifications to the project description and conservation measures. The DON provided information on changes to the project description, including updated acreage of recovery habitat that would be impacted by the project and the timing of range construction activities based on the data provided by the Service on December 19, 2014. The Service and DON also discussed the impacts to the critical habitat on Guam. The Service stated that based on the review of the information on the noise levels, they did not concur with DON's determination that the proposed action would "not likely to adversely affect" critical habitat for the Guam Micronesian kingfisher, Mariana crow, and Mariana fruit bat.

January 28, 2015. The Service requested written information on the changes to the project description, as discussed on January 16, 2015, from the DON. On January 31, 2015, the DON provided information on the project description changes via email and further clarified this information in a meeting on February 6, 2015.

January 28 to February 11, 2015. Emails were exchanged among U.S. Geological Survey (USGS), Fort Collins; the Service; and the DON on the noise levels and potential impacts to the close population facility located at NWF, AAFB. On January 30, 2015, a meeting was held to discuss noise levels and provide information on the future access and coordination that would be needed to access the facility. As a follow up to the January 30, meeting, the DON provided a response via email to questions about access and operations to the closed population facility on February 3.

February 3, 2015. The Service and DON conducted a site visit to the proposed Finegayan mitigation site on Guam.

February 3, 2015. The Service, via an email, stated that DON's proposed clearing of critical habitat for the relocation of the Guam National Wildlife Refuge (GNWR) headquarters was not acceptable. The Service stated that they were willing to identify alternative(s) proposed relocation sites. In addition, the Service confirmed completing the final Biological Opinion to the DON by May 18, 2015.

February 6, 2015. The Service and DON discussed: the logistics of the inspections of the surface danger zone (SDZ) in beach areas within the GNWR prior to the operation of the LFTRC; an update (and increase) in the number of acres of habitat that would be lost per listed species; conservation measures for *S. nelsonii*; USMC training at the NMS; and the Mitigation Framework.

February 12, 2015. The DON provided a response to the Service's request for additional mitigation to compensate for the loss of recovery habitat, as presented in the December 19, 2014, meeting and the Mitigation Framework. The DON provided a process for habitat conservation in one comprehensive document (INRMP) that is a planning and execution tool for the Navy, Air Force, Marine Corps and Army and is approved by the Joint Region Marianas Commanding Officer. Identifying mitigation ratios in the INRMP provides an incentive early in the planning process to avoid impacting mitigation sites and the associated increased cost to the program. DON included chapters 5 and 6 of the Marine Corps Air Station (MCAS) Miramar Integrated Natural Resource Management Plan (INRMP) to use as an example of how the DON proposes to address project and mitigation planning for this consultation and future DON consultations on Guam.. The DON stated that the Joint Region Marianas (JRM) will incorporate conservation measures of the BO into the INRMP.
February 13, 2015. The Service received updated information on the total number of acres of habitat for the Guam Micronesian kingfisher, Mariana crow, Mariana fruit bat, Guam rail, and *S. nelsonii* that would be lost as a result of the proposed project from the DON.

February 13, 2015. The Service sent an email to the DON that included recommended conservation measures for *S. nelsonii*. On February 18 and 19 and on March 4, 6, and 10, the DON and Service discussed by phone and corresponded via email about the conservation measures for *S. nelsonii*.

February 18, 2015. The Service requested clarification on the brown treesnake interdiction and control measures. The Service and DON discussed and corresponded about these measures on February 20, March 18 and 19, 2015.

February 20, 2015. The Service provided a preliminary draft of the Consultation History and Project Description sections of the BO for DON's review.

February 24, 2015. The Service and DON reconfirmed the due date of May 18, 2015, for the final DON BO. It was discussed that the due date of the Draft BO for the Navy's review would be April 27, 2015. The Service and DON also discussed the importance of a conservation measure which included maintaining a minimum of 30 outplanted individuals of *S. nelsonii*, parented from the Guam (*S. nelsonii*) adult tree, to adulthood. The DON stated that the Joint Region Marianas (JRM) has the responsibility to manage the conservation measures in the BO through JRM's INRMP.

February 28, 2015. The DON sent updated maps depicting the peak noise levels as a result of the operation of the LFTRC to the Service.

March 1, 2015. The Service provided a draft description of the project activities (based on the

BA) that are carried over from the 2010 DON BO into the proposed project for the DON's review.

March 3, 2015. The DON provided initial comments on the February 20, 2015, preliminary draft of the Consultation History and Project Description sections of this BO.

March 2-4, 2015. The Service and DON exchanged emails regarding the duration of the proposed project. The DON described the duration of the proposed project as indefinite.

March 5, 2015. The Service and DON met to discuss the Guam Micronesian kingfisher recovery needs on Guam and the Service's analysis of the amount of available habitat for the kingfisher on Guam. The DON also went through the calculations on the peak noise levels at the LFTRC and the SDZ. The DON stated that the peak noise levels presented in a model during the January 8, 2015, meeting no longer presented a valid estimate on peak noise levels and would provide the Service with new information using the noise calculations presented during the January 8, 2015, meeting on the peak noise levels within the LFTRC and SDZ. The Service also stated that a noise monitoring study should be developed and implemented during the operations of the LFTRC to validate the noise calculations on the peak noise levels. The DON presented a mitigation concept that included protecting large amounts of habitat for the recovery of the Guam Micronesian kingfisher on DoD land, and it was discussed that the DON and the Service should work together to develop language to present as a conservation measure for the proposed project.

March 5, 2015. The Service provided a map of the recovery habitat that is needed to support the recovery of threatened and endangered species in northern Guam. The purpose of this map was to provide guidance and information to DON regarding recovery habitat (within DoD lands) that should be protected and set aside in conservation status, as mitigation, for the proposed project. On the same date, the DON submitted an ambient noise study for the LFTRC (DON 2015a).

March 7, 2015. The DON provided comments on the preliminary draft sections of the Consultation History and Project Description, including the 2010 DON carry-over activities, to the Service. The DON also provided additional information on the peak noise levels at the LFTRC. The Service requested DON provide the rationale of why the new information on peak noise levels should replace the previously submitted (on January 8, 2015) peak noise levels.

March 9, 2015. The Service and DON discussed the intent of the brown treesnake interdiction and control measures and *S. nelsonii* conservation measures, and other clarification to the draft project description including the introductory paragraph to the conservation measures. On the same date, the Service requested via email that DON provide the rationale of why the new information on peak noise levels should replace the previously submitted (on January 8, 2015) peak noise levels.

March 10, 2015. The DON submitted a request for initiation of a Conference Opinion on proposed federally listed species. The DON determined that the proposed project *would not likely adversely affect* proposed federally listed species. On March 24, 2015, the Service

informed the DON via a conference call that the Service did not concur with their determination on the project effects to proposed federally listed species within the action area.

March 12, 2015. The DON provided additional information on the description of the LFTRC and number of construction workers that would contribute to the population increase over the life of the project.

March 13, 2015. The DON provided a statement via email that the January 8, 2015, model on peak noise levels should be replaced with the new information submitted on March 5 and 7, 2015, to the Service. The DON explained that the most current information on the peak noise levels at the LFTRC is coupled with the attenuation as appropriate for the directional aspects of position relative to the muzzle of the weapon, effects of humidity, vegetation, and a berm and an excerpt of the ambient noise study for the LFTRC (DON 2015a).

March 17 and 18, 2015. The Service requested information on the additional barriers that reduced the noise levels and effects on the listed species, as proposed by the DON on March 5 and 7. On March 19, 2015, the DON informed the Service that the additional barriers were intended to be Conservation Recommendations and would not be included in the Project Description. This change modified the DON's previous noise assessment provided on March 5, 2015.

March 17, 2015. The Service delivered a presentation to DON on the assessment of habitat in northern Guam for the recovery and survival of the Guam Micronesian kingfisher.

March 23, 2015. The Service and DON discussed conservation measures that would mitigate adverse effects to listed species as result of the proposed project. During this meeting, the DON stated the issue of concern was the Service's request that the DON should permanently set aside land for the recovery of the extirpated (listed) species (kingfisher, crow, rail) as mitigation for the proposed project. Given the broad implication of such an endeavor, the DON did not want to include their support of conserving land for future recovery of extirpated (listed) species on Guam as part of the proposed project. Both the DON and Service discussed establishing inter-agency conservation teams to work on commitments for land conservation. The DON requested that the Service include DON-drafted Conservation Recommendations, which would be submitted on March 25, 2015 to the Service, in the Biological Opinion.

March 24, 2015. The DON and Service discussed ongoing recovery efforts and requirements for the Guam Micronesian kingfisher.

March 25, 2015. The DON submitted proposed Conservation Recommendations to the Service.

March 27, 2015. The DON submitted via email revised conservation measures on project lighting requirements for the Mariana fruit bat and nesting sea turtles to the Service.

March 30, 2015. The DON via email clarified that the beach access road located outside the SDZ and northwest of the previously proposed new Service facilities would not be a stand-alone action and should be considered part of the proposed project. The DON stated that the

development of the beach access road would result in the clearing of 1.72 acre (ac) of designated critical habitat for listed species on Guam. On April 1, 2015, the Service reiterated to the DON that the clearing of critical habitat on the fee simple land at the GNWR was unacceptable as stated in the Service's February 3, 2015, email to the DON. The Service offered to work with the DON to identify alternative(s) to the proposed relocation that does not affect land with wildlife habitat value.

March 31, 2015. The DON submitted additional comments on the February 20, 2015, preliminary draft of the Consultation History and Project Description sections. The DON stated that the comments were mainly editorial and suggested the Service address the comments when the DON received the complete Draft Biological Opinion for their review.

March 31, 2015. The Service and DON discussed that the DON-drafted Conservation Recommendations will not be a part of the biological analysis and the beach access road would not be part of the project description. The DON inquired if an action alert for jeopardy was being issued for the consultation. The Service replied that they were not able to answer this question because the analysis has not been completed. The Service stated that they would have a Draft BO completed for the Service's internal review on April 17, 2015. In addition, both parties acknowledged that alternatives for the ISR Strike Fence would need to be further discussed.

April 13, 2015. The Service sent an email to the DON requesting clarification on their position on the reintroduction of native and listed species on DoD land on Guam. In this email, the Service stated that per a meeting on March 9, 2015, the Service and DON discussed reintroduction language (the same reintroduction language that was in the 2010 DON BO). During this meeting, the DON agreed that the reintroduction language could be included in the introduction paragraph to the Conservation Measures section of this Biological Opinion. However, on March 25, 2015, the DON sent the Service a list of proposed Conservation Recommendations. The first Conservation Recommendation included the reintroduction paragraph. The Service advised the DON that when the Service writes Conservation Recommendations for an action agency, these recommendations include items that the action agency is not currently doing or not currently committed to doing. Therefore, by including the reintroduction paragraph into the Conservation Recommendations, as requested by DON, the Service interprets this as DON reversing a previous commitment to allow the reintroduction of listed species on DoD land on Guam. The Service requested the DON provide clarification on this issue.

April 14, 2015. The Service and DON discussed that conservation recommendations in a biological opinion are not binding, and it is at the discretion of the action agency on their implementation. The Service and DON also discussed the reintroduction of native species language per the April 13, 2015, Service email sent to the DON. The Service requested that the language remain in this BO. The DON suggested that the Service include the reintroduction language in the introduction letter and in the baseline of this BO, as it is an action the DON will support in the future when threats are reduced. DON asked the Service for an update on the status of this BO. The Service stated that the Draft Biological Opinion would be available for DON's review on April 27, 2015, and that the analysis is in review at the RO.

April 16 and 17, 2015. The Service and DON exchanged emails regarding the ungulate fence conservation measure for *S. nelsonii*.

April 24, 2015. Office of the Secretary of Defense and Deputy Assistant Secretary of the Navy (Environment) met with Department of the Interior, Deputy Assistant Secretary for Fish, Wildlife, and Parts, the Deputy Director and Assistant Director for the Service, and Regional Director for the Service's Pacific Region to discuss staffing fixes and streamlining consultations. The Service and DoD agrees to develop a Memorandum of Agreement (MOA) to preserve a minimum amount of kingfisher habitat on DoD land in northern Guam.

June 4, 2015. The Service received updated information from the DON regarding the total number of acres of habitat for *Serianthes nelsonii*, Mariana crow, Guam rail, Mariana fruit bat, and the Guam Micronesian kingfisher that would be removed as a result of the proposed project.

June 11, 2015. The Service and DON entered into an MOA to ensure that sufficient amount of suitable survival and recovery habitat for the Guam Micronesian kingfisher is conserved and managed within DoD lands in northern Guam (see Appendix B).

June 26, 2015. The Service provided the DON with the Draft Biological Opinion for their review.

July 6, 2015. The Service received comments on the Draft Biological Opinion from the DON.

July 13, 2015. The Service received additional comments to the Draft BO entitled "Priority Issues" and "Top 5 Issues".

July 29, 2015. The Service met with DON and provided responses to DON comments received on July 6 and July 13. The agencies discussed both the DON comments and Service responses to comments.

July 31, 2013. Biological Opinion signed and submitted to DON

B. DESCRIPTION OF THE PROPOSED ACTION

The DON proposes to relocate USMC personnel from Okinawa, Japan to Guam; construct and operate a main cantonment area, including family housing; and construct and operate a live-fire training range complex (LFTRC); and conduct training activities on Guam. Project activities will occur on land administered by the Department of Defense (DoD) and the Government of Guam (for road and bridge work). The proposed action also includes activities that were initially proposed in the 2010 DON BO, and that will now be covered in this Biological Opinion. To be consistent with the BA (DON 2014a) and the Draft SEIS (2014b), these actions will be called "carry over" actions. The project description is based on information in the BA (DON 2014a), the Draft SEIS (DON 2014b), addendum to the BA (DON 2015b), and the DON's review of the Draft Biological Opinion (see Consultation History).

The proposed action includes the following components:

- Relocation of approximately 5,000 USMC personnel and 1,300 dependents from Japan to Guam
- Construction of the main cantonment within 1,213 acres at Finegayan, AAFB
- Construction of housing within 510 acres at AAFB
- Utilities and site improvement activities within DON-administered lands
- Road and bridge development and/or improvement within DON-administered lands and Government of Guam lands
- Construction and operation of the LFTRC at NWF, AAFB
- Establishment of a SDZ within NWF and the GNWR
- Development and operation of a hand grenade range at Andersen South
- Air craft training activities within the NMS and adjacent areas
- Conservation measures for federally listed species

Relocation of U.S. Marines and Population Growth on Guam

In furtherance of an agreement with the Government of Japan, the DON plans to relocate 5,000 USMC personnel and 1,300 dependents from Okinawa to Guam. Based on the most recent population estimate for Guam, which is approximately 161,000 residents (CIA 2015), the relocation is estimated to temporarily increase Guam's population by approximately 10,000 (DON 2014b, p. ES-4) or 6.2 percent by 2021. This number will decrease to about 7,400 additional residents after construction is completed in 2028 (DON 2014b, p. ES-4) or a 4.6 percent overall increase.

Probable Sources of Labor Supply

An estimated maximum number of 1,227 workers from Guam would work on construction projects related to the proposed project. A maximum of 3,227 workers from off-island would work on construction projects related to the proposed project. It is anticipated that the majority of off-island construction workers would be H-2B workers from the Philippines and other Pacific Islands. During the later years of construction (2025-2026), it is anticipated that more workers from Guam than from off-island would work on construction projects related to the proposed project.

Construction

The DON proposes over 130 separate construction projects on Guam (DON 2014a, Appendix A) to occur within a time period of thirteen years. The construction projects include clearing, grubbing, earthwork (such as digging, trenching, drilling, boring and/or cut and fill), processing and stockpiling of green waste, erosion and sediment control, roadways, sidewalks, curbs and gutters, traffic signs, temporary construction fence, perimeter / security fence, ungulate fence, landscaping and other site improvements. The construction projects also require removal of vegetation, stripping limestone rock, and removal and stockpiling of reusable topsoil. Typical equipment used would include heavy haul trucks, excavators, cranes, concrete trucks, cranes, backhoes, graders, and pick-up trucks. Construction activity would be temporary and localized

within existing noise contours that range from 60 to 85 dB average day-night sound level (ADNL) (DON 2014a, p. 64; see Operation of LFTRC section below for definition of ADNL). The use of heavy equipment can reach noise levels of 96 dB (USFWS 2006a, p. 15). No blasting or use of dynamite will occur as part of the proposed project. The construction activities are summarized below and details are provided in the BA (DON 2014a, pp. 9-18).

Main Cantonment

The proposed main cantonment development includes base operations and support facilities constructed within 1,213 ac at Finegayan, AAFB (DON 2014a; p. 2, 14-17, DON 2015b). An approximately 27,900-ft (8,500-m) long security fence will be constructed around the main cantonment perimeter. The main cantonment and support facilities are divided into the categories listed below, followed by examples of buildings/facilities for each category.

- Command core - Marine expeditionary brigade headquarters and command buildings
- Unit operations – 3rd Marine expeditionary brigade command element, 4th Marines, ground combat element infantry battalion 1 and 2, artillery battery, combat logistics battalion, 9th engineer support battalion and explosive ordnance disposal
- Base operations – base administration, fire station, public works, vehicle fueling, base auto shop, kennel, corrosion prevention and control, security
- Bachelor enlisted quarters and bachelor officer quarters
- Community support – dining facility, fitness center, recreation areas, education center, auditorium/theater, branch exchange, bank/credit union, food court/amusement center, medical/dental clinic, post office
- Training – battle training center, individual combat skills course

Family Housing

The proposed family housing will be located at currently existing family housing (510 acres of developed land) on AAFB. Family housing includes residences for accompanied permanent USMC personnel and their dependents and support and recreational facilities. Unaccompanied USMC personnel would stay at the main cantonment during their shorter-term (approximately 6 months) assignment to Guam. The proposed housing density at AAFB is 5.5 units per acre. The family housing area would be accessed by the existing family housing gate (the Santa Rosa Gate) at the northern end of Route 15, or from the AAFB Main Gate off Route 9. The existing family housing would be demolished and 912 family housing units would be constructed as replacements for the existing AAFB housing in addition to the 535 family housing units required for USMC families. All of the 1,447 family housing units would be integrated into one large housing pool where all eligible personnel and families would live.

Expansion of existing community support facilities, such as the child development center, youth center, and temporary lodging facility may be required. Other potential new facility construction may include a new temporary lodging facility, a new community center, and a new family support center.

Potable Water
Water for the family housing area would be provided by the current system, which would be modified to reroute the system along the new road alignments for the proposed family housing. There will be a connection from the AAFB well field water storage tank to the AAFB water system to provide water to the proposed family housing area. The new potable water distribution pipes would be installed underground at least 3-ft (0.9-m) deep. The width of the trench to install the pipes would be about 1.5 to 4 ft (0.46 to 1.2 m).

Wastewater Collection
The family housing wastewater collection system would include a network of gravity mains, manholes, two new wastewater pump stations, force mains and refurbishment of existing wastewater pump stations. The family housing wastewater collection system would use the existing connection to the Guam Water Authority's (GWA) wastewater collection system. Existing wastewater pump stations would be demolished as part of the proposed project. Wastewater would be conveyed to the Northern District Wastewater Treatment Plant for treatment and disposal.

Power
The existing AAFB main substation would have adequate capacity to serve the family housing, including the redeveloped housing units, new common facilities, and expanded common facilities. The distribution system would be rebuilt, enhanced, and reconfigured to accommodate the housing layout.

Solid Waste
Family housing areas would continue to have their solid waste handled as currently done for the existing AAFB housing area (Layon landfill).

Utilities and Site Improvements

The proposed action includes the development of on-site utilities, access roads, and related off-site infrastructure to support the main cantonment, family housing and LFTRC.

Grading and Earthwork
The utility and site improvement work includes major earth moving (mass grading) and limited fine grading along the roadway corridors and drainage systems. The cut and fill quantities associated with this mass grading would require approximately 5,300,000 cubic meters of structural fill material. The cut and fill quantities also assume a 2-ft (0.6-m) deep typical road pavement section including compacted base and pavement surfacing. The cut and fill quantities are based on the assumption that native material excavated on site is suitable for reuse as fill material. If soil testing and/or geotechnical recommendations indicate otherwise changes in grading or importation of material may be required. Contractors are required to obtain aggregate/soil from contractors/vendors who have local permits. Imported sand and other quarried products from abroad are subject to inspection by the Guam Department of Agriculture and require an importation permit. All sand and aggregate material imported must be accompanied by official records indicating chemical composition, pest-free certification, treatment certificate, and certificate of origin.

Although the Draft SEIS estimated that the amount of cut exceeds the amount of fill required, the DON contract does not prohibit quarry material from off-island. For example, any grading or other earthwork required during facility construction at any of the alternative sites would be implemented to balance cut and fill on-site to the extent possible. If off-site fill material were needed, it would be obtained from a permitted source. In addition, if a contractor needs fill material the excess cut from other DoD projects would be available for no additional cost as opposed to paying for fill material from a quarry (DON 2015b).

Best Management Practice for utilities includes the Comprehensive Waste Management Plan, August 2010 (DON 2010a or any applicable update), and the Integrated Solid Waste Management Plan for DoD Bases, Guam, February 20, 2013 (DON 2013a). Additional contractor requirements are as follows: process green waste on-site for reuse (goal of 100 percent) during construction; meet 50 percent diversion rate goal for construction/demolition debris through reuse (including such actions as concrete crushing and reuse as base material and grinding and reuse of asphaltic concrete from roads); and meet a goal of 50 percent diversion rate from disposal for project non-construction/demolition solid waste (not directly generated from materials used for erecting structures).

Based on the FAR 52.236-7, PERMITS AND RESPONSIBILITIES (DON 1991), the contractor shall, without additional expense to the government, be responsible for obtaining any necessary licenses and permits, and for complying with any Federal, State, and municipal laws, codes, and regulations applicable to the performance of the work. The contractor shall also be responsible for all damages to persons or property that occurs as a result of the contractor's fault or negligence. The contractor shall also be responsible for all materials delivered and work performed until completion and acceptance of the entire work, except for any completed unit of work which may have been accepted under the contract.

Reuse and Recycling Facility
Green waste processing and construction and demolition debris generated during construction will be handled by contractors at designated laydown areas. Contractors will be required to process the generated green waste as part of their assigned contract requiring 100 percent diversion of the green waste into mulch (trees and stumps) and compost (leaves and grass), and 60 percent minimum diversion of construction and demolition debris waste. The DON subject matter experts will review the contractor's green waste processing and composting facility operations plan to ensure that it meets industry and regulatory standards. The contractor will be responsible for obtaining the solid waste facility permit issued by Guam Environmental Protection Agency (GEPA) prior to commencing activities.

The construction and demolition debris and green wastes that cannot be recycled or reused, as well as wastes that are prohibited at Layon Landfill would be disposed at the Naval Base Guam Landfill, subject to ongoing discussions between the U.S. Environmental Protection Agency (USEPA), GEPA, and DON, and permitted private hardfill facilities (DON 2015b).

Electrical Substation

A main substation equipped with two 15-megavolt ampere, 34.5 kV-13.8 kV transformers will be constructed in the main cantonment area, south of the main gate. Provisions will be made in the substation for primary line connections to the planned 34.5-kV underground line from the Harmon Substation and to the planned 34.5-kV line from AAFB.

Water Distribution
A new transmission main, to be installed by the well field project, will convey water from the well field storage tank at AAFB to the boundary of the main cantonment area near the commercial/tactical vehicle gate. The DON proposes to construct a water pipeline from Route 3A near the commercial/tactical vehicle gate to the new two million gallon ground level water storage tank on Finegayan. The existing mains between some of the existing water wells on Finegayan will be demolished and realigned to the proposed roadways. The existing distribution mains servicing the abandoned Building 200 also will be removed. In the short term, the existing Finegayan water wells will provide the USMC water distribution system with water. The long-term plan will provide the USMC water distribution system with water from both the existing Finegayan wells and the well fields system.

Sanitary Sewer
The existing DoD wastewater collection system within the main cantonment area at the Finegayan site consists of a trunk sewer serving Building 200 and connected to the GWA wastewater collection system through a GWA interceptor sewer along Route 3. Wastewater is conveyed to the Northern District Wastewater Treatment Plant. Capacity evaluations of the existing collection system indicate the GWA interceptor sewer has adequate capacity for the project. The grading for the main cantonment area generally slopes downhill from north to south. A connection to the existing GWA interceptor sewer main along Route 3 is included.

Live-fire training range complex

The proposed LFTRC development area at AAFB NWF will require construction of the individual ranges, range support building, range towers, range access roads, and a perimeter fence (all within federally-controlled land at NWF), extending an ungulate exclosure fence (see Conservation Measures section) and the establishment of a SDZ within the NWF and the GNWR. The LFTRC would require construction of new electrical, telecommunication, wastewater and water lines and/or facilities configured to operate with the existing utility infrastructure of AAFB NWF (DON 2014a, pp. 18-22).

The proposed LFTRC would include five ranges and repairs to Route 3A. The individual ranges are described in more detail below (DON 2014b, p. 2-7).

Known Distance (*KD*) *Rifle Range*: The proposed KD Rifle Range would have 50 firing points for 5.56-millimeter (mm) weapons. The range would be 534 ft (163 m or 178 yards) wide and 1500 ft (457 m or 500 yards) from the farthest firing line to the target line. The target line would be flush with the ground, and there would be level ground from the 200 yard (183 m) firing line to the target line. The range would include a 25-foot (8-m) tall impact berm behind the target line. The range footprint would encompass approximately 18.5 ac (7.5 hectare [ha]).

KD Pistol Range: The KD Pistol Range would provide 25 firing points for training with 9-mm and 0.45-caliber (cal) weapons. The range would be 123 ft (37.5 m or 41 yards) wide by 150 ft (46 m or 50 yards) long with level ground from the firing line to the target line. The range would include a 12-ft (4-m) tall impact berm behind the target line and 12-ft (4-m) lateral berms. The range footprint would encompass approximately 0.4 ac (0.2 ha).

Non-standard Small Arms Range: The Non-standard Small Arms Range would provide 25 firing points, and be used for training with 5.56-mm weapons. The range would be 204 ft (62.5 m or 68 yards) wide by 328 ft (100 m or 109.4 yards) long with level ground from the 91 m firing line to the target line. There would be a 16-ft (5 m) tall impact berm behind the target line, and 16-ft (5-m) lateral berms. The range footprint would encompass approximately 1.5 ac (0.6 ha).

Modified Record of Fire Range (*MRF*): The proposed MRF Range would have 16 firing points for use by 5.56-mm weapons. This live-fire range area would be 525 ft (160 m or 175 yards) wide by 657 ft (200 m or 219 yards) in length with a 25-ft (8-m) tall impact berm at the far end of the range. The range footprint would encompass approximately 7.9 ac (3.2 ha).

MPMG Range: The proposed Multi-purpose Machine Gun (MPMG) Range would have eight stationary firing lanes to support training with 5.56-mm, 7.62-mm, and 0.50-cal weapons, as well as 40-mm inert training rounds (i.e., non-explosive). The range would be 525 ft (160 m or 175 yards) wide at the firing line, expanding to 1,050 ft (320 m or 350 yards) wide at the far end of the range. The range would be 3,281 ft (1,000 m or 1093.6 yards) long and would include a 25 ft (8 m) tall impact berm at the far end of the range. The range footprint would encompass approximately 59 ac (24 ha).

Except for the MPMG Range, the range footprints would be entirely cleared of vegetation and the range would be designed with berms to contain expended rounds of ammunition within the range footprint. The MPMG range would include more uneven terrain and with some vegetation. The purpose of the MPMG range is to simulate a more natural environment. Vegetation on the range would be designed using the Guam Landscaping Guidelines (DON 2011) and use appropriate or non-invasive species in order to reduce potential impacts associated with non-native vegetation.

The proposed LFTRC also would include three range observation towers, a target storage and maintenance shed, a ready issue ammunition magazine, covered bleachers, portable toilets, perimeter fencing, safety signage, parking, and lighting. Lighting will be designed to meet minimum safety, sustainable, antiterrorism, and force protection requirements. "Night-adapted lights" will be installed in the briefing and bleacher areas at NWF. Night-adapted lighting uses bulbs in red or other spectrums that allow a person's eyes to remain adapted to low light or night conditions while still providing enough light for work and safety. Illumination of the coastline or beach will be kept to an absolute minimum including the shielding of lights and directing lighting away from the forest or other wildlife habitat (see Conservation Measures section below).

The location and siting of firebreaks will be addressed in the fire management plan (see Conservation Measures section). The fire management plan, which is a component of the Range

Management Plan, will address issues as it relates to the potential for a fire to start on the range and how to control any fires.

Construction of LFTRC

Development of the LFTRC is anticipated to occur in two phases that would construct the smaller ranges and repair/improve Route 3A under one phase and construct the MPMG range under the second phase. Approximately 256 acres would be cleared as a result of the construction of the LFTRC (DON 2014a, p. 19). Proposed construction timelines are subject to availability of funding but are proposed as: 1) The dates for the KD ranges are March 2016 for the construction award, August 2019 for the completed construction, and start of range operations in February 2020, and 2) The dates for the MPMG ranges are January 2021 for the construction award, January 2024 for the completed construction, and range operation starting in December 2024.

Grading requirements for construction of the ranges and associated infrastructure would include 2,047,295 yd^3 (1,565,270 m^3) of cut and 1,932,392 yd^3 (1,477,420 m^3) of fill, resulting in a net of 114,903 yd^3 (87,850 m^3) of cut (DON 2015b). However, any grading and other earthwork required during facility construction at any of the ranges would be implemented to balance cut and fill on-site to the extent possible. If off-site fill material were needed, it would be obtained from a permitted source.

Operation of LFTRC

Range utilization would depend on the number of personnel required to complete annual individual training events, the duration of each event, and the training capacity of each range. However, the proposed live-fire operations at the LFTRC would occur between 7:00 a.m. and 7:00 p.m. for up to 39 weeks per year, and night operations (estimated to occur 2 nights per week over 39 weeks per year) would occur between 7:00 p.m. and 10:00 p.m. or 6:00 a.m. and 7:00 a.m. The estimated annual ammunition usage of the LFTRC by USMC and non-USMC personnel is 6,719,190 rounds (DON 2014b, p. 2-9) (Table 1).

Table 1. The estimated annual ammunition usage of the LFTRC (DON 2014b, p. 2-9).

Range	*Weapon*	*Ammunition Type*	*Estimated Ammunition Usage*		
			Day [1]	*Night* [1]	*Total*
Marine Corps					
KD Rifle Range	M16/M4	5.56-mm	1,533,300	322,800	1,856,100
	M249 SAW	5.56-mm	59,200	39,664	98,864
KD Pistol Range	M9	9-mm	324,956	19,328	344,464
Non-standard Small Arms Range	M16/M4	5.56-mm	569,356	403,500	972,856
	M249 SAW	5.56-mm	152,736	34,900	187,636
MRF Range	M16/M4	5.56-mm	304,920	62,820	367,740
	M249 SAW	5.56-mm	59,200	17,760	76,960
MPMG Range	M249 SAW	5.56-mm	377,104	0	377,104
	M40/M110	7.62-mm	13,824	4,104	17,928
	M240	7.62-mm	576,716	141,336	718,052
	M107	0.50-cal	3,520	0	3,520
	M2	0.50-cal	190,756	6,180	196,936
	MK19	40-mm inert	84,480	8,448	92,928
	M-203/ M-32 Grenade Launcher	40-mm inert	24,940	2,580	27,520
Marine Corps Total Estimated Use =			4,275,008	1,063,420	5,338,608
Joint Use (non-Marine Corps) Total Estimated Joint Use =			1,104,466	276,116	1,380,582
GRAND TOTAL (MARINE CORPS AND JOINT USE) =			**5,379,474**	**1,339,536**	**6,719,190**

Legend: SAW = Squad Automatic Weapon.

Notes: [1] "Day" operations would occur between 7:00 a.m. and 7:00 p.m. "Night" operations (estimated to occur two nights per week) would potentially occur between 7:00 p.m. and 10:00 p.m. or 6:00 a.m. and 6:59 a.m. Night firing training requirements need to be met during hours of darkness, dusk until dawn, and this timeframe differs from "acoustic" night (10 p.m. to 7 a.m.) used in noise modeling. Of the 1,063,000 rounds expected during darkness, only 326,000 rounds or 7% of the total number of rounds would occur during "acoustic" night, and no training is planned to occur between the hours of 10:00 p.m. and 6:00 a.m.

The noise levels at LFTRC are estimated at weighted day-night average sound levels (ADNL) within the immediate and adjacent areas and would range from 55 ADNL to greater than 85 ADNL, depending on the zone (area) (DON 2014a, p. 68). The ADNL is a metric that cannot be measured directly. Rather, it is calculated as the average sound level in decibels with a 10 dB penalty added to the night-time levels (10 p.m. to 7 a.m.). This penalty accounts for the fact that noises at night sound louder because there are usually fewer noises occurring at night so generally night-time noises are more noticeable. The day-night sound level (DNL) noise metric may be further defined, as appropriate, with a specific, designated time period (e.g., annual average day DNL, average busy month DNL). Noise levels due to .50 caliber or less small arms weapons use the average-weighted scale and are expressed as dB average-weighted DNL (ADNL).

The noise disturbance from the training will be impulse noise with very intense sounds of short duration (e.g., the discharge of a weapon). Firing noise from single shots merged in bursts, machine gun burst, and concurrent firing of multiple weapons would result in short periods of intense firing followed by periods of silence. Live-fire operations may occur for hours at a time, for 5 days a week, or not occur for multiple weeks in a row. The DON provided the Service with peak noise levels for the MPMG range using a formula to calculate peak noise levels at a specified distance from the source. Because the peak noise calculation did not account for sound

attenuation from the directional nature of the noise generated by the muzzle blast, terrain, ambient noise, vegetation, temperature, humidity, and other factors, the Service developed a model to estimate peak noise from the LFTRC (USFWS 2015a).

Surface Danger Zone

The DON proposes to establish a SDZ within the NWF and the GNWR (Figure 1). The SDZ would delineate areas that fired ammunition fragments or ricochet may land, forming the outermost limit of the LFTRC. The DoD standard for risk acceptance on ranges is a 99.9999% level of containment, which means the probability of munitions (for inert ordnance) or a hazardous fragment (for live ordnance) escaping the SDZ is one in a million. The SDZ projects north and outward over the GNWR-administered fee simple land and submerged lands. The DON would demarcate the SDZ beyond the shoreline through navigation map updates to alert maritime traffic of the potential hazard. For the land based perimeter of the SDZ, perimeter access roads (KD and MPMG), perimeter fencing and/or signage would indicate its boundaries for personnel and public safety. Approximately 3,701 acres (1,498 ha) acres of lands and submerged lands are required to support the SDZ. This includes approximately 142 acres (57 ha) of the Ritidian Point Unit (fee simple land) of the GNWR and 3,059 acres (1,238 ha) of the submerged lands of the Philippine Sea. No critical habitat within the GNWR would be cleared as a result of the proposed project.

Prior to operation of the LFTRC, the SDZ would be surveyed visually from observation towers to ensure the area is cleared of people. Since the GNWR has existing hours of operation (0800-1600) and the gate to the GNWR is locked outside of the hours of operation, the potential for incursion into the SDZ will be limited by the GNWR gate. However, when operation of the LFTRC is planned, the USMC would deploy USMC personnel to put up SDZ signage on trails and the beach at either end. If there are indications that people are in the area, a patrol would be deployed to ensure safety.

Although most of the SDZ area can be seen with binoculars from the observation towers at Ritidian Point at NWF, ground patrols within the GNWR are to ensure that the area under the surface danger zone is cleared of people prior to the operations of the LFTRC. Patrols would be conducted on the nesting beach prior to the operations of the LFTRC, which will operate daily up to 39 weeks per year. The purpose of the access is to ensure the water portion of the SDZ is clear of people. The Range Safety Specialist (RSS) would conduct a ground survey of three locations (Figure 1); however may only access one or two of these locations to clear the water portion of the SDZ. The RSS will access the location by using an all-terrain vehicle (ATV) (2 or 4 passenger Gator-type vehicle). The RSS will get out of the ATV and move to an area where the water portion of the SDZ can be seen (not on the beach). The RSS will use a pair of binoculars to clear the water portion of the SDZ. The RSS will walk back to the ATV and drive out the same trail taken to get to the access locations. Once the SDZ has been cleared, the RSS would notify Range Control and depart the area. The ground survey would last approximately 20 minutes.

As part of the RSS training package, personnel would be directed to not interact with sea turtles and report all sightings to the Service and coordinate with the GNWR on nesting surveys at the Refuge (see Conservation Measures).

Hand Grenade Range

In addition to the small arms training ranges collocated within the LFTRC, the proposed project also includes a development area for a separate HG Range at Andersen South. The proposed HG Range would include an approximately 0.9 ac-area developed as a hand grenade training complex for the M67 fragmentation grenade and will be connected to existing utility infrastructure where available. The following features would be developed within the hazard zone: a holding shelter for four persons, four throwing positions with grenade sumps, a range observation tower with ballistic glass, and a grenade "dudded" impact area. A grenade house would be collocated with the grenade throwing pits. There also will be a concrete munitions storage (i.e., magazine) surrounded on three sides by earthen berms for the temporary storage of hand grenades during training events.

In addition to the live-fire area, there would be a 1.0-ac non-live-fire training area developed adjacent to the range and outside of the SDZ. The training area would consist of a demonstration area with bleachers, an open practice throwing field with various targets and throwing positions, portable toilets, and a parking area. Inert practice grenades would be used at this training area to provide familiarization training prior to proceeding onto the live-fire area of the range.

Information and Communications

The proposed Information Technology/Communications (IT/Comm) development area would require inter-base connections between the proposed USMC main cantonment area, and other existing bases, the proposed LFTRC, and DON's 2010 Record of Decision-covered training facilities at Andersen South (DON 2010b). These hardwired connections would consist of conduits buried approximately 3-ft (0.9-m) deep. Off-site conduits would be encased in concrete and would have lockable manholes for security. Because redundant off-island communication paths are needed, an additional connection to the Tata Communications Cable Termination Facility (in Piti) from AAFB may be required. Off-site conduits would follow existing roads and rights-of-way between the facilities.

AAFB Well Field and Associated Water System

Increased water supply for the main cantonment area would come from the proposed AAFB well field, refurbished wells, and DON's existing water system. Based on conservative estimates, it is anticipated that to locate one well of sufficient yield to support production approximately three test wells would be required. During testing, only those wells with good water quality and capacity will be identified as production well sites. Test wells deemed unsuitable will be filled and capped and left in place, restored or converted to monitoring wells for management of the Northern Guam Lens Aquifer.

The development area would accommodate the construction of the approximately 22 test wells, 11 production wells, and associated equipment. The actual footprint of the final production wells and the access roads to each is not known at this time, but it would occur within the well field limits as shown (Figure 2).

During the design phase, the design contractor will conduct site investigations and drill test wells, determine locations of the wells, and design the entire water production system (wells, feeders, and storage tank). During the construction phase, the construction contractor will convert the test wells into production wells based on the locations identified in the design document and construct the water production system per the design specifications. Prior to start of work, efforts will be made by the design contractor to minimize disturbance to the limestone forest by inspecting the area with a DON biologist and identifying "already disturbed areas". In addition, the following actions would be implemented.

- Where disturbed areas cannot be identified, for each well location, a 14-ft (4.3-m) path will be created for the drill rig, trucks/vehicles and other equipment to get to the test well locations.

- An approximately a 100 ft x 100 ft (or 0.23 ac) work area will be required to set up the equipment at each test well location.

- For each test well, an 8 in. to 12 in. borehole will be drilled to a depth of approximately 500 ft to 600 ft below ground surface. A submersible pump will be placed at the bottom of the well, and a pump test and water sampling conducted. Based on the results of the pump test and water sampling, the well will either be abandoned or identified as a potential production well. For test wells identified as a potential production well, GIS survey coordinates will be taken and a stake placed at the test well site.

- A production well consists of well casing (approximately 10 to 12 in. diameter), screen, gravel pack, submersible well pump, pump motor housing, and surface/borehole seal. At each well station the following will be provided: well housing, discharge piping, and flow meter. Each well head will have electrical lines, water transmission pipes, and feeders to each well. The estimated disturbance area during construction is 100 ft x 100 ft (.23 ac).

- Locations of the water transmission and feeder lines will normally follow already disturbed areas made during test well drilling (path made by the drill rig/vehicles/equipment). A 20 ft to 30 ft wide strip will be required for construction of the pipelines, and manholes, valves, bends, anchor blocks, etc. as well as backfill material. The main transmission lines ranging from 8 in. to 16 in. will connect the well field storage tank facility to feeder lines. The individual well feeder lines, approximately 6 in. will connect the wells to the main transmission lines.

- In the well field storage tank facility area, there will be a booster pump, water treatment, storage tank, electrical room and central emergency backup generator and fuel storage tank. In addition to the 14-ft (4.3-m) path for cranes/vehicles/equipment, an

approximately 550 ft x 650 ft area (8.2 ac) will be disturbed during construction of the water storage tank and associated facilities.

- Unless cuttings or excavation materials are deemed contaminated or unacceptable as fill material, cuttings will be placed back into a borehole or trench. Unacceptable fill material or excess cuttings/excavation material will be removed from the site.

- When 68 ac (75 percent of the disturbance area) is reached, the construction contractor will stop work and re-evaluate to determine if 90 ac will be exceeded.

The new potable water production wells would feed a new well field collection tank, pump and water treatment facility (chlorination and fluoridation), all proposed within AAFB. The main cantonment area would be provided with a new ground level water storage tank supplied by the new well field storage tank.

Project Activities Carried Over from the DON Action addressed in the Service's 2010 BO

Andersen Air Force Base Operations

Currently, as of March 2015, the air combat element beddown facilities, air embarkation facilities, and associated buildings, a new north gate and access road with associated facilities are being constructed at AAFB.

There are two airfields on AAFB, the AAFB airfield with its north ramp and the south ramp runways. The facilities constructed at AAFB north and south ramps will be used by 12 permanently stationed MV-22 helicopters and will accommodate the loading of additional transient aircraft listed in Table 2. These aircraft will be used to conduct training and operational flights (sorties) including the following components: field carrier landing practice, familiarization-instrument, Marine air ground task force, tactical air operations center, and routine operations will occur in association with the air mobility campus and the air combat element. A training event consists of one aircraft performing a take-off, a training evolution, and a landing. These training operations will occur on airfields in current use by similar aircraft (Table 3) such as those addressed in the MITT Biological Opinion (USFWS 2015b, 66 pp.).

Table 2. Proposed aircraft loading (DON 2010b, vol 2, p. 2-91).

Element	*Number*	*Type*
Permanent stationed: Rotary wing	12	PCS (12) MV-22 (Assault Transport)
Fixed wing	12	F/A-18
Transients: Rotary wing	12	MV-22 Transport (Osprey)
	3	UH-1 Multipurpose Utility (Huey)
	6	AH-1 Attack (Super Cobra)
	4	CH53E
Fixed wing	2	KC-130
	24	F/A-18
	4-6	F-4 (visiting Allied Forces)

Table 3. Anticipated total flight operations at Andersen Air Force Base resulting from previous projects with the addition of the proposed action (Czech and Kester 2008).

Aircraft Type	**Anticipated Total Aircraft Operations per Year Andersen Air Force Base**			
	Previously Addressed	**DON Project**	**Total**	**% Increase**
Helicopter	19,029	19,489	38,518	102%
Jet/Propeller	25,697	6,424	32,121	25%

The new air combat element facilities will be used for aircraft operations, maintenance of MV-22 tilt rotor aircraft, and training and support functions. The air combat element facilities also will be used for USMC air control group training. The USMC air control group training involves coordination of air command, control, and defense units and the tactical air operations center. Training entails the operation of air traffic control radar and radio frequency emitters and facilities consisting of shelters, a portable tower, and electrical power sources. Tactical air operations center training involves the establishment and dismantling of these facilities within a 96-hour period. Training includes use of various emitters and sensors which need to be de-conflicted with other electronic equipment operating in the area. To minimize the constraints it puts on airspace availability, radar equipment, which generates strong electromagnetic radiation fields, will be operated for no more than one hour at a time. The air combat element beddown facilities will operate 24 hours per day and 7 days per week. Staffing levels will be contingent on surge and operational requirements of the air combat element facilities. Traffic will include government-owned vehicles, personal-owned vehicles, and shuttle buses from the proposed main cantonment area.

Approximately 1,000 annual field carrier landing practice and 79 annual familiarization-instrument flight events are proposed for Andersen Main Base. Field carrier landing practice operations entail one or more aircraft flying at a low altitude in almost circular patterns and involves landing on a simulated aircraft carrier during the day and, using night-vision goggles, at

night. Familiarization-instrument training, including autorotation and simulated engine-out approaches will occur on the improved airfields with the support of aircraft rescue and firefighting facilities.

Rotary-wing aircraft operations will occur at the AAFB airfields and in various proposed training areas on Guam. Fixed-wing aircraft operations will occur only in the immediate airfield environment of AAFB. Aircraft will then leave this area to conduct activities within established training areas of the MITT or other locations as described under MITT (USFWS 2015b, 66 pp.). Air traffic at the air combat element beddown and the north ramp will include helicopter, vertical lift aircraft, fixed-wing, and unmanned aircraft arrivals and departures.

In addition, a new air embarkation site is currently being built, as of March 2015, to serve as the passenger terminal for AAFB and temporary cargo storage. Air embarkation and disembarkation refers to the loading and unloading of passengers or cargo to and from aircraft. The passenger facilities are comparable to those of a small airport: luggage handling, waiting area, and ticket and documentation area. Cargo is staged for loading to aircraft or disbursement to warehouses or individual commands. Currently the Air Force has air embarkation facilities at the south ramp of the airfield. Once the new facility is built, the existing facility will be closed. The site will operate 24 hours per day and 7 days per week.

The project will result in noise levels in excess of 60 dB over the Guam landscape. Northern Guam will be periodically exposed to noise levels in excess of 93 dB PK15. Peak sound levels are the calculated peak noise level, without frequency weighting, expected to be exceeded by 15 percent of all events that might occur.

Andersen South

The proposed project will result in the construction of a military operations in urban terrain training area, a portion of which will be a modular unit and another will be reconstructed from the existing unit; a logistics and administration area; a convoy course; an advanced motor vehicles operators course; an aviation training landing zone; an aviation and maneuver area landing zone; Pioneer Road; other range roads; a perimeter fence; main, secondary, and range road gates; and the realignment of Route 15 at Andersen South.

Andersen South Operations

Convoy operations, maneuver training for military operations in urban terrain, and general maneuver and air-ground operations will vary, but may occur up to 5 days per week, 45 weeks per year, day and night. The maximum estimate is approximately 250 to 300 USMC personnel will participate in maneuver training at Andersen South each week, for a total annual throughput of 11,250 to 13,500 personnel. Convoy operations will typically consist of 7 to 10 vehicles (e.g., high mobility multipurpose wheeled vehicles) traveling in tandem along an established course. Military operations in urban terrain includes transporting units to Andersen South by helicopter or vehicle, maneuvering toward the military operations in urban terrain complex on foot or in vehicle, and engaging in integrated training at the military operations in urban terrain complex. Military operations in urban terrain at the reconstructed training area (also referred to as the

urban embassy component) will consist of 24 or more, multi-story concrete structures to simulate at least four city blocks.

The modular military operations in urban terrain (also referred to as the rural military operations in urban terrain) will consist of movable components that can be stacked and grouped into a number of configurations to present tactical situations to be overcome by training units. This modular military operations in urban terrain will consist of shipping containers that will be assembled on site to simulate a more rural village or set of suburban buildings located outside the core urban area. Forklifts or cranes will be used to reconfigure the modules of the military operations in urban terrain to add variety and diversity to training. The proposed military operations in urban terrain complex will include live-fire ranges, including a bleacher and shooting house that will be used for forced-entry training, and a hand grenade range and house. These will be suitable for units or organizations of up to 800 USMC personnel at a time, and will be used daily by 40 to 750 personnel. The military operations in urban terrain will operate day and night; night operations will comprise an estimated 15 percent of all operations. The military operations in urban terrain will be used by organizations based on Guam, transients, and visiting regional allied forces. Units using the military operations in urban terrain may bivouac in the vicinity, or arrive and depart daily.

Typically, dry runs and individual skills training will occur prior to the military operations in urban terrain exercise, which will involve fire teams (smallest unit of infantry, typically four or fewer individuals), and squad drills (a group of 8 to 12 individuals). Types of weapons that will be authorized for use at the military operations in urban terrain will include M16, M4, M249, and M240. Blanks, simulators, smoke grenades, diversionary devices (improvised explosive devices and booby traps that release smoke when activated), special effects small arms marking system (similar to paintball), and multiple integrated laser engagement system (small laser receivers scattered over the uniform of an individual soldier, which detect when the soldier has been shined by another soldier's firearm laser) are used instead of ammunition and explosives that would be used in a real combat situation.

Tactical motor vehicle operator training is a continuous requirement for USMC units. The proposed advanced motor vehicle operations course will consist of a route along which a series of obstacles will be placed for driver trainees to negotiate. This will include obstacles simulating terrain features such as narrow bridges, serpentine courses, brake modulation blocks, river crossing, side slope, pot holes, curb and ditch crossing, humps (similar to moguls on a ski slope), and narrow urban driving. The obstacles are connected with unpaved roads. The capacity of the advanced motor vehicle operations course facility will range from 25 to 60 personnel and will be used for individual, section, squad, or platoon training. An estimated 20 drivers per week will train at the advanced motor vehicle operations course, primarily with high mobility multipurpose wheeled vehicles. At two drivers per vehicle, an estimated 10 high mobility multipurpose wheeled vehicles will use the course during training events.

Convoy training consists of simulated threats and tactical scenarios to train in various defensive techniques. This area of Andersen South is currently used by the Air Force for expeditionary airfield and military operations in urban terrain training which has similarities to the proposed maneuver area training. The convoy training course is 2.5 mi (4 km) and will use existing and

new roadways (see Andersen South construction above) within areas identified for the maneuver training space. All existing roads will be open to motor vehicle use associated with maneuver area training; this will primarily be wheeled vehicles, but occasionally a tracked vehicle may be used in maneuver area training at Andersen South. The area will continue to support Air Force training, while also accommodating Marine Corps training requirements. Access to the site will be by vehicle or air lift. Air lifts will typically involve two to four CH-53 helicopters dropping off and picking up personnel twice a week.

Andersen South will support landing zones for aviation training and include helicopter support team training for ground units. Personnel train in rappelling from the helicopter and procedures that will be used in inserting and extracting troops via helicopter at combat locations. The air operation events associated with this air-ground training will typically consist of a pass for orientation, followed by a downwind approach, hovering at 30 ft (9 m) above ground level for approximately one minute at a designated landing zone and a departure. Since the maneuver area aviation training operations will be a component of training to meet the aviation training requirements, they are also described below under aviation training. Helicopter-insertion extraction activities include fast rope, rappelling, helocasting, and parachute operations. Helicopter insertion-extraction training operations will involve one pass for landing zone orientation, followed by an approach of the landing zone, hovering at approximately 30 ft (9 m) above ground level for approximately one minute, and then departing the landing zone. During each training event, approximately three helicopter insertion-extraction operations will be conducted at one or more closely located landing zones. Approximately 114 helicopter insertion- extraction events will occur at Andersen South per year. Confined area landing, external loads, and maneuver lift (see descriptions above) training will also occur on Andersen South at a frequency of 125, 63, and 720 events per year, respectively.

Shooting house operations, which are proposed to be located in Andersen South, are conducted in an enclosed structure and provide training in close-quarter skills, like room clearing and hallway navigation. No explosives are used; however, live-fire training operations with the 5.56 mm rifle will be authorized at the facility.

Naval Base Guam

Naval Base Guam (NBG) is located along the southern side of Apra Harbor on the western coast of Guam. The civilian Port of Guam flanks the northern side of the Harbor. The 2010 JPGO carry-over activities constructed and implemented within the NBG are described below. As of March 2015, the working dog kennel and the Apra Harbor wharf and utility upgrades and associated dredging and dredge disposal management activities are under construction.

Naval Base Guam Construction Projects

In-water ship berthing and embarkation areas, staging areas, an amphibious craft laydown area, a military working dog kennel relocation, a medical and dental clinic, washdown facilities, brown treesnake barriers, and quarantine areas will be developed at the NBG. In addition, a U.S. Coast Guard berthing and crew support building will be relocated to an area that is not currently forested. The military working dog kennel will be relocated from its existing site to a new site

on NBG. The proposed project location is in an existing laydown area for base maintenance with existing access roads and utility tie-ins. Associated with the aircraft carrier berthing at NBG are the shore-side facilities (recreation, gathering, laundry, waiting for transportation, and food and beverage sales), staging areas, new buildings, and parking. The Apra Branch Medical and Dental Clinic will be built on a previously disturbed area that is currently vacant. The Morale, Welfare, and Recreation area will be developed to provide food and beverage booths, seating for 500 people, 40 phone bank seats, 100 stalls for visitor and rental car parking, portable restrooms, laundry facilities, temporary lighting, and trash dumpsters.

All facilities will have security lights mounted on buildings or steel poles. Lighting along the wharves will consist of 1,000-watt high pressure sodium floodlights mounted on new or existing poles. Lighting will be shielded and aimed such that the majority of the illumination will be directed towards the wharf deck, extending over water approximately 100 ft (30.5 m). All actions related to development and improvement of waterfront facilities will occur in currently paved or landscaped areas. All utility distribution lines and ductwork will be located underground, generally within existing utility corridors.

The DON will develop permanent and temporary washdown, quarantine, and inspection areas at arrival areas on Guam at Apra Harbor (ship and amphibious vehicle loading and unloading) and AAFB (DON 2010c, p. 70) as follows.

1. A washdown, quarantine, and inspection facility will be built at Apra Harbor within 600 ft (183 m) of Victor Wharf to reduce the risk of exposure to invasive species after leaving the clean, biosecure area. During construction, invasive species and debris will be removed from the site. Prior to operation, the biosecure area will be inspected and will only begin operations when the area is invasive species-free. These facilities will provide vehicle cargo quarantine, inspection, and storage areas. These areas will be constructed with a brown treesnake barrier and active trapping for brown treesnakes will occur. These facilities will provide a pre-wash down area, vacuum equipment, wash racks (raised platforms with ramps at either end that facilitate cleaning and inspection of undercarriages), an inspection building, and fenced area that will meet the requirements for the use of inspection dogs and a cargo loading and inspection area. Specifically, these facilities will be built in a designated paved area with a wash down area and sufficient space for segregating "clean" from "dirty" equipment, cargo, and vehicles. The areas will be surrounded by brown treesnake barriers following specifications received from the Service: The barriers will be 4.5 ft (1.4 m) tall; made from pre-cast concrete with an outward projecting lip to deter snakes; the barriers will have only two gates providing one-way flow of traffic through the site; each gate made from sliding chain-link with fabric barriers or comparable materials to prevent snake ingress and egress.

2. When in Apra Harbor, the vehicles and equipment unloaded or loaded onto a ship will be inspected and receive a wash down on arrival and departure to prevent introduction of any pest or invasive species that may present a potential threat to agriculture, public health, or the natural resources of Guam or other Pacific Islands. All wash downs will be conducted and supervised by trained personnel in accordance with Armed Forces Technical Guide 31 (2008). Personnel from USDA may participate in inspections and

brown treesnake inspections will be conducted with involvement of USDA Animal and Plant Health Inspection Service (APHIS) personnel. Vehicles will be inspected (internally and externally) prior to passing into the biosecure area. The water used to wash vehicles will be captured and circulated through filters to prevent pests from spreading. All waste on board ships will continue to be steam sterilized prior to disposal in regulated landfills in accordance with base operating procedures.

3. Supplies for the Coast Guard Cutters are delivered to the wharves from existing DON supply warehouses where all supplies and material have undergone required USDA inspections upon arrival and before being transferred out of the warehouse and onto a U.S. Coast Guard ship. The U.S. Coast Guard ships will not be offloading supplies onto Guam from other locations (DON 2010c, p. 79).

4. Truck traffic at the wharf will be required to re-supply ships (DON 2010c, p. 85). Trucks may be from DON Supply or direct from commercial vendors. Equipment to move cargo will be brought to the wharf as needed. When an aircraft carrier is not berthed, the Port Operations building will be used for storage. All equipment and cargo will go through inspection procedures prior to being brought into "clean" areas or being loaded on to ships, regardless of vendor.

5. A washdown, quarantine, and inspection facility will also be built at the amphibious vehicle laydown area in Apra Harbor to reduce the risk of exposure to invasive species after leaving the clean, biosecure area. This facility will be adjacent to the shore so that amphibious craft can drive into the washdown, quarantine, and inspection facility. This facility will be built to the specifications described above for Victor Wharf with modifications to accommodate amphibious vehicles, specifically: the laydown area will have dedicated ramps for landing craft air cushion and amphibious assault vehicles in the quarantine area.

6. Typically, the Amphibious Task Force will arrive fully supplied to meet all training requirements or will be replenished as needed prior to training in the CNMI. If cargo is loaded or unloaded, inspection is required as described above for Victor Wharf. Cargo will be loaded and unloaded in the laydown area which will be of sufficient size to segregate "clean" from "dirty" cargos. If there is a training mission on Guam, the trucks will drive off the ships' stern ramps (and be inspected as described above). Other cargo may be offloaded by mobile crane. After inspection, cargo may be temporarily stored in a "clean" material handling equipment at the waterfront.

7. There are several projects in Apra Harbor. For all facilities, the DON will attempt to include USDA APHIS at the earliest possible time to plan for brown treesnake inspections. Planning for cargo storage will include considerations of the length of time for storage, risk of brown treesnake or other invasive species, and origin and destination of cargo. These considerations need to be vetted through the Biological Monitor (who will coordinate with other partners. Permanent barriers and moveable brown treesnake barriers will be used as the situation dictates.

8. The DON will develop permanent and temporary quarantine and inspection areas at a new Air Embarkation and Disembarkation area at Andersen Main Base to load and unload passengers and cargo from aircraft (DON 2010c, p. 62-63). USDA APHIS will be included in the design of this facility as early as possible to assist with planning. This facility will be surrounded by a brown treesnake barrier built to the specifications described above and will have inspection and quarantine areas to separate "clean" from "dirty" areas such that all aircraft, baggage, equipment, and cargo are 100 percent inspected upon arrival and 100 percent inspected upon departure. The aircraft carrier berthing will bring up to 59 aircraft to Guam that may beddown at AAFB. All transient aircraft will follow all existing invasive species inspection protocols, including brown treesnake protocols (DON 2010c, p. 83).

Naval Base Guam Operations

All amphibious training operations and conservation measures are assessed under the MITT Biological Opinion (USFWS 2015b, 66 pp.). Though new facilities will be constructed due to the proposed project, no additional amphibious training will occur in undisturbed areas, either new or increased frequency or tempo is proposed under the proposed project. Therefore, amphibious training will not be analyzed within this Biological Opinion.

New aviation training, called external load, will occur at Orote Airfield on NBG. The training requires access to pre-positioned cargo for practice, and ground access is needed for ground support team personnel. External loads cannot be carried across public roads or populated areas. External load training operations will involve one pass for landing zone orientation, followed by an approach of the landing zone, hovering approximately 30 ft (9 m) above ground level for approximately one minute while the ground support team attaches a load (e.g., concrete block, items in a cargo net, or a vehicle), departure of the landing zone vicinity with the load in tow, flying with the load in an arc, then returning to the landing zone with the load, and hovering for approximately 30 seconds while the ground support team retrieves the equipment, and then departing the landing zone vicinity. During each event, these operations will typically involve five repeated attachments and detachments of external loads at the same landing zone where the ground support team is positioned. Ground support teams will include up to 40 personnel at one time and will support landing zone operations. Approximately 10 to 12 wheeled vehicles (e.g., high mobility multipurpose wheeled vehicles) will be used by these teams. External load training will involve pick up and return from the same location on Guam.

Naval Munitions Site Operations

Company-level patrolling, jungle training, land navigation, and air-ground operations will occur on 5 to 7 consecutive days, 12 weeks per year, day and night, for a total annual throughput at the Naval Munitions Site of 1,440 Marines. Sixteen events are authorized under the MITT Biological Opinion (USFWS 2015b, 66 pp.), the number of days and weeks described above represent an increase of training events per year due to the proposed project (revised total of 28 events per year). This site is rural and rugged and is designated as the Southern Land Navigation Area, supporting foot land navigation training primarily for special forces personnel (USFWS

2015b, 66 pp.). Access to the NMS for training will occur via helicopter transport operations at proposed landing zones. Approximately eight CH-53 (heavy-lift transport helicopters) lifts will be required for a company-level training event. Personnel, hand-carried supplies, and equipment will typically be airlifted to the site on a Monday and lifted out on Friday of the same week. No other roads will be established and no vehicles will be used within the training site. The access road will have an associated parking area that will be periodically mowed to allow for parking and to reduce fuel loading and potential for fires. Foot trails will be established within the southern portion of the NMS due to repeated use during maneuver training.

Terrain flight, ground threat reaction, defensive maneuvering, confined area landing, and external load training will occur at the NMS. Terrain flights require a route with varying terrain for night flight with night-vision goggles, at 50 to 200 ft (15 to 61 m) above ground level. Training for terrain flights will occur only within the southern portion of the NMS, south of the southern extent of Fena Reservoir. Aircraft will leave AAFB and transit to southern Guam using standard military flight procedures (i.e., greater than 1,000 ft [305 m] above ground level). Aircraft may fly over land or over water on their way to the NMS. A typical training event may involve an aircraft leaving AAFB, moving to the east over the ocean, traveling along the coast at an altitude greater than 1,000 ft (305 m) until approximately the Talofofo River, and then flying up the river to the NMS still at an altitude equal to or greater than 1,000 ft (305 m). Flights may go up the Ugum River at altitudes of 1,000 ft (305 m) or greater above ground level until they reach 9,843 ft (3,000 m) from the mouth of the river at Highway 4 and then flights may conduct low-level terrain flights. Once the aircraft crosses into the NMS below Fena Reservoir (training restriction line), pilots will then be authorized to conduct low-level (50 to 200 ft (15 to 61 m) above ground level) terrain flights within the southern NMS. Low-level flights will not occur over the munitions bunkers, the main NMS, the area to the east of the munitions bunkers, over Fena Reservoir, or over the Almagosa Springs.

Ground threat reaction training requires a tactical flight maneuver area or route (similar to terrain flight routes) where ground-based electromagnetic radiation threat simulators may be placed. Defensive maneuvers are also conducted along a route over land or water. Differing helicopter types (AH-1, CH-53E, UH-1) and the MV-22 tilt rotor aircraft, will be used to conduct terrain flights, ground threat reaction, and defensive maneuvers training; however, terrain flights training operations are low altitude tactics and the ground threat reaction and defensive maneuvers training is conducted more in a tactical navigation area than along a route. Ground threat reaction is also low-altitude training like terrain flights, while defensive maneuver training is higher in altitude (equal to or greater than 1,000 ft [305 m] above ground level). Approximately 100 terrain flights, 94 ground threat reaction, 94 defensive maneuvers, and 1,104 maneuver lift flights per year will occur in the NMS.

Confined area landing training operations will also occur at the NMS. Confined area landing training consists of one pass of the landing zone for orientation, a downwind approach, followed by the landing, and takeoff. To meet qualification requirements, confined area landing training events typically will have five associated operations. Typically, a number of different, closely located landing zones, will be used during the training event. There will be approximately 125 confined area landing training operations per year at the NMS. Approximately 63 external load

training operations per year will also occur at the NMS and are described under "Naval Base Guam Operations".

Roadways

The proposed road projects on Guam will enable and improve roadway connectivity, capacity, and pavement strength for military construction and deployment in support of the proposed project. Some of these road projects will be funded by DoD pursuant to the Defense Access Roads program. The projects that are not funded by DoD will be the responsibility of the Government of Guam Department of Public Works or the Federal Highways Administration. Logistical routes for construction-related transport will connect the Port of Guam with NBG, AAFB, the proposed main cantonment, the NMS, and existing concrete batch plants, rock quarries, and precast concrete panel fabrication sites associated with the military buildup on Guam.

In addition to improvements to the construction routes, increased traffic associated with the presence of the military personnel and their dependents will require roadway modifications. As a result of the recent transportation and traffic studies on the island of Guam, 50 individual road projects have been proposed but would occur within urban areas. The more extensive roadwork projects will either occur within previously developed areas of Guam such as residential and commercial areas, or they will not entail impacts to woody vegetation or other natural resources potentially utilized by listed species (for instance, pavement strengthening will not require any additional disturbance to areas outside of the existing roadbed) (Table 4). However, the Agana Bridge 1 Replacement Project occurs along Route 1 and has the potential to impact wetland habitat.

Table 4. DON Actions Associated with the Military Relocation to Guam that are Carried Over from the 2010 DON BO (modified from Table 1-1, DON 2014a, p. 3)

Location	Action
AAFB	Location for the Marine Corps Air Combat Element and construction of associated facilities at AAFB North Ramp
AAFB	Construction of air embarkation facilities at AAFB South Ramp
AAFB	Construction of the North Gate and access road at AAFB, including a new Entry Control Point facility
Andersen South	Development of a training range complex to include maneuver training and landing zones
Apra Harbor	Waterfront functions at Apra Harbor to support embarkation, including wharf and utility upgrades, and associated berth dredging and dredge disposal management
Apra Harbor	Relocation of Military Working Dog Kennel
Apra Harbor	Relocation of U.S. Coast Guard
Apra Harbor	New Medical Clinic
Apra Harbor	Apra Harbor Embark Operations
Naval Munitions Site	Training activities, including aviation training and nonfiring operations training
Naval Munitions Site	Access to the NAVMAG area using the existing hiking trail as the access road (No Construction Required)

Naval Munitions Site	Use of Parsons Road area for the location of additional ammunition storage at NAVMAG
Roadway Project (by FHWA and Guam Department of Public Works[GDPW])	Route 1 and Route 8 intersection and improvement (Hagåtña) ("Guam Road Network" [GRN]1) – (Part of Hagåtña Bridge Replacement Project Scope)
Roadway Project(s)	Route 1 and Route 3 intersection and roadway improvements (Dededo) (GRN2)
Roadway Project	Replacement of Hagåtña (Agaña) Bridge #1 with reinforced concrete (GRN3)
Roadway Project	Route 11 roadway improvements from the port to Route 1, including pavement strengthening (GRN4)
Roadway Project	Widening of the Route 1 and Route 11 intersection, adding a second left turn lane and pavement strengthening (GRN5)

Term of the Proposed Action

The proposed project includes carry-over activities per the 2010 DON BO and new proposed activities as described above. The proposed construction activities would continue and occur over a 13-year period from 2015 to 2028. In addition, construction of the LFTRC is expected to be completed in January 2024. After the construction is completed, there will be about 6 months of equipment outfitting and testing before the range will be operational. There is no planned end date for the operation of the proposed action; therefore the duration of the project is indefinite.

CONSERVATION MEASURES TO AVOID OR MINIMIZE PROJECT IMPACTS

The project's conservation measures are designed to avoid or minimize project effects to listed species and their habitats or to contribute to the recovery of a listed species. The conservation measures are intended to represent a comprehensive summary of those measures that were proposed in the BA (DON 2014a), addendum to the BA (DON 2015b), and through discussions and email correspondence between the DON and the Service. Conservation measures are considered part of the proposed action and are vital to determining the scope of the proposed action. Implementation of conservation measures is required under the terms of the proposed action. The Service's effects analyses and determinations assume proposed project conservation measures will be implemented in full. Any changes to, modifications of, or failure to implement these conservation measures may result in a need to reinitiate this consultation. Modifications to aspects of the conservation measures described, that provide protection equal to or greater than the protection afforded by the measure, as it is proposed in this Project Description, may be substituted for those provided in this Biological Opinion with the Service's written concurrence. The conservation measures will be implemented prior to or concurrent with construction unless otherwise stated. After completing the conservation measures, the long-term management of the natural resources will be incorporated into the JRM INRMP (DON 2014a, p. 35). Based on discussions and meetings between the DON and Service, the Service understands that the implementation of the conservation measures would be the responsibility of the DON; however conservation measures over the long-term would be managed by the JRM. The JRM's mission is to provide executive level installation management support to all DoD components and tenants

through assigned regional installations on Guam and the Northern Mariana Islands in support of training in the Marianas.

General Conservation Measures to Contribute to the Recovery of Listed Species

1. Forest Enhancement

   The DON will implement a forest enhancement project on approximately 1,000 acres in Finegayan (Figure 3). The forest enhancement project will include:
   - Installation of ungulate exclusion fences around approximately 1,000 acres
   - Active removal of ungulates (i.e. trapping, snaring, shooting) with the goal of eradication within the fenced areas
   - Invasive plant removal
   - Propagation, planting, and establishment of dominant and rare species characteristic of native limestone forest habitats (e.g., *A. mariannensis*, *G. mariannae*, *F. prolixa*, *M. citrifolia*, *C. micronesica*, *W. elliptica*, *S. nelsonii*, *H. longipetiolata*, *T. rotensis*)

   When a DON-related project is initiated that results in clearing of recovery habitat, a commensurate amount of forest enhancement will begin. The exact amount of recovery habitat that will be cleared will depend on final design specifications. The DON's forest enhancement project will enhance at least the same number of acres of recovery habitat as that cleared by the proposed action. The DON expects that approximately 1,000 acres of forest will need to be enhanced as part of the Project Description (Table 6). The timeline of initiation of forest enhancement projects will be based on the construction timeline for the proposed action. The first construction funds that are released for a project that will clear recovery habitat will also trigger the initiation of the forest enhancement funding. The sequence of forest enhancement will be: (1) ungulate exclusion fence, (2) ungulate removal, (3) invasive plant control, and (4) native plant establishment.

2. Guam *Serianthes* Adult Tree

   a. DON will propagate, plant, and maintain a minimum of 30 individuals of *Serianthes nelsonii*, parented from the Guam *Serianthes* adult tree, within the forest enhancement areas. Outplanting methods and maintenance success criteria will be developed in coordination with the DON and the Service. Over the long term, the outplanted individuals will be managed by JRM through the JRM INRMP to ensure survivorship into adulthood.

   b. DON will ensure that seeds from the Guam adult Serianthes tree will be collected by entities specified on recovery permits, provide storage for these seeds, and provide funds for *Serianthes* seed viability testing. Seed storage and viability testing shall occur at a certified facility (*e.g.*, National Center for Genetic Resources Preservation or Lyon Arboretum). The DON will ensure the seeds are appropriately prepared or treated for shipping per the instructions of the certified facility.

c. The DON will protect the adult Guam *Serianthes* tree from ungulates through one of the following options.

i. DON will construct and maintain a fence, with a minimum buffer of 100 feet, around the forested area surrounding the Guam adult *Serianthes* tree to protect the tree and its seedlings from ungulates. The DON will remove all ungulates from the fenced area either prior to the completion of the fence construction or within six months of the fence construction.

OR

ii. DON will construct and maintain a fence around the LFTRC to encompass the area within the existing Ritidian ungulate fence (per the ISR Strike Biological Opinion and NWF Beddown project) and the Guam adult *Serianthes* tree. The DON will remove all ungulates from the fenced area either prior to the completion of the fence construction or within six months of the fence construction.

iii. This fence shall be completed within two years of award of the construction for the portion of the live fire training range complex that removes the Ritidian ungulate fence.

d. DON would allow access to the *Serianthes* adult tree at NWF for seed collection and seedling rescue provided (1) the need to collect seed and/or rescue seedling has been coordinated in advance with the Service, AAFB, and JRM, and (2) adequate timing and coordination is permitted for DON to process the access request. Access requests would be coordinated through Range Control, which is the entity responsible for scheduling all training events on military ranges.

3. Sea Turtle Public Outreach and Coordination

The DON, in cooperation with the Guam Department of Aquatic and Wildlife Resources (DAWR), has undertaken an educational program to inform military and civilian personnel about sea turtle nesting and the potential impacts to the species from nest disturbance, direct harassment of sea turtles, beach disturbance, and other threats. The DON has developed and distributed sea turtle conservation posters, tri-fold brochures and activity booklets for elementary school children. These educational materials have been distributed to local dive shops on Guam, and will continue to be used and refined throughout the construction period of the proposed relocation. As part of the RSS training package, personnel would be directed to not interact with sea turtles and report all sightings to the Service and coordinate with the GNWR on nesting surveys at the Refuge.

Brown Treesnake Control and Suppression

The DON has initiated support for large-scale, long-term efforts to refine methods for brown treesnake (BTS) control that will reduce the snake population on a landscape level more cost-effectively and increase the efficacy of capturing snakes in low-density situations. In early FY12, the DON coordinated with the Service, USDA, and U.S. Geological Survey (USGS) on priority BTS projects. The development of a bait formulation for BTS suppression was determined to be the highest priority project need. The USDA National Wildlife Research Center (NWRC) was funded for a multi-year project by the DON at the start of fiscal year 2013 to implement the bait formulation project.

The DON will implement selected projects identified as priorities in the BTS Technical Working Group Strategic Plan that are compatible with the military mission on Guam for up to 10 years from the start of main cantonment construction, subject to Congressional funding guidelines and restrictions. DON and the Service acknowledge financial support is subject to the availability of funds, and no provision herein shall be interpreted to require obligation of payment of funds in violation of the Anti-Deficiency Act, 31 U.S.C Section 1341.

The DON's intent with these projects is to identify and use successful technology to severely suppress or eradicate brown treesnakes. DON will install a BTS barrier to exclude brown treesnakes from approximately 160 acres (65 ha) after the current experimental suppression activities within the Habitat Management Unit (HMU) has been determined to be successful. If the DON is successful at eradicating brown treesnakes within the 160 acres, the DON will install a second brown treesnake barrier to exclude brown treesnakes from approximately 300 acres (121 ha).

In response to decreased BTS densities, the rodent and feral cat population is expected to increase. In order to address this anticipated increase the DON will implement rodent and feral cat control. Rodent control would benefit recovery habitat as rodents consume seeds of native plants. Feral cat control would benefit the recovery of endangered birds as cats predate on native birds.

Conservation Measures to Minimize the Effects of Construction

1. Contractor Education Program. The DON contractor education program ensures that construction contractor personnel are informed of the biological resources in the project area, including invasive species, special-status species, avoidance measures, and reporting requirements. The measure is intended to prevent inadvertent effects to terrestrial biological resources due to lack of awareness of resource presence, sensitivities, and protective measures. The measure will be implemented during pre-construction and construction.

2. Contractor Plans and Specifications: All construction will occur within the limits of construction shown in the plans and specifications. This measure is intended to prevent additional habitat loss. The measure will be implemented during pre-construction and construction.

3. Pre-Construction Surveys for the Mariana Fruit Bat. For projects within or in the vicinity of suitable fruit bat habitat, surveys following the Service-approved JRM protocol (USFWS 2009a) will be conducted one week prior to the onset of work. If a fruit bat is present within 492 ft (150 m) of the project site, the work will be postponed until the bat has left the area. The measure is intended to prevent avoid and minimize potential effects to fruit bats, and will be implemented during pre-construction and construction.

4. Guam Landscaping Guidelines. Appropriate or non-invasive species will be planted in all new landscapes. This measure is intended to reduce potential effects associated with non-native vegetation, promote habitat for native species, reduce water consumption, and reduce the need for fertilizers. The measure will be implemented during construction.

5. LFTRC Range Berm Controls. LFTRC range berms will contain native or non-invasive herbaceous vegetation, and other engineering controls. This measure will help to manage stormwater runoff and control erosion, and the berm will minimize the number of bullets that may fall outside the range footprint. The measure will be implemented during construction.

6. Lighting Installation. Lighting will be designed to meet minimum safety, sustainability, antiterrorism, and force protection requirements. Hooded-lights will be used to the maximum extent practicable at all new roads and facilities within known sea turtle land habitat and fruit bat roost areas. Either hooded or "night-adapted" lights will be installed at the LFTRC. Illumination of forest, coastline, or beach will be consistent with range safety and security requirements and kept to an absolute minimum including the shielding of lights and directing lighting away from the forest or other wildlife habitat. This measure will be implemented during pre-construction, construction, and during operations.

7. Monitoring. The DON will be responsible for oversight of avoidance, minimization, and conservation measures implementation by the contractors for projects associated with the proposed action. The DON shall ensure that construction remains within the limits of construction and that sensitive resources are avoided, unless otherwise specified in this Project Description. This measure will be implemented during pre-construction, construction, and operations.

Conservation Measures to Minimize the Effects of Invasive Species

Regional Biosecurity Plan. To address invasive species pathways and encourage a more holistic approach to managing invasive species, the DON funded the development of a Regional Biosecurity Plan (RBP) for Micronesia and Hawaii (formerly referred to as the Micronesia Biosecurity Plan). Individual activities for various species will continue, but the DON and others agree it is more efficient to manage pathways and prescribe corrective measures for a suite of species which will be monitored at discrete control points over time. The RBP will provide stakeholders in Micronesia and Hawaii with a platform for coordination and integration of inter-agency invasive species management efforts such as control, interdiction, eradication, and

research. The final RBP was completed in March 2015 (DON 2015c). Several of the recommendations are incorporated into the Project Description as BMPs:

1. Onsite vegetation waste management procedures. Green waste will be handled by the contractors at designated laydown areas within the limits of construction. Contractors will be required to divert all the green waste. The larger-sized green waste consisting of trees and stumps will be processed into mulch and the smaller sized green waste will be processed into compost. A proposed green waste processing facility at NBG Landfill may also be used to process green waste generated during construction. The DoD will seek permit authorization from the GEPA for the proposed green waste processing facility. (Refer above to Construction – Utilities and Site Improvements for additional detail.)

2. DON's Final Guam Landscaping Guidelines. The DON has developed a manual providing landscaping design guidelines specific to appropriate plant selection and establishment for all the DON construction activities on Guam (DON 2011). This manual implements required DON policies including, but not limited to:
    a. use of native regional plants for landscaping;
    b. design, use, and promoting construction practices that minimize adverse effects on natural habitat;
    c. pollution prevention by reducing fertilizer and pesticide use, integrated pest management practices, recycling green waste (composting), and minimizing runoff;
    d. implementing efficient water practices; and
    e. preventing the introduction of invasive species.

    The above measure is intended to reduce potential effects associated with non-native vegetation, promote habitat for native species, reduce water consumption, and reduce the need for fertilizers.

3. Biosecurity outreach and education - The DON has initiated and will continue to implement a targeted, comprehensive outreach and education program for DoD and civilian populations for biosecurity focused on prevention. As a starting point, the DON contracted for the development of biosecurity outreach and education materials. The contractor has designed and produced an activity booklet, a two-sided, tri-fold, educational brochure with an associated poster that differentiates native from introduced species, defines invasive species, describes the known impacts of invasive species on native species and ecosystems, and what can be done to prevent and control invasive species. This effort also included the development of radio public service announcements (PSA) in three languages, and a television PSAs both of which aired for one month in September of 2013 during peak broadcasting times.

    The DON's biosecurity outreach and education program has already begun concurrent with the actions that were initiated under the 2010 EIS ROD (DON 2010b). The DON will develop additional informational videos, expand the radio PSAs broadcasts, and other print media as well as active public outreach concurrent with the arrival of the first major influx of USMC personnel in 2020 and continue for an additional 5 years.

4. HACCP planning. Hazard Analysis Critical Control Point (HACCP) planning is a pathway management tool that provides a comprehensive method to identify risks and focus procedures to prevent spread of species through pathways. Construction work could unintentionally spread non-target (potentially invasive) species. These non-targets could hitchhike on construction equipment or be included in shipments of materials and supplies from locations outside of Guam. The pathways used by invasive species to move into new locations are not always obvious. Many problematic species, diseases, and parasites have been transferred to new locations as undetected (and unplanned) hitchhikers. HACCP planning is a management tool that provides a structured method to identify risks and focus procedures. Understanding pathways and developing plans to reduce non-target species and prevent biological contamination is necessary to avoid unintended spread of species.

   In August of 2011, the DON sponsored several HACCP training courses for DON employees and construction contractors. A HACCP Planning Overview for Managers was held on August 8, 2011, and 2 two-day HACCP Planning courses were held August 9 through 12, 2011. Over 60 people attended the three courses. Additional trainings are held at the various project sites when there is worker turnover.

   a. All construction contracts will contain a requirement to develop a HACCP Plan which will identify risks and potential pathways for non-native species and will outline procedures for controlling and removing risks identified. Construction contractors are required to provide documentation that supports prevention, worker awareness training, and control of non-native invasive and pest species in the project area and efforts to prevent the movement of non-native invasive species to areas outside the project area, whether in a purposeful or inadvertent manner. The contractor is responsible for ensuring that employees receive applicable environmental and occupational health and safety training and keep up to date on regulatory requirements for specific training for the type of work to be conducted onsite.

   b. Construction contracts also will contain a requirement for inspections and proper re-use or disposal of vegetation to avoid contributing to the further spread of the coconut rhinoceros beetle. The construction contractors are to identify and implement control measures to prevent the inadvertent movement of non-native, invasive species to Guam and to and from the project site to other locations. The contractor is required to establish appropriate facilities that comply with all environmental laws and regulations, provide training for proper vehicle hygiene, and promptly take corrective and preventative actions for noncompliance. This includes vehicle washdown and inspection for soil and other materials and appropriate control measures are implemented to prevent the inadvertent movement of non-native invasive species from the project site to other locations.

   c. All HACCP planning and implementation related to the proposed action will be the responsibility of the awarded project contractor(s) to ensure that proper

control measures are used throughout the construction activities to prevent the inadvertent movement of invasive species from one location to the project site, and/or from the project site to other locations. It will be the responsibility of DON to review and concur with the development phase of the HACCP planning process to ensure proper compliance by these contractors.

d. HACCP plans will be approved and inspected by the DON.

5. Monitoring to evaluate effectiveness of HACCP

The DON shall provide training, review, and technical guidance on HACCP plan development, implementation, and revision during the construction phase of the buildup on Guam. The HACCP planning covers Guam-related rapid response actions. The DON contracted a baseline ecosystem monitoring study for projects on AAFB in 2011. Transects were focused on areas where newly introduced species were most likely to occur. The intent of the project was to establish a baseline of both native and non native plants present prior to the beginning of planned construction activities. The baseline will serve as a reference for subsequent monitoring efforts conducted concurrently with construction in order to aid in evaluating the success of implemented HAACCP plans. The baseline will also provide a basis of comparison relative abundance of invasive species during construction as well as whether any species detected during long-term monitoring are newly introduced or were present prior to the beginning of construction. The AAFB project was completed in December 2012.

To document the effectiveness of the HACCP implementation at construction sites, the DON has developed and implemented a long-term monitoring program for terrestrial vegetation. For any clearing of vegetation that is adjacent to or contiguous with recovery habitat, the perimeter and 98.4 ft (30 m) into the habitat will be surveyed to identify vegetation community species composition. This survey will be repeated six months and at one year after vegetation removal to ensure effectiveness of HACCP implementation (clean equipment, supplies, and materials) during construction activities. If new nonnative, invasive species are detected, the DON will notify the Service and the DON will develop and implement an eradication plan or control effort to prevent infestation.

The DON will develop an early detection and rapid response component for when an incipient invasive species is discovered in the proposed action area.

6. Brown treesnake interdiction

a. JRM has established a comprehensive brown treesnake interdiction program to ensure that military activities, including the transport of civilian and military personnel and equipment to and from Guam, do not contribute to the spread of brown treesnake to other islands or regions. Brown treesnake interdiction requirements are specified in DoD instructions (i.e., 36 Wing Instruction 32-7004, Brown Tree Snake Control Plan and COMNAVMAR Instruction 5090.10A,

Brown Tree Snake Control and Interdiction Plan). The proposed action will continue to comply with these established procedures.

b. The DON will fund any increase of current federally funded brown treesnake interdiction measures (in Guam, CNMI, and Hawaii) where the increase is related to direct, indirect and induced growth caused by the USMC relocation to Guam. The fiscal year (FY) 2010 level of funding for the Federal interagency BTS interdiction effort on Guam, CNMI, and Hawaii and 2010 transportation levels associated with outbound cargo from Guam for the U.S. or U.S. territories will be used as the baseline. Any increase in funding will continue and become part of the DON's Brown Treesnake interdiction funding under authority of the Brown Tree Snake Control and Eradication Act (7 USC § 8501 note) (USFWS 2010a). The Service agrees that it is not DON's responsibility to fund increased interdiction measures *that are identified* more than one year after the end of the fiscal year both USMC relocation construction has ended and the permanent non-transient USMC military units have relocated to Guam. For the purposes of this Project Description, interdiction is defined as: "to hinder, prohibit, or prevent the brown treesnake from becoming established in new locations by conducting inspection and suppression processes."

   Since the original BO on DON was issued in 2010, the DON has worked with USDA and the Service to determine brown treesnake interdiction cost increases. To date, there has been no measurable increase in interdiction costs according to USDA.

c. Coordination with the USGS regarding the Brown Treesnake Research Closed Population Facility at NWF (located adjacent to the LFTRC and SDZ) – The DON will ensure through briefings or information packages that the personnel using the LFTRC know the importance of the facility and maintaining the integrity of the fence. An SOP will be developed as part of the Range Management Plan for the LFTRC to ensure the above and that USGS will be immediately notified in the event that the fence is accidentally damaged so the fence can be quickly repaired.

Conservation Measures to Minimize the Effects of Fire

The LFTRC and the Hand Grenade Range would be managed in accordance with Marine Corps Order (MCO) 3550.10, Policies and Procedures for Range Training Area Management, which addresses safe, efficient, effective, and environmentally sustainable use of the range area and includes fire management.

Fire management is a key component of range management. The DON goal is to reduce the effects of fires by limiting their frequency, size, and severity while still allowing the USMC to maintain a high level of combat readiness. In order to avoid or minimize impacts to listed

species or recovery habitat, the range management plan will include the following elements of fire management:

1. A Fire Danger Rating System tailored to the specific military uses at the LFTRC and the local weather and fuel conditions will be established. Weather readings will be taken every hour by remote automated weather stations (RAWS) on the installation. This information is immediately available to Range Control, who will use the output from the remote automated weather stations to determine the level of fire danger. This, in turn, determines any restrictions placed on military training for that hour. Restrictions are relayed to troops in the field via radio transmission. By restricting highly fire prone activities during periods of high fire danger, the likelihood of a fire start is reduced. Additionally, fires that are ignited are more likely to occur during periods of low or moderate fire danger, making them easier to control and extinguish.

2. Fuels management. All available fuel management techniques will be considered for fire break, fuel break, or fuel management area. Standard on-the-ground application is limited to mechanical cutting, herbicide application, and prescribed fire. If herbicide is to be applied, care will be taken to ensure there is no overspray into adjacent forested areas.

3. Locations and standards of fire breaks and fuel breaks. Fire breaks are similar to four-wheel-drive roads and are cleared of all vegetation to mineral soil. Fuel breaks are swaths of cut, burned, grazed or otherwise modified vegetation so that a fire's behavior is reduced. The fuel break widths are determined by fuels, topography, and prevailing winds. Fuel management corridors will be established and maintained providing areas through which fire will not carry. These corridors will provide several distinct areas where fire may be contained in order to prevent a catastrophic fire event. Each corridor will be approximately 100 to 300 m wide, although terrain, safety concerns, or protected resources may constrain the width in some areas. Fire breaks and fuel breaks shall be established immediately adjacent to the forest edge, along the outer perimeter of each range, so that there is no herbaceous vegetation along the edge of the forest.

   Fuel specifications within the corridor require that canopy cover not exceed 20 percent. Cover of fuel within the fuel management corridors will be measured at a scale of 10 meters. Within the fuel management corridors, no 10- by 10-meter area will have greater than 20 percent cover of fuel. Cover ‘starts/stops’ at the edge of a plant clump's canopy. The clump includes the dead herbaceous fuel on the ground. The frequency of a fuel break's upkeep is dependent on the speed of regrowth and/or colonization. If the vegetation within the range footprint is less than three feet tall, then no active management would be needed to maintain fuels at the < 3-ft height in the 40-60-m inner edge of the fuel break area.

4. Standard Operating Procedures (SOP). SOPs outline responsibilities for fire prevention, Fire Danger Rating System usage, staffing levels, equipment caches, fuel modifications, proper fire suppression actions, and post-fire reports. The SOPs also include fire prevention briefings to be given to range users prior to commencement of training,

notification lists in case of fire, operational decision charts for fires, and maps of resources, fuels, fire breaks, and Fuel Management Areas.

5. Range Control approval and guidance. Prior to firing all pyrotechnics (including tracers), Range Control approval and guidance must be obtained. Fire Department and Range Control personnel will have the authority to stop live-fire training for non-compliance with any training regulation and/or SOPs.

6. Fire Suppression. Water trucks (pickup truck with a tank in the back) will be on-site as a first responder vehicle. Water trucks may be supported by a fire truck or helicopter, as warranted.

7. The Service will be provided a 30-day review period, from the date of receipt of the draft draft Range Management Plan (including the fire management plan), to provide comments and recommendations for the DON's consideration. The Rire Management Plan will be finalized for the LFTRC prior to operation of the first range at the LFTRC.

Conservation Measures to Minimize the Effects of Training

1. Aviation Training in NMS (see Naval Munitions Site Operations above in the Project Description). All aviation training will be conducted so that flights will approach the southern portion of the NMS over the Talofofo River watershed and Fena Reservoir at heights of 1,000 ft (305 m) or greater above ground level. Flights may go up the Ugum River at altitudes of 1,000 ft (305 m) or greater above ground level until they reach 9,843 ft (3,000 m) from the mouth of the river at Highway 4 and then flights may conduct low level terrain flights. Low-level training flights will be restricted to the southernmost portion of the NMS where Mariana swiftlets are not commonly present. This measure is intended to avoid and minimize effects to swiftlets, and will be implemented during operations.

2. Ground Training in NMS (see Naval Munitions Site Operations above in the Project Description). The DON will maintain 328-ft (100-m) no training buffers around the known Mariana swiftlet nesting caves (*e.g.*, Mahlac Cave, Fachi Cave, Maemong Cave) in NMS. This measure is intended to avoid and minimize effects to Mariana swiftlets, and will be implemented during operations.

C. OTHER ACTIONS CONSIDERED FOR THE ANALYSIS

Although not part of the project description, a Memorandum of Agreement (MOA) between the DON and the Service regarding conservation of the Guam Micronesian kingfisher recovery habitat in northern Guam was signed by both parties on June 11, 2015. The purpose of the MOA is to ensure that a sufficient amount of suitable survival and recovery habitat (thereinafter "habitat") is conserved and managed in accordance with Federal agency obligations under section 7(a) of the ESA in northern Guam to support the reintroduction of the Guam Micronesian kingfisher (kingfisher). Another purpose of the MOA is to ensure that the DON meet the

purpose and need for the proposed action to relocation the USMC to Guam (DON and Service 2015c, p. 1; also see Appendix B).

The Service has determined that approximately 8,178 total acres are required on lands currently under the custody and control of DoD in northern Guam to provide sufficient habitat for the reintroduction and eventual recovery of the kingfisher. To facilitate kingfisher recovery goals, the DON agrees to designate approximately 5,234 acres under the custody and control of the DoD in northern Guam as identified in the MOA (DON and Service 2015c). These 5,234 acres have been identified by the Service as habitat for the kingfisher needed to offset impacts of the Guam Military Relocation (the proposed action). The DON and Service recognize that the designation of the 5,234 acres may also provide a conservation benefit to other federally-listed species with similar habitat requirements (*e.g.*, Mariana crow, Mariana fruit bat) (DON and Service 2015c, p. 3).

For the 5,234 acres of land identified, the Service required enhanced management activity to ensure this habitat supports the reintroduction of the kingfisher. Accordingly, starting in fiscal year 2016, the DON commits to provide an additional $2 million per year of funding for management activities above execution year INRMP funding levels (adjusted for inflation) for the next ten years, subject to Congressional authorization and appropriation. Upon expiration of this ten-year period, parties will reassess progress of recovery efforts and future funding may be available from DON (see section V4 of MOA, DON and Service 2015c).

D. ANALYTICAL FRAMEWORK FOR THE JEOPARDY/ADVERSE MODIFICATION ANALYSES

Jeopardy Determination

In accordance with policy and regulation, the jeopardy analysis of this Biological Opinion relies on four components: (1) *Status of the Species*, which evaluates the range-wide condition of the Guam Micronesian kingfisher (kingfisher), Mariana crow (crow), Guam rail (rail), Mariana fruit bat (bat), and *Serianthes nelsonii*, the factors responsible for that condition, and the survival and recovery needs of each species; (2) the *Environmental Baseline*, which evaluate the current condition of the kingfisher, crow, rail, bat, and *S. nelsonii* in the action area, the factors responsible for that condition, and the relationship of the action area to the survival and recovery of each affected species; (3) the *Effects of the Action*, which determines the direct and indirect impacts of the proposed Federal action and the effects of any interrelated or interdependent activities on the kingfisher, crow, rail, bat, and *S. nelsonii*; and (4) *Cumulative Effects*; which evaluates the effects of future, non-Federal activities in the action area on the kingfisher, crow, rail, bat, and *S. nelsonii*.

In accordance with the policy and regulation, the jeopardy determination is made by evaluating the effects of the proposed Federal action in the context of the kingfisher, crow, rail, bat, and *S. nelsonii* current status, taking into account any cumulative effects, to determine if implementation of the proposed action is likely to cause an appreciable reduction in the likelihood of both the survival and recovery of the kingfisher, crow, rail, bat, and *S. nelsonii* in the wild.

The jeopardy analysis in this Biological Opinion places an emphasis on consideration of the range-wide survival and recovery needs of the kingfisher, crow, rail, bat, and *S. nelsonii* and the role of the action area in the survival and recovery of the kingfisher, crow, rail, bat, and *S. nelsonii* as the context for evaluating the significance of the effects of the proposed Federal action, taken together with cumulative effects, for purposes of making the jeopardy determination.

Adverse Modification Determination

This Biological Opinion does not rely on the regulatory definition of "destruction of adverse modification" of critical habitat at 50 CFR 402.02. Instead, we have relied upon the statutory provisions of the ESA to complete the following analysis with respect to critical habitat.

In accordance with policy and regulation, the adverse modification analysis in this Biological Opinion relies on four components: (1) the *Status of Critical Habitat*, which evaluates the range-wide condition of designated critical habitat for the kingfisher, crow, and bat in terms of primary constituent elements (PCEs), the factors responsible for that condition, and the intended recovery function of the critical habitat at the range-wide scale; (2) the *Environmental Baseline*, which evaluates the condition of the critical habitat in the action area, the factors responsible for that condition, and the recovery role of affected critical habitat units in the action area; (3) the Effects of the Action, which determines the direct and indirect impacts of the proposed Federal action and the effects of any interrelated or interdependent activities on the PCEs and how that will influence the recovery role of affected critical habitat units; and (4) *Cumulative Effects*, which evaluates the effects of future, non-Federal activities in the action area on the PCEs and how that will influence the recovery role of affected critical habitat units.

For the purpose of the adverse modification determination, the effects of the proposed Federal action on kingfisher, crow, and bat critical habitats are evaluated in the context of the range-wide condition of the critical habitat at the range-wide scale, taking into account any cumulative effects, to determine if critical habitat at the range-wide scale would remain functional (or would retain the current ability for PCEs to be functionally established in areas of currently unsuitable but capable habitat) to serve its intended recovery role for the kingfisher, crow, and the bat.

The analysis in this Biological Opinion places an emphasis on using the intended range-wide recovery function of kingfisher, crow, and bat critical habitats and the role of the action area relative to those intended functions as the context for evaluating the significance of the effects of the proposed Federal action, taken together with cumulative effects, for purposes of making the adverse modification determination.

E. ACTION AREA

The term "action area" is defined in the implementing regulations for section 7 at 50 CFR 402.02 as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action."

The action area for this consultation is the island of Guam (Figure 4). The specific areas likely to be affected, directly or indirectly, by the proposed action are discussed in detail in the BA. In

addition to what is detailed in the BA, the following effects from the action may be Guam-wide: 1) effects from introduction of invasive species by the proposed action could spread throughout the whole island of Guam and 2) the population increase resulting from the proposed action will cause additional human disturbance throughout the island, including at recreation sites, hunting areas, traffic along roads, etc.

F. STATUS AND ENVIRONMENTAL BASELINE OF THE SPECIES

STATUS OF THE SPECIES

Status of the Guam Micronesian Kingfisher

Legal Status

The Guam Micronesian kingfisher (*Todiramphus cinnamominus cinnamominus*; "sihek" in Chamorro; hereafter, referred to as the kingfisher) was listed under the ESA as endangered in 1984 (USFWS 1984, 9 pp.). A revised recovery plan for the kingfisher was completed in 2008 (USFWS 2008a, 117 pp.). On October 28, 2004, the Service designated critical habitat for the kingfisher on approximately 376 ac (152 ha) in the fee simple portion of the GNWR (USFWS 2004, 117 pp.).

Species Description and Current Known Range

The kingfisher is endemic to the island of Guam in the Mariana Islands. Other subspecies, *Todiramphus* [=*Halcyon*] *c. pelewensis* and *T. c. reichenbachii*, exist on Palau (Republic of Palau) and Pohnpei (Federated States of Micronesia), respectively. The Guam subspecies is a small, sexually dimorphic forest kingfisher (Baker 1951, pp. 227–228). The adult male has a cinnamon-brown head, neck, upper back, and underparts. A black line extends around the back of the neck and the eye ring is black. The adult female resembles the male except that the upper breast is paler, as are the chin and throat, with the rest of the underparts and underwing coverts white (Jenkins 1983, p. 21). Immature birds have the crown washed in greenish-blue, and a whitish chin and throat. Underparts are buffy-white in the immature male, but may be paler in the female (Jenkins 1983, p. 21).

The kingfisher is extirpated in the wild on Guam but persists in captivity at the Guam DAWR facility and 24 U.S. mainland zoos and institutions. In response to the decline of Guam's native birds in the 1980s, the Association of Zoos and Aquariums (AZA) initiated the Guam Bird Rescue Project. Between 1984 and 1986, 29 kingfishers were translocated from Guam to zoos in the U.S. mainland to start a captive breeding program. The breeding program has been managed under the auspices of the AZA's *Micronesian Kingfisher Species Survival Plan* (Bahner et al. 1998, 54 pp.).

Life History

In the wild, kingfishers nest in cavities and feed primarily in mature, second growth limestone forest, and, to a lesser degree, in scrub limestone forest (Jenkins 1983, pp. 22–23). Kingfishers

are also known to use coastal strand vegetation containing coconut palm as well as riparian habitat. However, Jenkins (1983, p. 22) reported the kingfisher was probably most common along the edges of mature limestone forest. Few data exist about specific nest sites of the kingfisher in the wild, but in one study in northern Guam (Marshall 1989), 16 nest sites were correlated with closed canopy cover and dense understory vegetation. The report by Marshall (1989) indicated that kingfisher nest cavities were excavated from the soft, decaying wood of standing dead trees averaging 43cm (17 in) in diameter (Marshall 1989, p. 475). Kingfisher nests have been reported in a number of tree species including *Ficus* spp. (banyan), *Cocos nucifera* (coconut), *Artocarpus* spp. (breadfruit), *Pisonia grandis* (umumu), and *Tristiropsis obtusangula* (faniok) (Baker 1951, p. 228; Jenkins 1983, p. 24; Marshall 1989, p. 475).

Kingfisher breeding activity in the wild is thought to be concentrated from December to July (Baker 1951, p. 228; Jenkins 1983, p. 24). Pairs may excavate their own nests in soft trees, arboreal termitaria (the nests of termites [*Nasutitermes* spp.]), arboreal fern root masses, or they may utilize available natural cavities such as broken tree limbs (Jenkins 1983, p. 24; Marshall 1989, p. 474). Jenkins (1983, p. 23) observed that some excavated cavities were never used as nesting sites, which suggests that the process of excavating nest sites may be important in pair-bond formation and maintenance.

Both male and female kingfishers incubate eggs, and brood and feed nestlings (Jenkins 1983, p. 24). Clutch sizes from wild populations (n=3) were either one or two eggs (Baker 1951, p. 228; Jenkins 1983, p. 24) and clutch sizes of one to three eggs have been reported in the captive population (Bahner et al. 1998, p. 21). Incubation, nestling, and fledgling periods for populations of kingfishers in the wild are unknown. However, incubation and nestling periods of captive birds averaged 22 and 33 days, respectively (Bahner et al. 1998, p. 21).

Although there is still more to learn about the breeding behavior of Guam Micronesian kingfishers, it is known that the nest excavation and courtship stages are crucial to successful reproduction. Kingfishers excavate multiple cavities in trees before selecting a suitable nest site. Courtship includes cavity excavation, male feeding the female, and vocal duetting (simultaneous calling between members of a pair). These activities are common and are thought to function in both pair-bond maintenance and territorial maintenance (USFWS 2008a, p. 24; Bahner et al. 1998, p. 18). The breeding season for this species on Guam is reported to range from December to June, however, within the managed population (in captivity) we have seen reproduction in all months of the year with January through July being the prime breeding period. During the breeding season, it is important to minimize disturbance within the territorial range of breeding pairs. Based on experience with the managed population, Guam kingfishers are especially sensitive to stress which would likely be increased by noise and disturbance, and compounded during the breeding season (B. Bahner, Philadelphia Zoo, pers. comm. 2015). Additionally, anything that disrupts the availability of prey items in their territory would be detrimental would negatively affect kingfishers. There is no known recommended buffer around active kingfisher nests; however in captivity nesting kingfishers have sometimes been monitored by cameras to avoid disturbing breeding birds (Bahner et al. 1998).

In the wild, the kingfisher is known to feed on invertebrates and small vertebrates, including insects, segmented worms, hermit crabs, skinks, geckoes, and possibly other small vertebrates

(Marshall 1949, p. 210; Baker 1951, pp. 228–229; Jenkins 1983, p. 23). The species typically forages by perching motionless on exposed branches or telephone lines and swooping down to capture prey off the ground with their bill (Jenkins 1983, p. 24). They also will capture prey off nearby foliage and have been observed gleaning insects from bark (Maben 1982, p. 78).

Records of kingfisher distribution and intraspecific territorial behavior suggest this species maintains exclusive year-round territories in the wild (Jenkins 1983). Research and observations of the related Pohnpei kingfisher show this species has a "helper" social system where birds from previous nests may stay in the parental territory for several years. Pohnpei kingfishers defend their approximately 8.1 hectare (20 ac) territories from conspecifics (Kesler and Haig 2007a, pp. 386-387). Kesler and Haig (2007b, pp. 769–770) determined that kingfisher home ranges on Pohnpei consist of mixed forest and open areas and at least part of this area includes mature forest. It should be noted that Guam Micronesian kingfisher territories may differ from Pohnpei Micronesian kingfisher territories due to differences in forest structure (Mueller-Dombois and Fosberg 1998, pp. 269–275, 288–291). However, information on the related Pohnpei kingfisher as a surrogate species to the Guam Micronesian kingfisher represents the best available scientific information on kingfisher territory size and home ranges in the Pacific islands to date.

The life expectancy of the kingfisher in the wild is unknown. However, demographic data from captive kingfishers suggest that life history traits such as lifespan and reproductive span differ between the sexes. In captivity, males have a longer lifespan (23 years) than do females (15 years). Both males and females can reproduce at 1 year of age. In captivity, males have been observed to breed as old as 19 years, while females have not been observed to breed beyond the age of 12 (AZA 2014, p. 4).

Current Status

The kingfisher is currently extirpated from the wild. It was considered "fairly common" and occurred throughout forested areas on Guam in 1945 (Baker 1951, p. 229). Populations in southern and central Guam disappeared by the 1960s (Jenkins 1983, p. 25) and 3,023 individuals were recorded in 1981 in northern Guam (Engbring and Ramsey 1984, p. 34). The northern Guam population subsequently declined rapidly, and by 1985, fewer than 30 individuals were recorded on Guam (Marshall 1989, p. 474) and the taxon was considered extirpated from the wild by 1988 (Wiles et al. 2003, p. 1,354). Predation by the brown treesnake is considered the main cause of the decline of the kingfisher population on Guam (Savidge 1987, USFWS 2008a, p. iv). Between 1984 and 1986, 29 kingfishers were captured and sent to zoological institutions in the U.S. mainland (Hutchins et al. 1996, p. 4). Currently, the captive population consists of 155 adult kingfishers (86 males and 69 females) in captive rearing facilities (GMKF Recovery Team 2015, p.3). In 2015, the Service provided funding to the Boorkfield Zoo in Illinois to install 30 new cages, which would increase the population by more than 25 percent.

The goal of the captive kingfisher propagation program is to grow the population while trying to maintain genetic diversity above 90 percent heterozygosity. The current captive population was founded by 16 of the 29 individuals brought into captivity. The current gene diversity is 87.74 percent; with the potential to reach 92.45 percent (AZA 2014, p. 4).

Threats (see also the General Environmental Baseline section of this Opinion)

The Service intends to reintroduce the kingfisher into the wild on Guam. For that effort to be successful, the following threats need to be addressed. The following discussion is adapted from Service (2014, p. 2):

- Loss or Degradation of Habitat
    - Incremental habitat loss due to fire, especially in southern Guam (Department of Agriculture 2010), and urban and agricultural development is increasingly threatening the long-term conservation of the kingfisher because of the continued loss of habitat on Guam.
    - Ongoing and proposed plans by DoD to expand training and operations on Guam are threatening much of the remaining kingfisher habitat.
    - The persistence of large, feral ungulate populations is likely to further degrade remaining forest habitats, thus lowering their value for kingfisher recovery.

- Predation
    - Predation risk from brown treesnakes currently prevents effective reintroduction of the kingfisher to Guam.

- Stochastic Events
    - Typhoons will continue to degrade forest and the affected forest areas may require several years to regenerate.
    - Although birds in the Mariana Islands have evolved with typhoons, typhoons in concert with low population numbers, habitat loss, and behavioral and genetic consequences of captive breeding could negatively affect the recovery of the Guam Micronesian kingfisher.
    - Climate models indicate that hurricanes in the northwestern Pacific are expected to increase in intensity, frequency, and duration by 2200 and continue to increase further into the future (Emanuel et al. 2008, p. 360). These storm increases will likely have a significant effect on habitat and survival of listed species on Guam.

Survival and Recovery Needs

For purposes of this Opinion, the "survival condition" of the kingfisher in the wild represents the level of reproduction, numbers, and distribution necessary to support a persistent population on Guam that is fully protected by the ESA. For purposes of this Opinion, the "recovery condition" of the kingfisher is the survival condition where the threats to the species have been addressed such that the protections of the ESA are no longer necessary to ensure perpetuation of the survival condition of the kingfisher in the wild.

The recovery plan (USFWS 2008a) for the kingfisher calls for a total viable population of 2,000 adult kingfishers on Guam within two subpopulations of 1,000 adults each. One subpopulation would be located in northern Guam, and one subpopulation would be located in southern Guam to reduce the risk of a second extirpation event due to random, stochastic events. For the purpose of population viability modeling to identify viable subpopulations that would meet a minimum population growth rate to achieve recovery, we assumed that the 1,000 adults are 500 breeding pairs (see Environmental Baseline section for kingfisher). The area requirements for a breeding pair (approximately 20.0 acres; Kesler and Haig, 2007a) is less than the combined area for an individual non-breeding adult male (average of 17.5 acres; Kesler and Haig 2007a) and an individual non-breeding adult female (average of 14.1 acres; Kesler and Haig 2007a). Thus the total area for recovery will be minimized by assuming all 1,000 adults are in breeding pairs. Additional area may be needed if a significant number of adult kingfishers forgo breeding in any year.

Each subpopulation must have brown treesnakes and other predators controlled to a level where establishment of a sustainable kingfisher population is feasible and habitat to support this population level must be protected and managed. In the interim, the kingfisher also may need to be established in the wild on other islands outside their native range to reduce the detrimental consequences of long-term captivity and to spread the risk from stochastic events. Although any population(s) established on other islands outside of the kingfisher's historical range would be considered temporary and would not contribute toward the recovery goal of two subpopulations of 1,000 adults each on Guam, the ability to translocate wild birds versus captive birds to Guam would increase success of their recovery and survival on Guam. However, ultimately the recovery of the kingfisher is dependent on having adequate protected habitat free of threats on Guam to provide for the two subpopulations.

New management actions that have occurred in the last five years include:

- Construction of the 136-ac (55-ha) Habitat Management Unit (HMU) brown treesnake and ungulate exclosure fence at Anderson Air Force base. Ungulate removal within the HMU is near completion by DoD per a section 7 consultation requirement (USFWS 2006b).
- In 2014, the USDA-APHIS Wildlife Services, in coordination with the National Wildlife Research Center, the DoD-Environmental Security Technology Certification Program, and the Department of Interior-Office of Insular Affairs, conducted a test of aerial application of a brown treesnake toxicant (acetaminophen) over forested areas in AAFB (Dorr et al. 2014, unpublished data). The results of this study within the approximately 136-acre (55-hectare) HMU on AAFB may result in the reduction of snake numbers to a low enough level to allow kingfishers to survive and reproduce within this snake-proofed area on Guam. The knowledge gained from this study will help with potential future improvements to the method and efficiency of the delivery of the acetaminophen to snakes on Guam.
- Construction of a 312-ac (112-ha) ungulate exclosure fence at Northwest Field on AAFB by DoD per Biological Opinion requirements (USFWS 2006b and USFWS 2006c).

- Construction of a multi-species exclosure fence within the fee simple portion of the GNWR at Ritidian Point, Guam.
- Construction of 4,400 ft of coated chain link fence along Route 2A on the perimeter of NBG by DoD per Biological Opinion requirements (USFWS 2010a). The fence provides an ungulate exclosure for the 3,114 ac (1,260 ha) of the main base of NBG. The fencing project is intended to effectively close off Orote peninsula from any new ungulate incursions and only entry control gates will be left unfenced. Ungulate removal within NBG is ongoing.

Recommendations for Future Actions (adapted from USFWS 2008a; USFWS 2014a, p. 3):

- Maintain or increase genetic diversity in the captive kingfisher population by implementing management strategies to exploit the potential gene diversity in the captive populations at the DAWR and AZA facilities.

- Predator Monitoring and Control
  - Continue efforts to develop and refine brown treesnake control techniques and support small-scale and large-scale control and/or eradication efforts on Guam.

- Reintroduction / Translocation
  - Develop a reintroduction plan for the kingfisher on Guam and set aside and protect recovery areas to facilitate its de-listing as soon as possible following the reintroduction of the kingfisher on Guam.

- Protection and restoration of kingfisher recovery habitat, including permanent protection as conservation areas and fencing to exclude brown treesnakes and ungulates.

Status of the Mariana Crow

Legal Status

The Mariana crow ("aga" in Chamorro) was listed as endangered throughout its range in 1984 and critical habitat was designated on Guam and Rota (USFWS 1984, pp. 33881-33885; 2004, pp. 62944-62990). No significant new information regarding the biological status has come to light since listing to warrant a change in the federal listing status of the Mariana crow. On October 28, 2004, the Service designated critical habitat for the Mariana crow on approximately 376 ac (152 ha) in the fee simple portion of the GNWR (USFWS 2004, 117 pp.).

Species Description and Known Range

The Mariana crow is the only member of the genus *Corvus* occurring in Micronesia (Jenkins 1983, p. 25). This species is known historically only from the islands of Rota and Guam, but is now extirpated from Guam. Preliminary genetic studies indicate that the Rota population is most likely a genetic subset of the Guam population (Tarr and Fleischer 1999, p. 946).

Life History and Population Dynamics

Mariana crows are omnivorous, and their diet includes a wide variety of plants and animals, including insect larvae, centipedes, grasshoppers, mole crickets, praying mantis, earwigs, hermit crabs, skinks, geckos, and bird eggs (Jenkins 1983, p. 26, 31; Tomback 1986, p. 399; Ha and Ha 2010a, pp. 8-10; Faegre *in press*). Faegre (*in press*) observed 619 food captures from approximately 36 wild crows and found that 14 percent of food captures were of plant-based foods, and 86 percent were from animal prey; 65 percent of animal prey were of insects or their larvae.

Mariana crows use forested habitats including limestone, strand, ravine, agricultural forests, and secondary forests (Jenkins 1983, p. 25, 32). However, evidence suggests they are most abundant in native limestone forests (Morton et al. 1999, p. 13, 41; Ha et al. 2011a, p. 25; Ha et al. 2011b, p. 240) and nests are found exclusively in native trees (Morton et al. 1999, p. 13, 33; Ha et al. 2011a, 2012, and 2013, pp. 32, 25, and 24-31, respectively). Nesting occurs in closed canopy forests in trees that are on average 17 cm in diameter at breast height, 8.7 m high, and 290 m from roads (Morton et al. 1999, p. 32).

Breeding likely occurs all year on Rota, while peak nesting activity generally occurs between August and February (Morton et al. 1999, p. 12; Ha et al. 2013, p. 31). A minimum of 65 days is necessary to build the nest, incubate the eggs, and rear the brood through fledging (Morton et al.1996, p. 21). Both parents generally participate in all aspects of breeding, although the female incubates most of the time (Morton et al. 1996, p. 21). The incubation period is 21 to 23 days, and the nestling period is 36 to 39 days (Morton et al. 1996, p. 21). After fledging, Mariana crows will typically remain in family groups until the following breeding season, a period that averaged 241 days (SE = 33, median 197 days) for 15 banded family groups (Morton et al. 1996, p. 21). However, the period of parental attendance after fledging varies widely, from 99 to 537 days (USFWS 2005a, p. 19). Mariana crows will often reinitiate the nest cycle within two weeks after abandoning an empty nest, and within four weeks after losing a clutch or brood (USFWS 2005a, p. 18).

Mariana crows generally produce only a single brood per year; however, nest failure and other factors lead to multiple nest attempts each breeding season. From 1996 to 1999, 32 crow pairs on Rota constructed a mean of 2.2 nests per year (SE = 0.14, n = 78), with one pair building as many as seven nests in one season; however, not all nests resulted in egg deposition (Morton et al. 1999, p. 14, 36). Zarones et al. (2014, pp. 6-7) examined 204 active nests on Rota from the 1996 to 2009 breeding seasons and documented, on average, a clutch size of 2.57 (SD = 0.8, n = 82), 1.39 nestlings per nest that hatched (SD = 0.5, n = 106), 1.25 fledglings per nest that fledged (SD = 0.4, n = 68), and an overall nest success rate of 25.7 percent. The proportion of monitored pairs that produced at least one fledgling per breeding season ranged from 0.21 to 0.73, with an overall rate of 0.49 over the entire study period. During the 2013 breeding season, 16 of the 46 pairs (35 percent) successfully fledged young (Kroner 2014, p. 3). The estimated pair breeding success rate for 2013 was down from 60 percent in 2008 (Zarones et al. 2014, p. 7) and 57 percent in 2012 (Ha et al. 2013, pp. 59-60).

Little is known regarding lifespan, age of sexual maturity, and length of reproductive life in Mariana crows. The oldest known wild crow was at least 18 years old when last observed on Rota in 2014 (A. Kroner and S. Faegre, University of Washington, pers. comm. 2014). This same adult male was at least 17 years old when he was last seen feeding a fledgling in 2013. Another male was 14 years old when he last produced a chick in 2009, and a 15-year-old female was observed with a fledgling in 2014 (S. Faegre, University of Washington, pers. comm. 2014). Although it was originally thought that Mariana crows begin breeding around 3.5 years old (Morton et al. 1999, p. 2), a radio-tagged male Mariana crow built his first nest at 16 months of age and was observed feeding a fledging at 21 months of age. Two other banded crows, a female and a male, successfully fledged young in 2011 and 2013, just after they turned two years old (A. Kroner and S. Faegre, University of Washington, pers. comm. 2014). A banded female was observed at a recently failed nest when she was approximately 1.5 years old (A. Kroner and S. Faegre, University of Washington, pers. comm. 2014).

Survival to one year of age for male and female Mariana crows banded on Rota between 1990 and 2010 was 49.9 and 75.2 percent, respectively (Ha et al. 2010b, p. 25). Annual survivorship for adult males and females was 83.5 and 82.7 percent, respectively (Ha et al. 2010b, pp. 25-26). Recent analyses suggest that first-year survival has increased to 0.65 and adult survival has remained steady at about 0.80 since 2010 (R. Ha, University of Washington, pers. comm. 2014).

Mariana crows are known to be highly susceptible to disturbance from human activities (Morton 1996, p. 60, 62, 72; Ha, R. 2015, pers. com.; Ha et al. 2011, p. 5). Based on observations of disturbance of crow nests on Guam, Morton (1996, p. 72) recommended a 300-meter radius for a buffer zone around active crow nests; Morton's recommendations were based on observations of crows reacting to facility/grounds maintenance, brown treesnake trapping, research activities, loud music, and human voices. One Mariana crow nest on Guam was abandoned due to disturbance from maintenance activity and from radio noise coming from a sound system 150 meters away (Morton 1996, p. 62). Ha et al. (2011, p. 236) found that nest sites were always greater than 300 meters from any buildings, and that actual nest sites were almost twice as far from roads and buildings as random sites.

Distribution, Status, and Threats

Guam

Although the Mariana crow was once present throughout Guam (Baker 1951, p. 246), the population has been declining since at least the 1960's (Engbring and Ramsey 1984, p. 30; Engbring et al. 1986, p. 92) and is now extirpated. The last known crow of Guam origin was observed in 2001, and the last known wild Mariana crow that was captive-reared from Rota and released on Guam was observed in 2012 (J. Quitugua, DAWR, pers. comm. 2014). Predation by brown treesnakes is the overriding factor in the extirpation of Mariana crows from Guam (USFWS 2005a).

Suitable habitat for Mariana crows is still present on Guam. As described below in the Environmental Baseline for the Mariana Crow, we estimate that 24,919 acres (10,084 ha) of Mariana crow habitat is left on Guam. More information on crow habitat is provided in the Environmental Baseline for the Mariana Crow section below.

Rota

In 1976, Mariana crows were considered relatively common and widely distributed on Rota (Pratt et al. 1979, p. 234). Reanalysis of the first island-wide survey for the species on Rota in 1982 using current density estimate methods resulted in a population estimate of 1,491 birds (815-3115 birds, 95 percent confidence interval) (Engbring et al. 1986, pp. 92-95; F. Amidon, USFWS, pers. comm. 2014). The most recent island-wide pair survey on Rota was conducted during the 2013 breeding season and documented 46 breeding pairs; an approximate 94 percent decrease in the population since 1982 (Kroner 2014, p. 3). The primary threats to the Mariana crow on Rota are suspected to be predation by cats, human persecution, and habitat destruction (USFWS 2014b, p. 3), but evidence is limited and substantially more research is needed.

Mariana crow telemetry studies were conducted from 2009-2013 and will begin again in the 2014-2015 nesting season. Before telemetry studies began on Rota there was no evidence available to suggest feral cats (*Felis silvestris*) were predating crows. The lack of evidence was likely due to high scavenging and decomposition rates, and the extreme unlikelihood of finding a fresh carcass in time to retrieve any useful information regarding cause of death. Since telemetry efforts began, nine recently-deceased, radio-tagged Mariana crows have been found with evidence suggesting cat predation, and one untagged adult was taken in for care and later died after receiving what a veterinarian confirmed as an infected cat bite (Ha et al. 2013, pp. 5-6).

Recovery Criteria for the Mariana Crow

The following criteria are taken from the Draft Revised Recovery Plan for the Mariana Crow (USFWS 2005a).

1. The Mariana crow may be considered for downlisting from endangered to threatened status when all of the following criteria are met:
    a. Mariana crow occur in two populations, one on Rota consisting of a minimum of 75 territorial pairs, and 1 in northern Guam consisting of a minimum of 75 territorial pairs;
    b. Both populations are stable or increasing based on quantitative surveys or demographic monitoring that demonstrates an average intrinsic growth rate (λ) not less than 1.0 over a period of at least 10 consecutive years;
    c. Sufficient Mariana crow habitat, based on quantitative estimates of territory and home range size, is protected and managed to achieve criteria 1 and 2 above;
    d. Brown treesnakes and other introduced predators found to be a threat to Mariana crow are controlled at a sufficient level to achieve criteria 1 and 2 above;
    e. Brown treesnake interdiction efforts are in place to prevent the establishment of brown treesnakes on Rota; and
    f. Efforts to resolve Mariana crow and landowner conflicts have been implemented.

2. The Mariana crow may be removed from the Federal list of threatened and endangered species when all of the following criteria are met:
    a. Mariana crow occur in three populations, one on Rota consisting of a minimum of 75 territorial pairs, one on northern Guam consisting of a minimum of 75

territorial pairs, and one in southern Guam consisting of a minimum of 75 territorial pairs;

b. All three populations are stable or increasing based on quantitative surveys or demographic monitoring that demonstrates an average intrinsic growth rate (λ) not less than 1.0 over a period of at least 10 consecutive years;
c. Sufficient Mariana crow habitat, based on quantitative estimates of territory and home range size, is protected and managed to achieve criteria 1 and 2 above;
d. Brown treesnakes and other introduced predators are controlled at a sufficient level to achieve criteria 1 and 2 above;
e. Brown treesnake interdiction efforts are in place to prevent the establishment of brown treesnakes on Rota;
f. Efforts to resolve Mariana crow and landowner conflicts have been implemented; and
g. A monitoring plan has been developed and is ready for implementation, to cover a minimum of five years post-delisting, to ensure the ongoing recovery of the species and the continuing effectiveness of management actions.

Since the draft revised recovery plan was published in 2005, additional work on population viability of the Mariana crow has occurred. This recent assessment of population viability indicated that 75 territorial breeding pairs may not be viable over the long-term due to potential inbreeding depression (O'Grady et al. 2006) and projected increases in tropical storm intensity, duration, and frequency (Emanuel et al. 2008) and that 100 territorial breeding pairs may be a more appropriate recovery target (Amidon 2012, unpubl. data).Therefore, the Service now considers 100 territorial breeding pairs as our recovery target for each of the three regions identified above.

Survival and Recovery Needs on Rota

Management and recovery actions that have occurred in the last five years (USFWS 2014b, pp. 3-4) include:

- Banding: The University of Washington's Rota Avian Behavioral Ecology Program (RABEP) has banded 80 Mariana crows since 2005 (Ha et al. 2013 pp. 5-6; Kroner 2014, p. 3). Re-sight data has been used to develop age-specific survivorship models.
- Nest monitoring: RABEP have conducted nest monitoring for the Mariana crow on Rota since 2005. Efforts provide data that is used for analyses of nesting success and demographics.
- Mariana crow mortality monitoring: From 2009 to 2013, transmitters were attached by RABEP to 32 Mariana crows that were tracked and monitored for the life of the battery (n=14), until death of the bird (n=12), loss of the signal (n=1), or until the harness was removed (n=5) (Ha et al. 2013, pp. 5-6).
- Habitat and natural process management and restoration: The Mariana Crow Conservation Area (MCCA) was established on Rota through an MOA between the Commonwealth of the Northern Mariana Islands (CNMI) and PIFWO (USFWS 2011, pp. 1-4).
- Human interaction monitoring and management: The Mariana Crow Incentive Plan (2012-2014) compensated participants on Rota with a monetary award in exchange for

protecting occupied crow habitat and allowing access for population monitoring and feral cat control on their land (USFWS 2012a, pp. 1-8). The goal of the plan was to change human perceptions of the Mariana crow and protect valuable habitat.

- Predator monitoring and control: The University of Washington Rota Island Feral Cat Removal Project began cat removal efforts on Rota in February 2012 (Ha et al. 2013, p. 49). As of June 2014, the project removed 589 cats from areas in and around crow territories (Leo 2014, p. 3). The Institute for Wildlife Studies took over cat control efforts on Rota in October 2014.
- Captive care: Captive care of sick or injured crows is conducted on an as-needed basis by RABEP captive care specialists.
- Release of rehabilitated crows: Crows are released into the wild after they have been rehabilitated and reared to at least 2 years of age. Two crows were successfully released after being taken in as fledglings and reared to adulthood in captivity (Hannon 2014, pp. 1-3).
- Strategic planning / threats management planning: The Service in cooperation with the Mariana Crow Recovery Team conducted an exercise in structured decision making (SDM) to determine which actions should be taken now and over the next several years to maximize the probability of preventing extinction and set the foundation for at least one stable to increasing population in the wild (see below). The two primary objectives driving the SDM were to prevent the extinction of the Mariana crow and to ensure a viable stable or increasing population in the wild.

Recovery actions still needed to prevent the extinction of the Mariana crow on Rota:

- Implement priority actions identified in the Mariana crow SDM exercise:
  - Predator control on Rota
  - Phased approach to captive propagation, beginning with rear and release program
- Identify and manage sources of adult and juvenile mortality
- Improve public perception of the crow to reduce potential human persecution
- Protect important habitat on Rota and Guam
- Research and reduce the threat of the brown treesnake on Rota and Guam

<u>Survival and Recovery Needs on Guam</u>

Management and recovery actions that have occurred in the last five years include:

- Construction of a 312-ac (112-ha) ungulate exclosure fence at Northwest Field on AAFB by DoD per Biological Opinion requirements (USFWS 2006b). However, the DON has proposed to build the proposed LFTRC within this mitigation site, which is also located on Overlay Refuge.
- Construction of the 136-ac (55-ha) Habitat Management Unit (HMU) brown treesnake and ungulate exclosure fence at AAFB. Ungulate removal within the HMU is near completion by DoD per a section 7 consultation requirement (USFWS 2006c).
- Construction of a multi-species exclosure fence within the fee simple portion of the GNWR at Ritidian Point.
- Construction of 4,400 ft of coated chain link fence along Route 2A on the perimeter of NBG by DoD per Biological Opinion requirements (USFWS 2010a). The fence provides

an ungulate exclosure for the 3,114 ac (1,260 ha) of the main base of NBG. The fencing project is intended to effectively close off Orote peninsula from any new ungulate incursions and only entry control gates will be left unfenced. Ungulate removal within NBG is ongoing.

- In 2014, the USDA-APHIS Wildlife Services, in coordination with the National Wildlife Research Center, the DoD-Environmental Security Technology Certification Program, and the Department of Interior-Office of Insular Affairs, conducted a test of aerial application of a brown treesnake toxicant (acetaminophen) over forested areas in AAFB (Dorr et al. 2014, unpublished data). The results of this study within the approximately 136-acre (55-hectare) HMU on AAFB may result in the reduction of snake numbers to a low enough level to allow kingfishers to survive and reproduce within this snake-proofed area on Guam. The knowledge gained from this study will help with potential future improvements to the method and efficiency of the delivery of the acetaminophen to snakes on Guam.

Recovery actions still needed to allow the reintroduction of the Mariana crow to Guam

- Development and implementation of large-scale, long-term methods for brown treesnake control that will reduce the brown treesnake population on a landscape level.
- Protection and restoration of Mariana crow habitat in northern and southern Guam including in-perpetuity protection as conservation areas and fencing to exclude brown treesnakes and ungulates.
- Continued management of the fenced exclosures at Northwest Field, the HMU, and NBG as described above.

Status of the Guam Rail

Legal Status

The Guam rail (*Gallirallus owstoni*; ko'ko' in Chamorro; hereafter, rail) was listed as endangered on Guam in 1984 (USFWS 1984, pp. 2485-2488). An experimental, nonessential population of rails occurs on Rota. The rails on Rota are treated as threatened species, rather than as endangered species, for the purposes of sections 4(d) and 9 of the ESA (USFWS 1989, pp. 43966-43970). Critical habitat for the rail has not been designated on Guam.

Species Description and Current Known Range

The Guam rail is endemic to the island of Guam in the Mariana Islands. The species is derived from the closely related barred rail (*Gallirallus torquatus*) of the Philippines and Indonesia (Ripley 1977). No closely related species occur in Micronesia. The rail is medium-sized and capable of short burst of flight (1 to 2 m), but is seldom observed in flight (Jenkins 1979, p. 404). Rails are about 28 cm (11 in) in total length (Taylor 1998, p. 258). Guam rails have elongated and laterally compressed, particularly in the neck and breast regions, bodies allowing the birds to move rapidly through dense vegetation.

The rail is extirpated in the wild on Guam but persists in captivity at the Guam DAWR facility and twelve U.S. mainland zoos (AZA 2014, p. 1). Efforts to establish a nonessential experimental population on the island of Rota has been underway since 1989. The establishment

of a wild population on Rota will ensure that a source wild population is available for future repatriation of rails to Guam when brown treesnakes have been controlled or eradicated on Guam (USFWS 1989, p. 43967). On Cocos Island (a small islet approximately 1.6 km (1 mi) off the southern coast of Guam), breeding pairs of rails have become established in a predator-controlled habitat through efforts associated with a Safe Harbor Agreement and activities permitted under section 10(a)(1)(A) of the ESA (USFWS 2008b; USFWS 2008c, p. 1-2). This agreement, signed in 2008, has allowed for the establishment of Guam rails on private land owned and managed by Cocos Island Resort and public land owned by the Government of Guam and managed by the Guam Department of Parks and Recreation. The rails are monitored to learn more about survivorship, breeding behavior, habitat preference and nesting success.

Life History

The Guam rail formally occurred in most habitat types on Guam, including forest, savanna, secondary grassland, agricultural areas, mown grass bordering scrub communities, mixed woodland and scrub, and fern thickets (Jenkins 1979, p. 405-406; Taylor 1998, p. 259). Guam rails were predominantly observed using scrubby secondary growth area and the edges of mixed forest areas (Jenkins 1979, Engbring and Ramsey 1984). Jenkins (1979) reports that they were seldom observed in the interior of mature limestone forests or savanna areas and did not occur in wetlands. As Guam was probably mostly limestone forest before the arrival of humans (Forsberg 1960), the rail may have become more common after much of the mature forest had been converted to scrubby second-grown or mixed forest (Engbring and Ramsey 1984).

The diet of the Guam rail is comprised of snails, slugs, lizards, insects, and vegetable matter such as seeds and palm leaves; the rail feeds on food items from the surface of the ground, especially snails and slugs after rain showers (Jenkins 1979, pp. 405-406). They chase low-flying insects and feed on seeds and flowers from low grasses and shrubs, stretching up to reach items 40 cm above the ground. They often forage along edge habitat but seldom venture far from cover (Jenkins 1979, p. 404; Taylor 1998, p. 259). During the dry season the rails were reported to damage crops such as tomatoes, cucumbers and melons, but such damage probably resulted from their obtaining moisture rather than food. Rails also ingest coral chips and pieces of small shell for grit (Jenkins 1979, p. 405-406). They are able to forage at night, but are most active during the dawn and dusk (Jenkins 1979, p. 404-406; Taylor 1998, p. 259).

Guam rails are monogamous and breed throughout the year (Jenkins 1979, p. 406; USFWS 1990a, p. 9), with a possible peak breeding period during the rainy season (May-October) (Perez 1969 as cited in the USFWS 1990a, p. 9). They can lay two to four eggs per clutch and both parents share in the construction of the nest. Nests are located on dry ground in dense grass, are a shallow cup of interwoven loose and rooted grass, and are built by both sexes (Jenkins 1979, p. 406; Taylor 1998, p. 260). Incubation of eggs is 21 days (Beck 1985, unpubl. data cited in USFWS 1990a, p. 9) with both sexes sharing the nesting duties. The eggs hatch asynchronously, and the young are precocial, leaving their nests within 24 hours of hatching to forage with the aid of their parents (Jenkins 1979, p. 406).

In captivity, Guam rails can live up to 17 years, while females can reach 16 years old. Median life expectancy for captive males is 9.5 years; captive female median life expectancy is slightly lower at 5.7 years (AZA 2014, p. 5). The median life expectancy of Guam rails in the wild is unknown. Both males and females can begin reproducing at approximately 5 months old. Males have bred until the age of 11, and females as old as 9 years old have successfully reproduced. Breeding in captivity is complex, as males can be extremely aggressive and have at times injured or killed females. In captivity, clutch sizes range from one to six eggs, averaging 2.1 eggs, with an incubation period of 19 days.

Population Dynamics and Status

Guam rails were once distributed throughout Guam (USFWS 1990a, p.7). They first disappeared from southern Guam in the early 1970's (Jenkins 1979). In 1981, the population was reduced to approximately 2,300 individuals and only existed in northern Guam (Engbring and Ramsey 1984, p. 28). In 1983, estimates of the population size indicated that fewer than 100 individuals remained on Guam and 22 individuals were moved to captive propagation facilities (Haig and Ballou 1995, p. 446). The rail was extirpated on Guam by 1987 (Wiles et. al. 1995, p. 38).

There have been two releases of rails on Guam since this species has been listed as endangered. In 1998, 16 rails were released in "Area 50" at AAFB in northern Guam (Beauprez and Brock 1999). A temporary brown treesnake barrier was constructed around Area 50 and snake populations in the barrier were reduced through snake control. Breeding was documented, although the small population was extirpated by predators, mainly feral cats. In 2003, a second release of 44 rails occurred in a brown treesnake-reduced area of the Munitions Storage Area on AAFB (P. Wenninger, DAWR, pers. comm. 2008). Efforts to reduce cat predation on the rails were limited due to difficulty in obtaining approval to control cats in the area. By 2008, rails no longer were present in the Munitions Storage Area (P. Wenninger, DAWR, pers. comm. 2008; USFWS 2009b, p. 5).

On Rota, over 800 captive-bred Guam rails have been released between 1989 and 2008 in an effort to establish an experimental wild population (Witteman and Beck 1990, Beck 1991, Brock and Beck 1995, Beauprez and Brock 1996-1999a, P. Wenninger, DAWR, pers. comm. 2008). The introduction to the island of Rota, which is outside the historical range of the species, was justified because primary habitat on Guam had been altered through the establishment of the introduced, predatory brown treesnake (USFWS 1989, p. 43966). Improvements in managing the captive flock have increased the number of rails available for each release and the larger release cohorts have increased the likelihood of population establishment. Population estimates in 2002 indicated 100 rails were present on the northeast end of Rota near two release sites, Duge and Saguagaga. Based on surveys conducted in July 2013, there are approximately 125 rails on Rota (S. Medina, DAWR, pers. comm. 2013). However, released birds still suffer mortality primarily due to feral cat predation, which slows population establishment. Current release strategies include intensive cat trapping and a review and update of monitoring protocol for rails on Rota.

On Cocos Island, sixteen captive bred rails were released in November 2010. Prior to the release, rats (*Rattus* spp.) were eradicated on Cocos Island. Guam rails are successfully breeding

(16 nests and 12 chicks have been observed) on Cocos Island. Sightings of unbanded adults have been documented, which suggests that chicks are surviving into adulthood (S. Medina, DAWR, pers. comm. 2013).

As of December 30, 2014, the Guam rail captive population is distributed among 14 institutions, with the Guam DAWR facility holding 116 birds and the 13 Association of Zoos and Aquariums (AZA) facilities housing 46 birds. At that time, current gene diversity was 88 percent in the DAWR facility and 83 percent at the AZA facilities (AZA 2014, p. 4). When gene diversity falls below 90 percent in a founding population, it is expected that reproduction will be compromised by, among other factors, lower hatch rates, small clutch sizes, and greater neonatal mortality (Ross et al. 2006). However, there still remains the potential to increase the gene diversity in DAWR and AZA facilities over the long term (AZA 2014, p. 6). The DAWR and AZA work cooperatively and closely coordinate on the transfer of birds to facilities, as needed, in order to manage the genetic diversity within the captive Guam rail population (AZA 2014, p. 4). These facilities also support the releases of individuals into the wild on Rota.

Threats (adapted from USFWS 2014c, p. 2-5):

- Loss or degradation of habitat –
    - Agricultural and urban development is a factor in habitat loss and degradation on Guam.
    - Nonnative snake predation. The brown treesnake continues to limit efforts to reestablish rails on Guam.
    - Cat predation. Feral cats continue to limit efforts to reestablish rails on Guam and impact the rail experimental population on Rota.
    - Rodent predation. Because rats have been eradicated and are absent from Cocos Island, there is continued efforts to prevent the reintroduction of rats to this island. Rats can negatively impact rails by consuming eggs and preying on chicks.
    - Stochastic events – Although birds in the Mariana Islands have evolved with typhoons, typhoons in concert with low population numbers, habitat loss, and behavioral and genetic consequences of captive breeding could negatively affect the recovery of the Guam rail.

Survival and Recovery Needs

Before the Guam rail is considered for downlisting from endangered to threatened, the repatriation of 1,000 birds to northern Guam and 1,000 birds to southern Guam (total = 2,000 individuals; USFWS 1990a, p. 33) would need to occur and brown treesnakes would need to be controlled on Guam (USFWS 1990a, p. 33-34). No criteria were defined for delisting. Traill et al. (2009) proposed a minimum population target of 5,000 individuals as an appropriate target for species conservation.

New management actions that have occurred in the last five years include:

- Brown treesnake eradication and control using acetaminophen, as a toxicant to the snake, is being conducted within the approximately 136-acre (55-hectare) Habitat Management

Unit on AAFB. In 2014, the USDA-APHIS Wildlife Services, in coordination with the National Wildlife Research Center, the DoD-Environmental Security Technology Certification Program, and the Department of Interior-Office of Insular Affairs, conducted a test of aerial application of a brown treesnake toxicant (acetaminophen) over forested areas in AAFB (Dorr et al. 2014, unpublished data). The results of this study indicate that development of a scalable automatic bait application system could be used in the near future for large landscape scale brown treesnake control and suppression (Dorr et al. 2014, unpublished data). The project may result in the reduction of snake numbers to a low enough level to allow for rails to survive and reproduce within this snake-proofed area on Guam.

- Management unit planning – On Guam, a management plan, funded by DoD, is currently being developed for the HMU on AAFB. The plan will consider the reintroduction of Guam rails to this site.
- Predator control – Cat control is conducted on Rota and will continue with increased efforts from additional funding by the Service in fiscal year 2015.

Recommendations for Future Actions (adapted from USFWS 2014c, p. 3):

- Maintain or increase genetic diversity in captive rail population – Implement management strategies to exploit the potential gene diversity in the captive populations at the DAWR and AZA facilities.
- Predator monitoring and control
    - Continue efforts to develop and refine brown treesnake control techniques and support small-scale and large-scale control and/or eradication efforts on Guam.
    - Continue and increase efforts to control and eradicate brown treesnakes on Guam and prevent introduction of brown treesnakes on other Mariana Islands.
    - Implement large-scale cat control and/or eradication.
- Reintroduction / translocation
    - Consider alternative sites for establishing other experimental populations.
    - Develop reintroduction plan for Guam rails on Guam and set aside and protect recovery areas for these rails on Guam.
- Revise recovery objectives and criteria – Revise recovery plan.
- Population monitoring and viability analysis – Continue population and demographic monitoring on Rota and Cocos Island.
- Protection and restoration of Guam rail recovery habitat including in-perpetuity protection as conservation areas and fencing to exclude brown treesnakes and ungulates.

Status of the Mariana Fruit Bat

Legal Status

The Mariana fruit bat (*Pteropus mariannus mariannus*; "fanihi" in Chamorro; hereafter, fruit bat) was listed as endangered on Guam in 1984, but was downlisted to threatened in 2005 when it was determined that all fruit bats on Guam and throughout the Commonwealth of the Northern Mariana Islands (CNMI) comprise a single subspecies (USFWS 2005b, p. 1191). In 2004 critical habitat for the fruit bat was designated at the Guam National Wildlife Refuge Ritidian Unit (USFWS 2004, p. 62944).

Species Description

The Mariana fruit bat is a medium-sized fruit bat in the family *Pteropodidae* that weighs 0.66 to 1.15 pounds. Males are slightly larger than females. The underside (abdomen) is black to brown with gray hair interspersed that creates a grizzled appearance. The shoulders (mantle) and sides of the neck are bright golden brown, but may be paler in some individuals. The head varies from brown to dark brown. The well-formed, rounded ears and large eyes give the face a canine appearance.

Current Known Range

The Mariana fruit bat is a subspecies endemic to the Mariana archipelago (Guam and the CNMI), where it was historically present on every island except Uracas (Wiles et al. 1989, p. 69). The fruit bat is currently thought to be extirpated from Tinian (USFWS 2009c, pp. 269-272; USFWS 2014d, pp. 2-3).

Life History

The diet of the fruit bat is comprised of fruits, nectar, pollen, and some leaves (Wiles and Fujita 1992, pp. 26-31; Wiles and Johnson 2004, p. 591), and it uses several forest types for foraging, roosting, and breeding, including native primary and secondary limestone forest, volcanic (or ravine) forest, old coconut plantations, and groves of *Casuarina equisetifolia* (Glass and Taisacan 1988, pp. 6–13; Worthington et al. 2001, pp. 137–138; Wiles and Johnson 2004, pp. 589–591). Most fruit bats roost during the day in maternity colonies at sites to which they show a high level of fidelity (unless disturbed). A small proportion of fruit bats, usually males, roost alone or in small groups called bachelor colonies. Fruit bats will abandon roost sites if disturbed and have been reported to move to new locations as far as 10 kilometers (km) (or 6 miles) away (USFWS 1990b, p. 9). Any fruit bat colony can be disturbed by humans close enough to be smelled; which can be up to 200 m (656 ft) away (J. Boland, pers. obs. 2009). In addition, fruit bats have flushed from maternal roosts in response to aircraft overflights on Guam with noise levels above 90 dB (SWCA 2012, p. 23, 37). When colonies are disturbed, fruit bats may be negatively affected in a variety of ways, including but not limited to, destruction of social structures, direct injury, disruption of energetic and hormonal balance, forced relocation to lower quality habitat, abandonment of non-volant young, and disruption of breeding activities (Wingfield et al. 1998, pp. 191-204; Heideman 2000, pp. 469-499; Klose et al. 2006, p. 341; CNMI 2010, p. 7).

Within colonies, fruit bats typically group themselves into harems (one male and 2-15 females) or bachelor groups (predominantly males; Wiles 1987a, pp. 93-94; J. Boland, unpubl. data). Unlike most Pteropus species, mating and the presence of nursing young have been observed in Mariana fruit bats throughout the year on Guam and Rota (Wiles 1987a, pp. 93-94; CNMI 2010, p. 12; CNMI 2011, p. 12; J. Boland, unpubl. data). Data is limited for age of sexual maturity,

reproductive rates, length of gestation, and lifespan of Mariana fruit bats. Female bats of the family Pteropodidae generally have a gestation period of 4.6- 6.3 months and one offspring per year (Pierson and Rainey 1992, pp. 1-17). Many Pteropus species typically do not give birth before 18 months of age (Pierson and Rainey 1992, pp. 1-17; McIlwee and Martin 2002, p. 76). Based on these reproductive traits, several authors have suggested that Pteropus bats have a low maximum population growth rate and thus a slow rate of recovery when a population is diminished (Pierson and Rainey 1992, p. 1-17; McIlwee and Martin 2002, p. 76).

Population Dynamics and Status

The total population of the Mariana fruit bat is estimated to be approximately 6,000 animals (USGS 2010, p. 36; CNMI 2011, p. 6). Surveys suggest populations are stable or declining throughout most of their range (Table 5). A notable exception to the declining trend is the island of Rota, where the population has increased since 2008 (CNMI 2008, p. 11; CNMI 2011, p. 6). The population increase on Rota is due to a recent decrease in illegal hunting at roost sites of fruit bat maternity colonies, and the decrease in illegal hunting can be attributed to an increase in enforcement of wildlife regulations that began in 2009 (CNMI 2010, pp. 7-9).

The fruit bat population on Rota is estimated at approximately 2600 (CNMI 2011; p. 6). Although comprehensive surveys have not been conducted on Saipan, there have been no confirmed observations of maternity colonies in recent years, and the island-wide population is expected to be less than 50 individuals (T. Willsey, CNMI DLNR, pers. comm. 2014). The population of fruit bats on Guam is estimated to be less than 30 bats (SWCA 2013, pp. 19-22; DON 2013b, pp. 11-15). The most recent and last colony to exist on Guam was at Pati Point, but recent surveys indicate that this colony no longer exists (Figure 5) (SWCA 2013, pp. 13). On July 3, 2014, a survey was conducted on Andersen Air Force Base which resulted in 10 observations of bats; analyses are still in progress to determine duplicate observations and detection probability given the amount of area surveyed on the Base (DON 2014c).

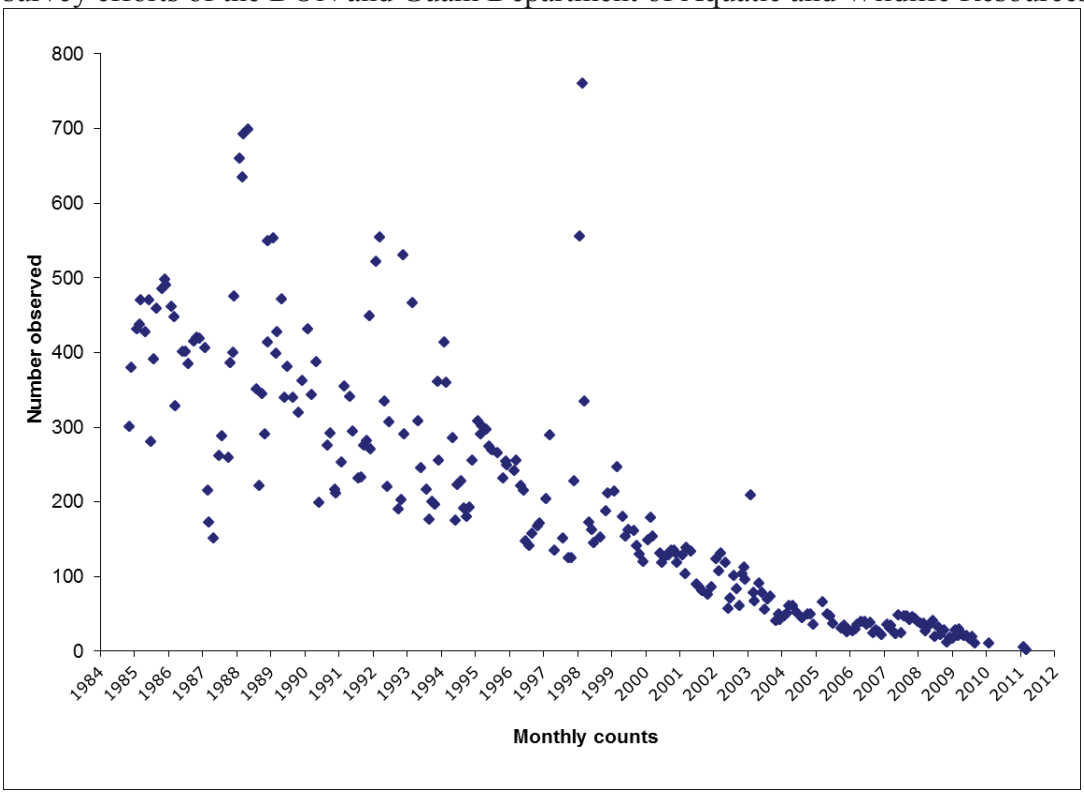
Table 5. Summary of population estimates for the Mariana fruit bat throughout the Mariana archipelago from 1983-2010 (USFWS 2014d, p. 2).

Island	**Area square mile (square kilometer)**	**Estimated minimum number of bats 1983-1984[1]**	**Estimated number of bats 2000[2]**	**Estimated number of bats 2008[3]**	**Maximum number of bats counted 2010[4]**
Maug	0.8 (2.0)	< 25	not surveyed	not surveyed	11
Asuncion	2.9 (7.4)	400	not surveyed	not surveyed	573
Agrihan	18.3 (47.4)	1,000	1,000	not surveyed	858
Pagan	18.4 (47.7)	2,500	1,500	not surveyed	1,017
Alamagan	4.3 (11.0)	0[5]	200	not surveyed	86
Guguan	1.5 (4.0)	400	350	not surveyed	226
Sarigan	1.9 (5.0)	125	200	not surveyed	157

Anatahan	12.5 (32.3)	3,000	1,000	not surveyed	150
Saipan	47.5 (122.9)	< 50	not surveyed	not surveyed	not surveyed
Tinian	39.3 (101.8)	< 25	not surveyed	0	not surveyed
Aguiguan	2.7 (7.0)	< 10	150-200	40-60	not surveyed
Rota	32.9 (85.2)	800-1,000	not surveyed	1019[6]	2,283[8]
Guam	212 (549.0)	425-500	119-179	<40[7]	not surveyed

[1] Wiles *et al*. 1989. Count methods: Evening dispersal counts at colonies and evening station counts of solitary fruit bats. All counts considered to be minimum estimates.
[2] Cruz *et al*. 2000a-f. Count methods: Evening dispersal counts at colonies, evening and morning station counts of solitary fruit bats. Data for Guam represents the range of 10 counts conducted in a separate effort in 2000 (A. Brooke pers. comm. 2007 *in* USFWS 2009d).
[3] Data for Tinian and Aguiguan from USFWS (2008). Data for Rota from CNMI (2008).
[4] Data for Northern Islands from USGS (2010). Data for Rota from CNMI (2010).
[5] Alamagan was inadequately surveyed in 1983 and may have held some fruit bats.
[6] Direct counts at all maternity colonies plus departure counts at extra-colonial sites in July 2008
[7] Brooke (2008) and SWCA (2013)
[8] Direct counts for all maternity colonies in May 2010 plus departure/arrival counts at extra-colonial sites in April 2010

Figure 5. Direct counts of fruit bats at the historical fruit bat maternity colony at Pati Point on Andersen Air Force Base from 1984-2011 (A. Brooke, pers. comm. 2014, data compiled from survey efforts of the DON and Guam Department of Aquatic and Wildlife Resources).



Threats (adapted from USFWS 2014d, pp. 4-5):

- Loss or degradation of habitat:
  - Human development is a factor in habitat loss on all inhabited southern islands and on northern islands with military activity.

  - Feral ungulates and Philippine sambar deer (*Rusa marianna*) degrade habitat on many of the Mariana Islands. The successful eradication of feral ungulates from Sarigan and Anatahan suggests that similar projects may succeed on other islands. However, once grazing and browsing pressure is removed, the potential invasion of native forest by alien plants may be a more difficult and long-term recovery issue.
- Human disturbance:
  - Illegal hunting is a threat to Mariana fruit bats throughout its range. Although law enforcement activity has increased since 2009 (CNMI 2008, 2009a-b, 2010), illegal hunting of fruit bats on Rota continues and will likely resume to historical levels unless consistent, effective law enforcement efforts in tandem with education and outreach programs continue. Fruit bats appear to be extirpated from Tinian and are declining on Saipan and Guam, and illegal hunting is thought to have greatly contributed to the decimation/decline of those populations (Wiles and Payne 1986; Wiles and Glass 1990; Sheeline 1991; Stinson et al. 1992; Wiles 1992; Esselstyn et al. 2006). As with Rota, recovery of the fruit bat on human-inhabited islands will not likely be possible without strong education programs combined with effective control of illegal hunting.
- Nonnative snake predation – The brown treesnake is thought to prey on non-volant young left at the roost during the night, thus preventing the recruitment of young bats into the breeding population. Effective control of brown treesnakes must be achieved before fruit bat population on Guam can recover. The interdiction, control, and ultimate eradication of brown treesnakes in the archipelago are the focus of major, ongoing projects, and the fruit bat is likely to benefit from these efforts in the long term. This prognosis would change drastically if the brown treesnake were to become established widely throughout the archipelago.
- Stochastic events – Typhoons and volcanic eruptions result in mortality, reduced population viability, and habitat loss. Natural disasters can be especially damaging to the viability of smaller fruit bat populations (e.g., on Guam, Saipan, Aguiguan, and Maug). The significant loss of habitat on Anatahan after the volcanic eruption in 2003 resulted in the loss of a substantial fruit bat population that has not yet recovered.

Survival and Recovery Needs

Before the Mariana fruit bat is considered for delisting, the Service proposes that stable or increasing populations should exist on three of the five southern islands (Saipan, Tinian, Aguiguan, Rota, and Guam), and six of the northern islands where Mariana fruit bats have persisted historically (Anatahan, Sarigan, Guguan, Alamagan, Pagan, Agrihan, Asuncion, and Maug; USFWS 2009d, pp. 37-39). Of the six northern islands that require stable or increasing fruit bat numbers, two of these must include Pagan, Anatahan, or Agrihan. Since publication of the draft revised recovery plan in 2009, new information on the Mariana fruit bat has resulted in changes to how we look at recovery for the species. We now consider recovery in terms of stable or increasing subpopulations of sufficient size distributed across Guam and the Mariana Islands. To meet recovery objectives, stable or increasing fruit bat subpopulations should at a minimum be distributed on the islands that currently have extant populations (USFWS *in*

review). The final version of the Mariana fruit bat recovery plan is currently in review, and recovery criteria stated here may change upon completion of the final plan

Of the six northern islands, the only evidence for a possibly increasing population is on Asuncion (USGS 2010, p. 33). Of the five southern islands, only Rota has achieved an increasing population. Although a conservation area containing some important habitat for fruit bats was recently established on Rota (USFWS 2011, pp. 1), there is not currently enough protected fruit bat habitat on Rota, Guam, Tinian, or Saipan to support substantial population recovery on any of those islands. Even if sufficient habitat is set aside in conservation to support recovery of populations, controlling illegal hunting may continue to be a challenge that limits recovery of the species.

New management actions (adapted from USFWS 2014d, pp. 4-5):

- Monitoring and analysis of population viability – Technical assistance was obtained in 2008 to analyze fruit bat survey data from Rota and refine survey methods and the existing monitoring program (CNMI 2008, 2009a-b, 2010).
- Law enforcement and compliance – On the island of Rota, the Service and the CNMI Division of Fish and Wildlife (DFW) have increased law enforcement actions since 2009. With support from Service law enforcement and federal discretionary funds, CNMI Conservation Officers have participated in nine fruit bat-related arrests on Rota, all resulting in convictions. Enforcement actions have contributed to a decrease in illegal hunting, and approximate doubling of the fruit bat population on Rota.
- Development of monitoring protocol – Experts were consulted to review and refine survey methods for fruit bats to develop standardized, quantitative monitoring that permits data comparison at multiple timescales. Standard operating procedures were developed for CNMI DFW (CNMI 2009a) and a monitoring protocol was developed for Service for fruit bat surveys in the Northern Mariana Islands (Mildenstein and Boland 2010).
- Surveys / inventories – Surveys were conducted on Anatahan, Sarigan, Guguan, Alamagan, Pagan, Agrihan, Asuncion, and Maug in 2010 (USGS 2010). A base-wide survey was conducted on AAFB in 2014 (DON 2014c)
- Habitat and natural process management and restoration – The Mariana Crow Conservation Area was established on Rota through an MOA between the CNMI and the Service (USFWS 2011). This area encompasses 444 hectares (1097 acres) and contains some high-quality foraging and roosting habitat for fruit bats.
- Outreach and education – Discussions were initiated with CNMI DFW and CNMI Public School System (PSS) to develop outreach and education materials and opportunities to curb illegal hunting. Several education and outreach programs were funded by the Service, Bat Conservation International, Disney, and Lubee Bat Conservancy, and these programs were implemented on Rota through a local non-profit. An education curriculum was developed with the CNMI PSS, but has not yet been implemented.

Recommendations for Future Actions (adapted from USFWS 2014d, pp. 5-6):

- Outreach and education – Decrease illegal hunting by developing and supporting outreach and education programs that emphasize the value of and need to protect fruit bats and other native plant and wildlife species in the Marianas.

- Law enforcement and compliance – Decrease illegal hunting by continuing to provide technical and financial assistance to CNMI DFW enforcement officers to facilitate apprehension and prosecution of poachers.
- Ungulate monitoring and control
    - Decrease habitat loss by eradicating feral ungulates on islands where they exist, and preventing their introduction on other islands where fruit bat recovery is desired.
    - Decrease habitat loss by controlling deer in areas of high-quality fruit bat habitat.
- Habitat and natural process management and restoration
    - Improve habitat through support of native forest restoration, especially on Guam, Saipan, and Tinian.
    - Set aside enough high-quality habitat including in-perpetuity protection of conservation areas to support the recovery of fruit bat populations on three of the five southern islands.
- Human interaction monitoring and management
    - Limit military training in areas occupied by fruit bats to activities that will not disturb fruit bats or their habitat.
    - Limit urban development in areas occupied by or potentially used for roosting and foraging by fruit bats.
- Population monitoring and viability analysis – Continue monitoring fruit bat numbers on Anatahan to understand the fluctuation of numbers in response to volcanic activity.
- Population monitoring and viability analysis – Hire and ensure consistent employment of a full-time, resident DFW or Service biologist who is charged with monitoring the fruit bat population on Rota according to established protocols (CNMI 2009a, Appendix 1).
- Predator / herbivore monitoring and control
    - Development and implementation of large-scale, long-term methods for brown treesnake control that will reduce the brown treesnake population on a landscape level on Guam.
    - Continue and increase efforts to prevent introduction of brown treesnake populations on other Mariana Islands.

Status of *Serianthes nelsonii*

Legal Status

Serianthes nelsonii, "hayun lågu" or "tronkon guafi" in Chamorro was listed as endangered in 1987 (USFWS 1994, p. 1). No critical habitat has been designated for this species.

Species Description and Current Known Range

Serianthes nelsonii is a large tree in the pea family (Fabaceae, subfamily Mimosoideae). Adult trees can reach heights over 30 m (98 ft) and diameters over 1.5 m (4 ft) (USFWS 1994, p. 11). Its bark is smooth and light brown in color. Fine rusty hairs cover the flowers, seed pods, and newer vegetation growth. Leaves are doubly pinnate with many pairs of leaflets. Flowers are brush-like with pink and white coloration, and fruits are hard, dry, brown pods (Stone 1970, p. 304). Seedlings closely resemble those of a small introduced tree, *Leucaena leucocephala*

(tangantangan), but can be discerned by the fine pubescence on new leaf buds (USFWS 1994, p. 6).

Serianthes nelsonii is endemic to the islands of Guam and Rota (USFWS 1987, p. 4907). Recorded specimens on Guam were mostly from northern limestone forests, but a few trees were recorded in southern clay soils (USFWS 1994, p. 8). Currently, the last remaining wild adult tree on Guam is located at NWF, AAFB in northern Guam. A new fence was constructed to exclude ungulates in 2012 by AAFB, the *Serianthes* tree and seedlings are monitored monthly by DoD. DoD has conducted research on limiting factors for seedlings, fallen seeds collected and stored for future use. In 2014, 31 *S. nelsonii* seedlings supplied to the Service by JRM were planted at the GNWR in northern Guam (Demeulenaere et al. 2015, p. 4). The 31 seedlings are maintained with 2 previously outplanted saplings on the GNWR. On AAFB, one outplanted sapling is located in the Tarague Basin.

The history of *S. nelsonii*'s abundance and distribution on Rota is poorly known (USFWS 1994, p. 7), but surveys in 1994 estimated 121 adult trees with very little regeneration (Wiles et al. 1996, p. 232). Current estimates for Rota are 40 to 50 wild adult trees with little to no regeneration (J. Manglona, CNMI DLNR, pers. comm. 2015).

Life History and Ecology

Serianthes nelsonii is recorded mainly from limestone soils, with a few historical occurrences in clay soils in Guam (USFWS 1994, p. 8). Most of the adult trees in Rota occur on or near steep limestone cliffsides, and the last wild adult tree in Guam is located in rugged limestone karst habitat at NWF. What little is known about pollination, seed dispersal, phenology, flowering, and fruiting for this species comes mainly from incidental reports (USFWS 1994, p. 11). Fruiting occurs throughout the year, as seed pods have been observed during all months of the year (USFWS 1994, pp. 11-13). Similarly, flowering has been recorded during all months of the year, with one report (Schreiner and Nafus 1991, as cited in USFWS 1994, p. 11) reporting the highest proportion of branches with flowers in May and June. This report also indicated leaf production throughout the year with declines during the dry season from January to June. Age of reproduction in the wild is also unknown, but flowers and pods have been observed on cultivated trees as young as 10 years old (USFWS 1994, p. 13).

Serianthes nelsonii, being a large, canopy tree species, provides habitat for a number of smaller species. This species supports a diverse community of arthropods including predator species such as spiders and mantids that may control other potentially problematic insect populations (Wiles et al. 1996, p. 233). *S. nelsonii* also hosts a variety of epiphytes including ferns, orchids, and other plants such as *Ficus* sp., and *Freycinetia reineckei* (Wiles et al. 1996, p. 233-234).

Population Dynamics and Status

The total wild population of *Serianthes nelsonii* is estimated to be 50 adult trees, with almost all of the population occurring in Rota, and a single wild adult tree in Guam. In addition, there are outplanted occurrences on each island, all younger than 20 years of age. Seedling propagation and outplanting on Rota have been ongoing with limited success over the past 20 years, mainly

in the Isang area in southern Rota, and between the main villages of Songsong and Sinapalo. Approximately 10 outplanted individuals in Rota have survived to a reproductive age (J. Manglona, CNMI DLNR, pers. comm. 2015). Twenty seedlings were outplanted in 1999 in the Tarague Basin, on AAFB in Guam (M. Marutani, University of Guam, pers. comm. 2015). To date, only one of these saplings has survived (AAFB 2015), but has not produced any seed pods (A. Gawel, USFWS, pers. obs. 2014). In 2009, approximately 30 seedlings were planted at the GNWR; all but 5 have survived (J. Cruce, USFWS, pers. comm. 2015). In 2014, 31 seedlings were donated to GNWR by JRM and outplanted and are being maintained by the Guam Plant Extinction Prevention Program (Demeulenaere 2015, p. 4) and GNWR staff.

Recent *Serianthes nelsonii* recovery efforts on Guam and Rota have been dependent on funding, the amount of available propagated seedlings in nurseries, and the seedling to adult survival rates in the wild. In early 2015, the total number of nursery seedlings and saplings in Guam and Rota was estimated at 300 individuals, with approximately 200 in Guam nurseries. However, this estimation may change rapidly if outplanting seedling survival is low. Recent studies from AAFB indicated that although many seeds fall from the Guam adult tree and many of the seeds germinate, there is very limited survival under the mother tree (AAFB 2015). Both islands' populations have constant regeneration of wild seedlings that are several days to several months old. However, these seedlings experience incredibly high turn-over, and in recent decades, none have been known to survive to adulthood in the wild (J. Manglona, CNMI DLNR, pers. comm. 2015; AAFB 2015, pp. 4-5). Although wild seedling survival is bleak, progress has been made on increasing the likelihood of survival of outplanted individuals with new methods of insect control and exclusion, given insect herbivory and damage are the major cause of outplanted seedling early mortality (E. Demeulenare, GPEPP, pers. comm. 2015).

Threats (adapted from USFWS 2012b, pp. 10-14):

- Loss and degradation of habitat – Development from construction and military training has decreased the total recovery habitat for this species. *Serianthes nelsonii* habitat continues to be degraded by ungulates (Wiles et al. 1996, p. 234; DON 2013c), i.e. feral pigs and Philippine deer (*Rusa mariannae*), and by encroachment of invasive plants. In addition, declines in pollinators, seed dispersers, and insectivores have contributed to habitat loss (Wiles et al. 1996 p. 230).
- Introduced predators and herbivores – Introduced deer and pigs feed on *Serianthes nelsonii* (Wiles et al. 1996, p.234; Morton et al. 2000, p. 230). A number of invertebrate predators and herbivores also have been reported on this species: mealybugs (*Dysmococcus brevipes*, *D. neobrevipes*, *Ferrisia virgate*, and *Planococcus* sp.), caterpillars of *Eurema blanda*, termites (USFWS 2012b), and katydids (A. Moore, University of Guam, pers. comm. 2014). In addition, insect predation occurs on seed pods in Rota, but the insect is unknown (USFWS 2012b).
- Stochastic events – Typhoons have resulted in damage and mortality to this species as well as damage to habitat (USFWS 2012b).

Survival and Recovery Needs

For *Serianthes nelsonii* to be considered for delisting, the Service proposes that at least four populations be established on each island – Guam and Rota – each with a 10-year average of 500

or more reproductive plants (USFWS 1994, p. 26). The populations should have age structures comprised of a large proportion of adult trees as well as seedlings and immature trees (USFWS 1994, p. 26). In addition, the Service recommends that the populations on Rota be separated by at least 1 km (0.621 mi), and that at least one of the populations in Guam should be in the southern part of the island (USFWS 1994, p. 26).

To achieve recovery needs, the Service outlines the following recovery actions (adapted from USFWS 1994, pp. 27-37):

- Additional surveys are needed on both islands since the last surveys for this tree were in 1994. To prevent ungulate degradation and herbivory, subpopulations should be fenced wherever possible. Methodology to control insect pests should be developed and implemented. Existing individuals need to be monitored for survivorship, new threats, and any possible evidence of regeneration. Public education and community involvement should also be encouraged and developed.
- Conduct research important to the management of *Serianthes nelsonii*. The ecology, life history, and habitat requirements of *S. nelsonii* are poorly understood and should be studied. Although a number of insect pests have been identified, many remain unidentified, and their ecology, specific effects, abundance, and especially control methods need to be investigated. The Service also recommends genetic studies, especially on the variation between Guam and Rota populations, as well as any effects from small population size and inbreeding.
- Augment current populations and reintroduce to historical range. Plans for augmentation and reintroduction should be developed for both Guam and Rota. Areas for outplanting should be identified and secured, and plants should be propagated and transplanted to the identified areas.
- Prevent clearing of forest next to *S. nelsonii*. Maintenance of an intact forest canopy next to *S. nelsonii* will reduce the potential of edge effects and for high winds during typhoons to break tree limbs and trunks.
- Implement standardized control procedures for insect pests after research on insect control determines appropriate methodology.

New management actions that have occurred in the last five years include:
Since *Serianthes nelsonii* was listed in 1987, outplanting of individuals have been attempted with limited success. However, several recovery projects aimed at understanding and improving outplanting efforts and management of individuals have begun since 2012:

- The last remaining adult tree in Guam is fenced to prevent access by ungulates. The Air Force has funded research to look at ecology, seedling survival, propagation methods, and health and life history of the adult tree (AAFB 2015).
- The Service has funded a project with the CNMI Division of Forestry in Rota to outplant and maintain *Serianthes nelsonii* in fenced plots on private property.
- The Service has funded a multi-year project for *Serianthes nelsonii* recovery on the GNWR to be managed by a full-time biologist. This person will work with the Guam Plant Extinction Prevention Program to maintain the *S. nelsonii* seedlings that were outplanted at the GNWR in 2014. The Service is collaborating with Guam Department

of Agriculture, DoD, the University of Guam, and the Guam Plant Extinction Prevention Program.

Recommendations for Future Actions (adapted from USFWS 2012b, pp. 17-18)

- Captive propagation for genetic storage and reintroduction:
    - Continue to collect seeds from all existing populations and propagate at multiple locations to increase success.
    - Perform genetic studies to determine if Guam and Rota populations are distinct.
- Captive propagation protocol development – Protect seed pods with a fine mesh covering to prevent predation by arthropods before seeds mature.
- Reintroduction / translocation implementation:
    - Propagate and maintain all outplanted individuals on the GNWR to a size where insect herbivory is less likely to cause mortality. This will likely be when plants produce multiple branches and the main stem achieves a girth sufficient enough to withstand damage from *Eurema blanda* butterflies laying eggs in the plant's tissue.
- Ungulate control – Continue to protect all populations against disturbances from feral ungulates.
- Invertebrate control research – Research and identify the effects of invertebrate predation on seeds and seedlings of *S. nelsonii.* If determined to be a limiting factor, develop and implement control measures to protect the species.
- Population biology research – Research the use of mechanical pollination to enhance outbreeding of the species.
- Surveys / inventories – Resurvey the historical range of the species to determine if previously unknown or newly reestablished populations exist.
- Threats research:
    - Research what factors are limiting the natural recruitment of individuals in Guam.
    - Assess the modeled effects of climate change on this species, and use to determine future landscape needed for the recovery of the species.
- Ecosystem-altering invasive plant species control – Control invasive introduced plant species within fenced exclosures.
- Site / area / habitat protection – Develop and implement effective measures to reduce the impacts of agricultural and urban development and hurricanes (typhoons).
- Fire protection – Develop and implement a fire management plan for all populations.
- Alliance and partnership development – Continue to work with GNWR, Guam Rare Plant Restoration Group, and other land managers to continue implementation of ecosystem-level restoration and management to benefit this species.

F. ENVIRONMENTAL BASELINE OF THE SPECIES

General Environmental Baseline

Below we provide a general overview of the status of, and threats to, limestone forest habitat within the action area, followed by species-specific environmental baseline sections. We focus

on habitat in this overview section as the three bird species are extirpated, there is one remaining adult *Serianthes nelsonii* tree, and only a very small population of Mariana fruit bats left on Guam. Therefore, protecting the remaining habitat on Guam is critical for the future recovery for all the listed species addressed in this Biological Opinion.

Limestone karst forests on Guam

Limestone karsts are sedimentary rock outcroppings consisting primarily of calcium carbonate and are recognized as important ecosystems, with high species diversity (Mueller-Dombois and Fosberg 1998, p. 217; Clements et al. 2006, pp. 733-734). The high species diversity on karsts arises from the numerous ecological niches created by complex terrains and variable climatic conditions (Clements et al. 2006, p. 734). On Guam, karst is found on an uplifted karst plateau in the northern half of the island and on uplifted weathered volcanic terrain in the southern half (Fosberg 1960, p. 54; Stone 1970, p. 12; Mueller-Dombois and Fosberg 1998, p. 241). The limestone soils of north and south Guam were historically forested (Stone 1970, p. 14; Mueller-Dombois and Fosberg 1998, p. 270; Guam Department of Agriculture 2010, p. 7), and limestone forest on Guam is composed primarily of mature growth of native trees and plants with a moderately dense canopy 10-30 m high (DAWR 2006, p. 19). We define primary limestone forest as forest with vegetation that was never cleared and is dominated by native species (Fosberg 1960, p. 56; DAWR 2006, p. 218).

Primary limestone forests are critical for Guam's native flora and fauna (Stone 1970, p. 22; USFWS 2005a, p. iv; DAWR 2006, p. 28; DON 2014b, p. 3-40). They retain key functional components of native forests such as large native trees and high canopy cover (Fosberg 1960, p. 56; Mueller-Dombois and Fosberg 1998, p. 217 and 270; DON 2014b, p. 3-40), and are necessary for the recovery of listed species on Guam (Jenkins 1983, p. 22; Michael 1987; Morton et al. 1999, p. 22). Intact primary limestone forests harbor greater tree species diversity than degraded habitat (Stone 1970, p. 22) and provides habitat for a broad diversity of wildlife; these forests are also highly productive and often store more carbon than degraded forests (Caves et al. 2013, p. 7). The primary limestone forest on AAFB is considered some of the best native limestone forest left on Guam to serve as habitat for listed species (Morton 1996, p. 69).

Threats to Guam's limestone forests

Over the past several centuries, Guam has lost much of the native forest to agriculture, a growing human population, economic development, and military activities (Mueller-Dombois and Fosberg 1998, p. 270; USFWS 2009d, p. 27). The distribution of primary limestone forest on Guam has been steadily declining (Fosberg 1960, p. 54; DAWR 2006, p. 28). Although little is known about the nature of Guam's vegetation before World War II, progressive alteration of the island's vegetation clearly began with human colonization (Fosberg 1960, p. 54). On limestone soils, native forest was cleared and replaced by coconut plantations, open fields and gardens, pasture, and secondary forest (Mueller-Dombois and Fosberg 1998, p. 242). During World War II, large areas were cleared and some habitat was destroyed during heavy fighting (Fosberg 1960, p. 54).

Currently, the remaining limestone forests on Guam face numerous threats including habitat fragmentation and loss, lack of management, introduced ungulates, invasive species, typhoons, forest conversion, and loss of pollinators (USFWS 2005a, p. 27; DAWR 2006, p. 28; USFWS 2008a, p. 17-18). These combined threats will degrade the habitat quality of remaining limestone forests and limit the acres of high quality primary limestone forest habitat available to recover listed species on Guam. Currently, forested areas cover approximately 48 percent of Guam (DAWR 2006, p. 31), with only 13 percent of Guam covered with limestone forests (Brown 2005 as cited in DAWR 2006, p. 28).

Habitat Fragmentation, Degradation, and Loss

Habitat fragmentation is a change in habitat configuration caused by clearing, development, invasive species, typhoons, and ungulates that causes remaining habitat to occur in patches among areas of non-habitat (Noss et al. 2006, p. 213). Habitat fragmentation creates edges that have different properties than the habitat itself. For example, edges often have different microclimate patterns that are drier, less shaded, and warmer than forest interiors; they are often areas with increased predation and serve as entry points into native habitats for invasive vegetation, pests, and pathogens (Noss et al. 2006, p. 228). Edges can affect avian density up to 60 m into the forest, and affect the forest canopy up to 150 m (Murcia 1995, p. 59). Habitat fragmentation and edges can result in localized extinctions, shifts in community composition, increases in invasive species, increased predation, and in suitable habitat becoming unsuitable due to pollution, invasive species, physical size, or barriers blocking access to habitats (Groom and Vynne 2006, p. 174; Noss et al. 2006, 38 pp). Habitat fragmentation has been implicated in reduced species richness, avian abundance, productivity, and food supply (Blake and Karr 1987, VanderWerf 1993, Burke and Nol 1998, Trine 1998, Porneluzi and Faaborg 1999). Overall, edges have deleterious effects to wildlife populations and ecological processes (Murcia 1995, p. 58; Laurance 2000, p. 134) and may affect forests at larger landscape scales (Laurance 2000, p. 134).

Habitat degradation and loss on Guam has been caused by various human activities including agriculture, mining, forestry, fires, infrastructure development, military training, urbanization, industry, pollution (including light, noise, and toxic chemicals), and changes in community and ecosystem structure due to invasive species (Groom and Vynne 2006, p. 164; USFWS 2008a, p. 17). Habitat loss and degradation from human activities is a threat to recovery of listed species on Guam (USFWS 2008a, p. 17; USFWS 2012c, p. 3).

Introduced Ungulates

Non-native ungulate species that occur in Guam include pigs (*Sus scrofa*), Philippine deer (*Cervus mariannus*), and Asiatic water buffalo (*Bubalis bubalis*). Ungulates have caused severe damage to Guam's forests by browsing on plants, causing erosion, inhibiting plant growth and regeneration, and facilitating the establishment of invasive plants, which can impede forest regeneration by displacing or smothering native species (USFWS 2009d, p. 27). For example, deer and pigs foraging on fallen fruits and seedlings of the native breadfruit (*Artocarpus mariannensis*), an important fruit bat food, in combination with impacts from typhoons, have resulted in a decline in the number of native breadfruit trees on Guam (Wiles 2005; p. 509).

Introduced pigs are extremely destructive and have both direct and indirect effects on native plant communities. While rooting in the soil in search of invertebrates and plant material, pigs directly affect native plants by disturbing and destroying vegetative cover and trampling plants and seedlings. They may also reduce or eliminate plant regeneration by damaging or eating seeds and seedlings. Pigs are a major vector for the establishment and spread of competing invasive non-native plant species, by dispersing plant seeds on their hooves and coats as well as through the spread of their feces (Diong 1982, pp. 169-170), and by fertilizing the disturbed soil with their feces (Matson 1990, p. 245; Siemann et al. 2009, p. 547). Pigs feed preferentially on the fruits of many non-native plants, spreading the seeds of these invasive species through their feces as they travel in search of food. In addition, rooting pigs contribute to erosion by clearing vegetation and creating large areas of disturbed soil, especially on slopes (Smith 1985, pp. 190, 192, 196, 200, 204, 230–231; Stone 1985, pp. 254–255, 262–264; Medeiros et al. 1986, pp. 27–28; Scott et al. 1986, pp. 360–361; Tomich 1986, pp. 120–126; Cuddihy and Stone 1990, pp. 64–65; Aplet et al. 1991, p. 56; Gagne and Cuddihy 1999, p. 52).

On Guam, feral pigs were introduced in the 1600s, established a feral population by 1772, and distributed island wide by the early 1900s (Conry 1988, p. 26). As documented in other locations, wallowing, rooting, and trampling are common in most forested areas and can be locally severe (Conry 1988, p. 27). A large complex of wallows and feeding sites in Tarague Basin on AAFB measured over 5.7 ac (2.3 ha), and was stripped of all ground cover with no tree regeneration (Conry 1988, p. 27). On AAFB, densities of Philippine deer and feral pigs were estimated at 1.8 deer per hectare (0.8 deer per acre) and 0.4 pigs per hectare (0.2 pigs per acre), which are some of the highest densities recorded in the world (Knutson and Vogt 2003, unpubl. manuscript).

Philippine deer were introduced to Guam in the 1770s (Safford 1905, p. 76), and are distributed throughout the island (Conry 1988, p. 27). Heavy browsing pressure has been documented, even at relatively low densities, and browse lines are common (Conry 1988, p. 27). Deer populations in the 1990s appeared to be expanding (Wiles et al. 1999, p. 193), and may be the largest in Micronesia (p. 200). Philippine deer have caused significant changes in forest structure and species composition in native ecosystems on Guam, and are not considered compatible with conservation of native ecosystems and recovery of endangered species (Wiles et al. 1999, p. 193).

The Asiatic water buffalo was introduced to Guam in the 1600s from the Philippines (Conry 1988, p. 27). High densities, and the gregarious habits of Asiatic water buffalo, have resulted in habitat damage such as mud wallows, broad trails, vegetation trampling, and tracks, and some areas were so heavily trampled that ground cover has been denuded and soil erosion scars and slumping are evident (Conry 1988, pp. 27-28). Asiatic water buffalo occur primarily on the Ordnance Annex and surrounding non-Navy lands in southern Guam, with a population estimated at 50-60 animals (USFWS 2008a, p. 18).

Conversion of Forest to Savanna in Southern Guam

Savanna areas in southern Guam are enlarging into previously forested areas as a result of human-caused wildfires and grazing (Stone 1970, p. 14; Mueller-Dombois and Fosberg 1998, p. 242). To estimate the rate of historical forest conversion to savanna, Greenlee (2010) delineated

areas that were dominated by forest vegetation in 1975 aerial photographs and compared them to recent infrared imagery. Based on this analysis, approximately 1,119 ac (453 ha) of forest was converted to savanna in southern Guam since 1975; this estimate indicates the average rate of forest loss in southern Guam is approximately 37 ac/year (15 ha/year) (Greenlee 2010).

Habitat Destruction and Modification by Typhoons
Guam has been affected by typhoons in 37 of the last 50 years (USFWS 2005a, p. 32). Super-typhoons (with wind gusts of over 240 km (150 mi) per hour) occur approximately once every five years (the last one, Pongsona, occurred in 2002). Typhoons destroy native vegetation by opening the canopy and modifying the availability of light, and create disturbed areas conducive to invasion by non-native pest species (Asner and Goldstein 1997, p. 148; Harrington et al. 1997, pp. 539-540). Typhoons also can cause defoliation (loss of leaves), uprooting of trees, and breakage of stems, branches, and trunks of trees depending on the severity and duration of the storm and its point of impact (Brokaw and Walker 1991, p.442). Super-typhoons fragment and decrease the suitability of existing habitat, and exacerbate the effects of introduced plants and ungulates (USFWS 2005a, p. 34). Following a typhoon, forest canopies may be disrupted, facilitating the establishment and spread of introduced plants. Climate models indicate that hurricanes in the northwestern Pacific are expected to increase in intensity, frequency, and duration by 2200 and continue to increase further into the future (Emanuel et al. 2008, p. 360). Therefore, we expect habitat destruction and modification by typhoons to increase in the future.

Loss of Pollinators, Seed Dispersers, and Frugivores
The loss of forest birds on Guam by brown treesnakes has caused a disruption in the ecosystem services provided by birds as pollinators, seed dispersers, and frugivores (Mortenson et al. 2008, p. 2146; Caves et al. 2013, p. 7). Seeds are dispersed significantly farther from parent trees on islands with birds compared to Guam, and seed ingestion by birds doubles to quadruples the chance of germination for plant species (Rogers 2011, p. 2). The combination of loss of seed dispersal and reduced germination can produce major changes in the spatial pattern, abundance, and diversity of Guam's forests as a result of bird loss (Rogers 2011, p. 2). In addition, seed set and seedling recruitment were significantly higher on Saipan than Guam for bird pollinated trees (Mortensen et al. 2008, p. 2146). These studies concluded that the loss of ecosystem services provided by birds will cause a loss in species diversity, distribution, and abundance; slow regeneration of degraded forests; and reduce plant species recruitment (Mortensen et al. 2008, p. 2146 and 2153; Rogers 2011, p. 2; Caves et al. 2013, p. 5).

Human Disturbance
The listed birds and bat on Guam are also threatened by disturbance from human activities including, but not limited to, noise from military training (aircraft, munitions, firing ranges, vehicles, etc.), noise from recreational pursuits (hiking, and hunting), human voices, and construction noises. These disturbances not only negatively affect species, but reach into forested interiors and degrade the quality of habitat for listed species. The listed birds and bat addressed in this consultation are all sensitive to human disturbance, and as development continues on Guam, disturbance-free forested habitats are increasingly rare on Guam.

Land Management on DoD Lands

The majority of remaining limestone forests on Guam are found on DoD lands at AAFB and the Naval Base Guam's NMS. As noted above, the primary limestone forest on AAFB is considered some of the best native limestone forest left on Guam to serve as habitat for listed species (Morton 1996, p. 69). The Service and the DoD (USAF, U.S. Navy, and JRM) have worked together over the past 20 years to manage DoD lands for threatened and endangered species. In 1993, a Cooperative Agreement (Agreement) was established between the USAF, U.S. Navy, and the Service for purposes of establishing and managing the GNWR Overlay on DoD lands. The GNWR includes approximately 152 ha of fee simple Service-owned land and 9,106 ha of Overlay Refuge on land owned by DoD. The Agreement, which is still in effect, affirms the parties commitment for a "coordinated program centered on the protection of endangered and threatened species and other native flora and fauna, maintenance of native ecosystems, and the conservation of native biological diversity in cooperation with the Guam Department of Agriculture-Division of Aquatic and Wildlife Resources, consistent with the national defense mission of the Navy." Notably, all signatory parties to the Agreement agreed that Navy lands included within the GNWR shall be managed and administered, consistent with the national defense mission of the Navy, for the following goal: to consult under section 7 of the Endangered Species Act (ESA) on proposed Federal actions that are funded, authorized, or carried out by the Federal government within the Refuge, inclusive of Overlay Refuge lands, "that may impact habitat of endangered or threatened species even if those species are extirpated from the affected area, but are not extinct."

Management of listed species habitat on DoD lands has occurred with some success. The approximately 73-ha (180-ac) Haputo Ecological Reserve Area (ERA) on AAFB and the 12-ha (30-ac) Orote Point ERA on NBG are but two examples. Both were established in 1984, prior to the Agreement, as mitigation for the Kilo Wharf project. The 54-ha (133-ac) Habitat Management Unit (HMU) on AAFB was developed as mitigation under the 2006, informal consultation on the Beddown of Training and Support Initiative at the Northwest Field (USFWS 2006c, p. 2), and currently serves as an experimental site for brown treesnake research and control.

However, in contrast, the DoD has recently proposed to build a LFTRC within an existing 312-acre mitigation site on Overlay Refuge at Ritidian Point on AAFB (DON 2014a, p. 22). This mitigation site is a requirement under the 2006 ISR Strike Biological Opinion (USFWS 2006b). After years of working with partners in selecting and preparing the site, constructing and maintaining the ungulate fence, and spending over $1.1 million (AAFB 2015, p. 15), the proposed construction of LFTRC may result in the loss and degradation of listed species habitat, which was to be protected for listed species, and may result in the removal (as part of this proposed action) of parts or all of the ungulate fence.

Another example showing a lack of success to protect and carry-through conservation and management actions on Overlay Refuge is "Area 50", which was established near NWF on AAFB in 1991 to exclude ungulates and control brown treesnakes in an exclosure. The DOI and USAF were working collaboratively towards building a pre-stressed concrete barrier for brown treesnake control at the site, when the USAF restricted access to the site and ended the conservation project.

In addition, cooperation between the DoD and the Service for land management actions on Overlay Refuge lands has not progressed as originally intended after signing of the Agreement. As DoD and Service staff changed, access became more and more challenging until it reached a point where Service biologists could no longer access Overlay Refuge lands. In recent years, access has improved on Overlay Refuge lands.

The DoD agencies have also not historically managed ungulates to full success on DoD lands to benefit listed species or their habitats. For many years, the DoD relied on a Volunteer Conservation Officer (VCO) program to "manage" ungulates on DoD property. These hunting efforts were not effective to manage or control the large ungulate populations on DoD lands. The lack of ungulate eradication can have significant adverse effects to native plants. Recently, the DON has installed an ungulate fence and is removing ungulates from NBG.

Finally, the Sikes Act requires the DoD to develop and implement INRMPs for military installations across the United States. INRMPs are prepared in cooperation with the Service and State/Territorial fish and wildlife agencies to ensure proper consideration of fish, wildlife, and habitat needs. The Service, Guam DAWR, and JRM have been working together to finalize a new INRMP; however, the draft INRMP has still not been approved by the Service or DAWR.

The DON also has installed approximately 4,400 ft of coated chain link fence along Route 2A on the perimeter of NBG. The fence provides an ungulate exclosure for the 3,114 ac (1,260 ha) of the main base of NBG. The fencing project is intended to effectively close off Orote peninsula from any new ungulate incursions and only entry control gates will be left unfenced. These gates are manned twenty-four hours a day/seven days a week. The fencing project was initiated in 2013 and is complete.

In addition, per negotiations in the JGPO 2010 Biological Opinion (USFWS 2010a, p. 51) the DON has committed to support the re-introduction of native endangered or threatened species on DoD lands on Guam consistent with species recovery plans. When the DON and Service mutually agree the constraints to reintroduction of native threatened or endangered species on DoD lands on Guam have been minimized to a point that a feasible and successful re-introduction of the affected species is more probable than not, the DON will work with the Service to develop a re-introduction plan and supporting programmatic biological opinion that ensures such re-introduction efforts are consistent with the species recovery plans and the military mission on Guam.

DoD has had limited success in fulfilling requirements under Biological Opinions. The lack of management on DoD lands significantly increases the uncertainty that adequate habitat will be protected and managed for the conservation of listed species on Guam.

Previous or On-going DoN Projects Addressing the Conservation and Management of the Mariana Swiftlet

- 2000-2015: USDA BTS trapping around NMS caves.
- 2010-2015:

  - Quarterly surveys of NMS caves (Mahlac, Maemong, and Fachi) to estimate population size and monitor trends.
  - Surveys for potential additional swiftlet caves on NMS.
- 2012-2015:
  - Evaluation and development of new techniques to estimate swiftlet population size.
  - BTS control (trapping, bait tubes, and hand removal) at swiftlet caves.
  - BTS surveys to assess activity and use at swiftlet caves.
  - Operational assessment of current BTS control methods around swiftlet caves and field examination of what affects interception rates.
  - Assessment of whether BTS predation on captive birds (surrogate species) increases in the vicinity of rodent-baited traps.
  - Collection, necropsy, and data analysis of BTS to evaluate diet composition and predation of swiftlets.
  - Assessment of target and non-target take at BTS bait tube stations.
- 2014: Swiftlet roosting/nesting abundance study.
- 2014: Assessment of BTS activity and control methods at caves.
- 2014: Remote monitoring system to estimate and monitor swiftlet population size, spatial distribution of roosting birds, monitor nests and rodents.

Previous or On-going DoN Projects Addressing the Conservation and Management of ESA-listed, ESA Proposed, and GovGuam-listed Plant Species

Serianthes nelsonii:

- Reconstructed the ungulate fencing around the area of the Ritidian tree.
- Monitoring of seedling emergence and growth throughout the study showed 488 seedlings emerged beneath the Ritidian tree, only 4 seedlings exhibited a lifespan greater than 200 days (DoN 2014). These results were unexpected because past reports indicated deer browsing was the major cause of in situ seedling death. The ungulate exclusion fence was intact throughout the study and deer or pigs could not have been responsible for the seedling mortality.
- Nursery propagation trials using seed from the Ritidian tree determined:
  - optimum light levels for growth. In situ and nursery insect pests that caused seedling mortality were the butterfly Eurema blanda and Acacia whitefly (Trialeurodes acacia).
  - the influence of shade on seed germination and initial seedling growth was quantified for optimal growth in nursery and in situ plants.
  - Effects of experimental treatments of nitrogen, phosporous, potassium, and mycorrhizae.

<u>Brown treesnake predation</u>

The primary threat to native forests birds on Guam for over 60 years has been the non-native brown treesnake. Since the accidental introduction of the brown treesnake to Guam around 1950, Guam's avifauna has been decimated, with most of the native birds disappearing from Guam's forests (Savidge 1987, p. 660). The brown treesnake was found to be the main cause of

the decline of the native forest birds on Guam as it opportunistically preys upon eggs, nestlings, and adult birds (Savidge 1986, 1987, p. 660; Conry 1988). Extirpations of all but two resident forest avian species in southern Guam occurred within 27 to 32 years after the accidental introduction of the brown treesnake. In northern Guam, the average time for the bird populations to decline by 90 percent was 8.9 years (Wiles et al. 2003). Brown treesnakes have been reported to prey on Mariana fruit bats (USFWS 2009d, p. 8). Data collected from 1982 to 2006 at the Pati Point fruit bat colony suggest the brown treesnake preys on non-volant fruit bat pups, thereby inhibiting fruit bat recruitment on Guam (USFWS 2010b, p. vii). Brown treesnake densities are high on Guam and in the 1990s were estimated at 20 individuals per ac (50 per ha) in favorable habitats (Rodda and Savidge 2007, p. 315). The persistence of high densities of brown treesnakes has limited recovery efforts to reestablish the Mariana crow, Guam Micronesian kingfisher, and Guam rail populations in the wild on Guam.

In 2014, the USDA-APHIS Wildlife Services, in coordination with the National Wildlife Research Center, the DoD-Environmental Security Technology Certification Program, and the Department of Interior-Office of Insular Affairs, conducted a test of aerial application of a brown treesnake toxicant (acetaminophen) over forested areas in AAFB (Dorr et al. 2014, unpublished data). The results of this study indicated that development of a scalable automatic bait application system could be used in the near future for large landscape scale brown treesnake control and suppression (Dorr et al. 2014, unpublished data). This significant development makes reintroduction of the extirpated avian species a real possibility on Guam (USFWS 2015c). As control efforts continue, we expect that the Guam Micronesian kingfisher, Mariana crow, and Guam rail will be re-introduced onto Guam in the foreseeable future (L. Mehrhoff, USFWS, pers. comm. 2013). With the potential for brown treesnake to be controlled, it is imperative that a sufficient area of forested habitat be conserved in Guam to allow for recovery of these species (USFWS 2015c).

Control of brown treesnakes on DoD lands

The DoD has a long history of working cooperatively with natural resource agencies and stakeholders to prevent the dispersal of brown treesnakes to other Pacific islands and refine techniques to control snakes on Guam. As mentioned above, the DoD and the DOI have recently supported the successful development and application of an aerially dispersed toxicant to control brown treesnake numbers over a landscape on Guam. The DoD also provides funding and support to USDA Wildlife Services to maintain active snake traps around air and sea ports, and housing on DoD lands. As a requirement of a Biological Opinion, the DoD also maintains active snake traps in areas adjacent to the Mariana swiftlet caves at the NMS. The goal is to decrease brown treesnake numbers in swiftlet habitat and reduce the predation of swiftlets by snakes. Because swiftlet habitat within forested areas overlaps with habitat for the Guam Micronesian kingfisher, Mariana crow, Mariana fruit bat, and the Guam rail, snake trapping also benefits these species.

In fiscal year 2014, the DoD funded three projects that will explore methods to detect brown treesnakes and/or evaluate movement of snakes within a landscape. These projects potentially will provide information used to refine rapid response actions and brown treesnake eradication efforts. The DoD continues to work cooperatively with the Brown Treesnake Working Group to identify and implement future brown treesnake projects.

Climate Change

Climate models indicate that hurricanes in the northwestern Pacific are expected to increase in intensity, frequency, and duration by 2200 and continue to increase further into the future (Emanuel et al. 2008, p. 360). These storm increases will likely have a significant effect on habitat and survival of listed species on Guam. We do not expect that additional climate change features including increases in temperature, precipitation, and sea level (Australian Bureau of Meteorology and CSIRO 2011, Ch. 6, p. 178) will significantly affect listed species on Guam.

Environmental Baseline for the Guam Micronesian Kingfisher

Guam Micronesian kingfishers are extirpated from the action area; however, habitat suitable for the survival and recovery of the species (hereafter, kingfisher habitat) is present. For purposes of this Biological Opinion, the "survival condition" of the kingfisher in the wild represents the level of reproduction, numbers, and distribution necessary to support a persistent population on Guam that is fully protected by the ESA. For purposes of this Opinion, the "recovery condition" of the kingfisher is the survival condition where the threats to the species have been addressed such that the protections of the ESA are no longer necessary to ensure perpetuation of the survival condition of the kingfisher in the wild on Guam. Under those circumstances, the kingfisher would qualify for de-listing under the ESA.

As further described below, the role of the action area for the survival and recovery of the Guam Micronesian kingfisher is to provide protected habitat sufficient for two recovery populations (one in north Guam and one in south Guam) of sufficient size to each support 500 territorial breeding pairs in habitat where threats are managed and controlled. Because DON lands within the action area include approximately 75 percent of the kingfisher's habitat in northern Guam, and 43 percent in southern Guam, protection of habitat sufficient to help support two subpopulations (one in northern Guam and one in southern Guam) on DON lands in the action area is essential to the survival and recovery of the kingfisher.

Rationale for Delineation of Guam Micronesian Kingfisher Habitat

Survival and recovery of the Guam Micronesian kingfisher has required maintaining a population in captivity while threats from the brown treesnake are addressed on Guam. Retaining lands containing kingfisher habitat on Guam is essential for recovery and survival of the species. The success of such efforts is dependent on protecting a sufficient amount of habitat within the kingfisher's historical range to support two subpopulations of kingfishers upon reintroduction to northern and southern Guam.

Recently, we updated and conducted an detailed habitat assessment for the Guam Micronesian kingfisher on Guam (USFWS 2015c). Our goals were 1) to identify lands suitable for reintroduction of the species; 2) to determine how much habitat was needed to support survival and recovery of the species, based on the kingfisher recovery plan criteria (USFWS 2008a, p. vi); and 3) to develop a method to offset loss of remaining habitat so that a minimum amount of

habitat needed to support the species is permanently protected. The methods used to calculate kingfisher habitat are provided below.

Methods for Habitat Calculations for the Guam Micronesian Kingfisher

Recovery Targets
The recovery plan for the Guam Micronesian kingfisher (USFWS 2008a) requires the following criteria to be met for delisting. First, there must be two subpopulations of at least 1,000 adult kingfishers (one in northern and one in southern Guam). In addition, both populations must be either stable or increasing based on quantitative surveys or demographic monitoring that demonstrates an average intrinsic population growth rate of greater than 1.0 over a period of at least 10 consecutive years. Third, sufficient habitat, based on quantitative estimates of territory and home range sizes, must be protected and managed to support the population size and trajectory criteria identified above. Finally, brown treesnakes and other introduced predators need to be controlled over 10 consecutive years at a level sufficient to achieve the first and second criteria, above.

Habitat needed to support the Guam Micronesian kingfisher survival and recovery
The following analysis was completed to determine the amount of kingfisher habitat on Guam that must be protected and managed to support both the survival and recovery of this species. This analysis relies on known and estimated life history requirements of the kingfisher and closely related species, and the findings in the final revised recovery plan for the kingfisher (USFWS 2008a).

Delineation of Survival and Recovery Habitat
As noted in the Status of the Guam Micronesian Kingfisher section above, kingfishers utilize a mosaic of forested and open habitats for foraging and breeding. However, as forested habitats, especially mature forest, are likely limiting, the analysis focused on identifying forested habitats as recovery habitat for the kingfisher. This approach was taken for two reasons. First, kingfishers need forested habitat for breeding, so forested habitat is essential to the species. Second, typhoon impacts to forested habitat are not well understood. Therefore, by focusing on forested habitats we provide a more conservative estimate of kingfisher habitat needed for its survival and recovery in the wild on Guam.

All areas identified as limestone, ravine, coconut, and palma brava (*Heterospathe elata*) forests in the 2006 Forest Service landcover map of Guam (Liu and Fischer 2006) were considered to be potential kingfisher habitat. The amount of available habitat was updated by removing all forested areas cleared since the landcover map was completed. This process used 2011 satellite imagery of Guam (USFWS, unpublished data) and other reported clearing (USFWS, unpublished data).

The remaining forested areas were subdivided into potential and non-potential recovery habitat based on forest patch area and isolation. Forest areas that were sufficiently large to hold a kingfisher territory were identified using a "territory building" algorithm (USFWS unpublished algorithm) developed using the Raster package (Hijmans 2014) in the statistical program R. This algorithm accounted for the size of the territory and percentage of forested habitat per territory,

thereby omitting areas that were insufficient in size or placement of forested habitat to meet the criteria of a kingfisher territory. We classified forest patches as too isolated for recovery habitat if they were of insufficient size to hold three or more territories and if they were greater than 0.87 mile (1.4 km) (the maximum dispersal distance reported by Kesler and Haig 2007c for the Pohnpei Micronesian kingfisher) from the nearest neighboring forested area supporting three or more territories. The results of these analyses indicate that there is approximately 14,997 acres of kingfisher habitat in northern Guam and 13,314 acres of kingfisher habitat in southern Guam.

Estimated Population Size and Area Needed for Recovery

1. Each breeding kingfisher pair requires 20 acres of habitat (Kesler and Haig 2007a, Pohnpei subspecies of the Micronesian kingfisher). Therefore, under ideal conditions 10,000 acres of habitat will be needed to support a stable kingfisher population with 500 breeding pairs in northern Guam, where the breeding pairs are using 100 percent of the habitat throughout the year, the habitat is in ideal condition to support kingfishers, and there is never any loss of habitat due to manmade or natural disturbances such as fires or storms. These ideal conditions are unrealistic and not sustainable. Consequently additional area is needed for a more realistic estimate of kingfisher recovery habitat, as follows.

2. Density estimates for Guam Micronesian kingfisher in undeveloped areas of northern Guam give an average density of 4 acres per bird (adults and juveniles; calculated with data from northern Guam for the Guam subspecies of the Micronesian kingfisher in Engbring and Ramsey 1984). Thus, the 10,000 acres will actually support 2,500 adult and juvenile kingfishers. This density estimate includes areas that are periodically not used as territories, but are an integral part of the kingfisher habitat, allowing for natural disturbances such as storm, tree falls, landslides, etc.

3. A stable age distribution with 1,000 adult kingfishers gives a population comprised of 38.24 percent adults (calculated with data on the Tuamotu subspecies of the Micronesian kingfisher in Kesler et al. 2012). Thus, 38.24 percent of 2,500 birds are 956 adults, equaling 478 breeding pairs in 10,000 acres; each pair requiring approximately 21 acres (10,000 acres ÷ 478 pairs). An additional 22 breeding pairs (44 adults) are needed to reach the recovery threshold of 500 breeding pairs (1,000 adults). An additional 462 acres of habitat is needed for these 22 breeding kingfishers. Thus the total habitat needed to support 1,000 adults (500 breeding pairs) is 10,462 acres.

4. The 10,462 acres supports the minimum number of breeding kingfishers needed to reach recovery, and does not provide for natural population fluctuations below the recovery threshold. For instance, climate change is predicted to increase the frequency, intensity and duration of storms in the area of the Mariana Islands by several percent over the next 100 years (Emanuel et al. 2008, p. 360); this will likely increase the fluctuation of the northern Guam kingfisher population. To prevent the kingfisher population from fluctuating below the recovery threshold, additional habitat is required for protection against current and future severe storms. Severe storms (strong - category 3 and above - typhoons and super-typhoons) currently affect Guam once a year on average (FWS

analysis of the Joint Typhoon Warning Center best track data 1975-2014). Climate modeling indicates that these storms will increase in the future. A single severe storm can affect habitat, survival, and reproduction. A 10 percent increase in breeding pairs (50 pairs) requiring an additional 1,050 acres of habitat will serve as added protection against population fluctuations due to climate change and other unforeseen natural and manmade events.

5. The area needed to support a viable northern Guam kingfisher subpopulation that maintains itself above the minimum recovery threshold is estimated to be 11,512 acres. This minimum area assumes that the habitat is restored and managed as follows: restoration of kingfisher habitat requires establishing land cover to 56 percent forested that support trees greater than 17 inches in diameter, and 44 percent open or low cover areas for foraging; management of kingfisher habitat requires the continual control of invasive plants, ungulates, non-native predators such as the brown treesnake, rats, and cats, as well as protection from fire. These restoration and management activities have never been fully demonstrated on Guam and so their success remains an assumption. Predator, weed and ungulate control activities can be very difficult in open wilderness terrain where access and monitoring are difficult. Because of this uncertainty in restoration and management of kingfisher habitat, additional habitat beyond the 11,512 acres may be required to achieve the recovery of kingfisher in northern Guam. This minimum recovery area (11,512 acres) also assumes that at least 1,000 adults are breeding, thus 500 breeding pairs. The area requirements for a breeding pair (approximately 20.0 acres; Kesler and Haig, 2007a) is less than the combined area for an individual non-breeding adult male (average of 17.5 acres; Kesler and Haig 2007a) and an individual non-breeding adult female (average of 14.1 acres; Kesler and Haig 2007a). Thus the total area for recovery will be minimized by assuming all 1,000 adults are in breeding pairs. Additional area may be needed if a significant number of adult kingfishers forgo breeding in any year.

Estimated Amount of Habitat Needed to Support Kingfisher Survival and Recovery
Based on the above analysis, the final area needed to support a viable Guam Micronesian kingfisher population that maintains itself above the minimum recovery threshold is estimated to be 11,512 ac for each kingfisher subpopulation in northern and southern Guam. Collectively, a total of 23,024 ac of habitat would be needed to support the survival and recovery of the kingfisher on Guam (Figure 6).

Summary of Remaining Habitat to Support the Survival and Recovery of Kingfishers on Guam

We estimate that there are currently 14,997 ac and 13,314 ac of kingfisher habitat in northern and southern Guam, respectively. However, kingfishers excavate nest cavities in trees over 17 inches in diameter that are located in closed canopy forests with dense understory vegetation, and this habitat type is limited on Guam due to extensive forest clearing and ungulate effects to forest regeneration. Additionally, natural disturbance events, such as severe typhoons, will continue to affect the availability of the large forest trees necessary to support kingfisher nesting, and these typhoons are expected to increase in intensity, frequency, and duration (Emanuel et al. 2008, p. 360). Therefore, while it currently appears there is adequate potential habitat to support

kingfisher survival and recovery, the actual suitable habitat is likely less; thus any loss of potential habitat must be carefully considered in regards to whether it appreciably reduces the likelihood of kingfisher survival and recovery in the wild.

For kingfisher habitat to support the survival and recovery of kingfisher, much of it will likely have to be restored, and all of it will have to be managed. Restoration of kingfisher habitat requires establishing land cover to approximately 56 percent forested that support trees greater than 17 inches in diameter, and approximately 44 percent open or low cover areas for foraging. Management of kingfisher habitat requires the continual control of invasive plants, ungulates, non-native predators such as brown treesnakes, rats, and cats, as well as protection from fire. Predator, weed and ungulate control activities can be very difficult in open wildness terrain where access and monitoring are difficult. Because of the uncertainty in restoration and management of kingfisher habitat, the Service developed a mitigation ratio to ensure kingfisher habitat to support the recovery of kingfisher on Guam would be protected and conserved (USFWS 2015c).

Mitigation Framework

In consideration of the on-going and increased habitat loss and degradation on Guam (as detailed in the General Environmental Baseline section) the Service has endeavored to finalize the draft Mitigation Framework (USFWS 2014e), including the mitigation ratio for habitat loss, to address future habitat conservation needs for the Guam Micronesian kingfisher (USFWS 2015c). As land management actions are proposed that will affect habitat needed for the recovery and survival of the kingfisher, it will be necessary to offset these effects by assuring that durable habitat will be protected and available for species reintroduction. This can be accomplished by ensuring that any habitat that is lost is offset with permanent habitat conservation at rates that ensure an adequate amount of habitat is needed to support the survival and recovery of the kingfisher on Guam.

The mitigation ratio took into account kingfisher habitat that were already protected in northern and southern Guam. For northern Guam, approximately 571 acres of kingfisher habitat is protected. There is no kingfisher habitat protected in southern Guam. Kingfisher habitat should be protected to the maximum extent possible until restoration and management practices for kingfisher habitat are proven to work.

The Mitigation Framework provides guidance to ensuring that adequate amounts of the habitat will be available for species reintroduction in the future. We have recommended to the DON that they should assure that any habitat that is lost as a result of proposed projects is offset with permanent habitat conservation at a rate that ensures the minimum amount of habitat needed to support kingfisher conservation will ultimately be available to support the recovery and survival of the species in the wild on Guam. Although not part of the project description, please refer to the MOA (DON and USFWS 2015), for information on kingfisher habitat that will be protected to ensure the survival and recovery of the kingfisher on Guam.

Environmental Baseline for the Mariana crow

Mariana crows are extirpated from the action area; however, habitat potentially suitable for the survival and recovery of the species (hereafter, crow habitat) is present. For the purposes of this biological opinion, the "survival condition" of the Mariana crow in the wild on Guam represents the level of reproduction, numbers, and distribution of each species that is necessary to support a persistent population on Guam. Achievement of the survival condition is facilitated by recovery planning and the protections afforded to listed species under the ESA. For purposes of this biological opinion, the "recovery condition" of these species is the survival condition where the threats to the species have been addressed such that the protections of the ESA are no longer necessary to ensure perpetuation of the survival condition of the listed species in the wild on Guam and Rota. Under those circumstances, the species would qualify for de-listing under the ESA.

As further described below, the role of the action area for the survival and recovery of the Mariana crow is to provide protected habitat sufficient for two recovery populations (one in north Guam and one in south Guam) of sufficient size to each support 100 territorial breeding pairs in habitat where threats are managed and controlled. Because DON lands within the action area include approximately 75 percent of the Mariana crow's habitat in northern Guam, and 43 percent in southern Guam, protection of habitat sufficient to help support two subpopulations (one in northern Guam and one in southern Guam) on DON lands in the action area is essential to the survival and recovery of the Mariana crow.

Rationale for delineation of crow habitat

Survival and recovery of the Mariana crow has required maintaining a population off-island or in captivity while threats from the brown treesnake are addressed on Guam. Retaining unoccupied habitat on Guam is essential for recovery of the species. The success of such efforts is dependent on protecting a sufficient amount of habitat within the Mariana crow's historical range to support a crow population upon reintroduction.

We conducted an updated detailed habitat assessment for the Mariana crow on Guam (USFWS 2015c). Our goals were 1) to identify lands suitable for reintroduction of the two species; 2) to determine how much habitat was needed to support survival and recovery of the species; and 3) to develop a method to offset loss of remaining habitat so that a minimum amount of habitat needed to support the species is permanently protected. The methods used to calculate crow habitat are provided below.

Methods for Habitat Calculations for the Mariana Crow

Recovery Targets
The delisting criteria from the draft revised recovery plan for the Mariana crow calls for a minimum of 225 territorial breeding pairs (75 on Rota, 75 in northern Guam, and 75 in southern Guam) (USFWS 2005a, p. v). Since the draft revised recovery plan was published in 2005, additional work on population viability of the Mariana crow has occurred. This recent assessment of population viability indicated that 75 territorial breeding pairs may not be viable over the long-term due to potential inbreeding depression (O'Grady et al. 2006) and projected increases in tropical storm intensity, duration, and frequency (Emanuel et al. 2008), and that 100

territorial breeding pairs may be a more appropriate recovery target (Amidon 2012, unpubl. data). Therefore, we used 100 territorial breeding pairs as our recovery target for this assessment for each of the three regions identified above.

A sustainable population of territorial pairs requires a floater population of juvenile and pre-breeding Mariana crows to replace any pair members that die. We utilized demographic information from the Rota population (Morton et al. 1999, Ha et al. 2010b, Zarones et al. 2013) to estimate a stable age distribution using the popbio package (Stubben and Milligan 2007) in the statistical program R (R Core Team 2014). We then used this distribution to determine the number of non-breeders needed to support the breeding population. Based on this analysis, an additional 96 adult Mariana crows (males and females), 54 juveniles and 42 pre-breeders, would be needed to support a breeding population of 100 territorial pairs at each of the three areas described above. We assumed that each of these birds would require space for foraging and roosting.

Finally, the long-term stability of the Mariana crow population is dependent on the availability of suitable breeding habitat and successful reproduction. Typhoons are a regular occurrence on Guam and Rota and are expected to affect the availability of suitable nesting sites and overall nesting success. Unfortunately, estimates of typhoon damage to nesting trees and demographic estimates of typhoon impacts on Mariana crow breeding success are limited. This assessment should be reconsidered when these data become available. In the interim, we will use more conservative estimates of habitat requirements and delineation of habitat areas (see below) to help account for some of these effects.

Density Estimates
Morton et al. (1999, p. 2) reported that Mariana crow territories ranged from 29.65 to 91.43 ac on Rota, with a mean territory size of 54.36 ac. Therefore, we utilized 54.36 ac as our estimate of forested habitat needed to support a breeding pair. Home range estimates for non-breeders were not available, and we do not currently have information on Mariana crow territory overlap. Therefore, we assumed that each bird would need approximately half a territory, 27.18 ac (11 ha).

Delineation of Crow Habitat
As noted above, Mariana crows are more likely to occur in native dominated forest. For this assessment, we assumed that all areas identified as limestone and ravine forests on the 2006 Forest Service landcover maps of Guam and Rota (Liu and Fisher 2006a,b) are potential Mariana crow habitat. We then updated the amount of available habitat on Guam by removing all forested areas cleared since the landcover map was completed using 2011 satellite imagery of Guam (Metevier 2014, unpubl. data). We then subdivided the remaining forested areas into potential and non-potential habitat based on forest patch area and isolation. We identified forest areas that were sufficiently large to support a Mariana crow territory using a "territory building" algorithm that we developed using the Raster package (Hijmans 2014) in the statistical program R. This algorithm accounted for the size of the territory and suitability of habitat, thereby omitting areas that were insufficient in size to meet the criteria of a Mariana crow territory. We then classified forest patches as too isolated for crow habitat if they were of insufficient size to hold three or more territories and if they were greater than 3.5 kilometers (the maximum

dispersal distance reported by Ha (2012, *in litt*.) for the Mariana crow on Rota) from the nearest neighboring patch of forest capable of supporting three or more territorial pairs. Remaining habitat for the Mariana crow is shown in Figure 7.

Estimated Crow Habitat Needed

Utilizing the recovery targets for the species and density information, approximately 5,436 acres of forest is needed to support 100 territorial breeding pairs. In addition, 2,609 acres of forested habitat would be needed to support the non-breeding crow population. Therefore, a total of 8,046 acres of forest habitat would be needed at each of the three regions (Rota, northern Guam, and southern Guam) to support the survival and recovery of the Mariana crow. However, the 8,046 acres supports the minimum number of breeding Mariana crows needed for survival and recovery of crows in the wild, and does not provide for natural population fluctuations below the recovery threshold. For instance, climate change is predicted to increase the frequency, intensity, and duration of storms in the area of the Mariana Islands by several percent over the next 100 years (Emanuel et al. 2008, p. 360), and this will likely increase the fluctuation of the northern Guam Mariana crow population and increase the acres of suitable habitat needed for the survival and recovery of the crow.

To prevent the crow population from fluctuating below the recovery threshold, additional habitat is required for protection against current and future severe storms. Severe storms (strong [category 3 and above] typhoons and super-typhoons) currently affect Guam every five to 10 years (FWS analysis of the Joint Typhoon Warning Center best track data 1975-2014). Climate modeling indicates that these storms will increase in the future (Emmanuel et al. 2008, p. 360). A single severe storm can significantly affect survival and reproduction in that breeding season. A 10 percent increase in breeding pairs (10 pairs) requiring an additional 544 acres of habitat will serve as added protection against population fluctuations due to climate change and other unforeseen natural and manmade events.

Based on the above analysis, the final area needed to support a viable Mariana crow population that maintains itself above the minimum recovery threshold is estimated to be 8,590 ac for each Mariana crow subpopulation in northern and southern Guam.

Remaining Crow Habitat on Guam

There is currently 13,962 acres of potential Mariana crow habitat left in northern Guam. However, very little of this remaining habitat is set aside for conservation (a total of 502 acres), and even less of that habitat is managed to control threats. There is currently 10,957 acres of Mariana crow habitat left in southern Guam. No crow habitat in southern Guam is set aside for conservation or managed to control threats.

In addition to lands being set aside for conservation, crow habitat needs to be managed for threats including brown treesnakes and other predators, invasive species, and ungulates. Most of the lands set aside for conservation are not currently managed to reduce threats. Therefore, it is urgent that habitat protection and management of Guam's forests begin immediately to prepare for the reintroduction, and potential recovery, of extirpated avian species. If crow habitat is degraded enough to no longer provide the ecological functions necessary to support Mariana

crows (for example, loss of native trees necessary for crow breeding and foraging), then this habitat will need to be removed from baseline calculations.

Furthermore, the habitat model does not account for differences in habitat quality. As described above, primary limestone forest is the highest quality habitat for the Mariana crow. Secondary limestone forest is of lower quality, but due to data mapping challenges, is counted equally in the habitat model. Given the current threats from military and civilian development, typhoons, invasive species, ungulates, and forest conversion, and the small amount protected habitat, it is imperative that conservation efforts begin to protect and enhance the quality of Mariana crow habitat on Guam.

Mitigation Framework
In light of on-going and increased habitat loss and degradation on Guam (as detailed in the General Environmental Baseline section) the Service has developed a draft Mitigation Framework to address future habitat conservation needs for the Mariana crow (USFWS 2015c). As land management actions are proposed that will affect recovery habitat needed for the conservation of the Mariana crow, it will be necessary to offset these effects by assuring that durable habitat will be protected and available for species reintroduction. This can be accomplished by ensuring that any habitat that is lost is offset with permanent habitat conservation at rates that ensure the minimum amount of habitat needed to support the survival and recovery of the Mariana crow on Guam.

The Mitigation Framework provides certainty that adequate minimum amounts of the remaining habitat will be available for species reintroduction in the future. We have recommended to the DON that they assure any habitat that is lost as a result of proposed projects is offset with permanent habitat conservation at a rate that ensures the minimum amount of habitat needed to support crow conservation will ultimately be available to support recovery of the species. Although not part of the project description, please refer to the MOA (DON and USFWS 2015), for information on kingfisher habitat that will be protected to ensure the survival and recovery of the kingfisher on Guam. The habitat that will be protected pursuant to the MOA may also provide conservation benefit to the Mariana crow (DON and USFWS 2015, p.3).

Environmental Baseline for the Guam Rail

Guam rails are extirpated from the action area; however, habitat suitable for recovery of the species ("recovery habitat") is present. For the purposes of this Section 7(a)(2) analysis on a species extirpated from the action area, we define "survival" of the species in terms of the amount of habitat needed to support a target recovered Guam rail population and "recovery" of the species as a point when this population is present on recovery habitat on Guam.

Rationale for delineation of recovery habitat

Survival and recovery of the Guam rail has required maintaining a population off-island or in captivity while threats from the brown treesnake are addressed on Guam. Retaining unoccupied habitat on Guam is essential for the recovery and survival of the species. The success of such

efforts is dependent on protecting a sufficient amount of habitat within the rail's historical range to support a viable rail population upon reintroduction on Guam.

Methods for Recovery Habitat Calculation for the Guam rail

Recovery Targets
Before the Guam rail is considered for downlisting from endangered to threatened, the repatriation of 1,000 birds to northern Guam and 1,000 birds to southern Guam (total = 2,000 individuals; USFWS 1990a, p. 33) would need to occur and brown treesnakes would need to be controlled on Guam (USFWS 1990a, p. 33-34). As mentioned above, no criteria were defined for delisting. However, Traill et al. (2009) proposed a minimum population target of 5,000 individuals as an appropriate target for species conservation.

Density Estimates
Engbring and Ramsey (1984) estimated Guam rail densities 0.07 to 0.33 birds per ha on Guam in 1981. The weka (*Gallirallus australis*), another rail species of conservation concern, had densities ranging from 0.3 to 0.8 birds per ha (Beauchamp 1987) while the Cocos buff-banded rails (*Gallirallus philippensis andrewsi*) typically had densities from four to nine birds per ha (Reid and Hill 2005). The Guam rail and weka densities both reflect species undergoing population declines. Therefore, their density estimates may not reflect the potential densities that could be obtained from a recovered population. However, because the maximum Guam rail density does overlap with the weka estimates it does serve as a good conservative estimate of potential densities until further data are collected. Therefore, to meet the population goal of 5,000 individuals on Guam we would need 41,184 ac (16,667 ha) (5,000 birds/0.3 birds per ha) of appropriate habitat on Guam. In addition, to meet the downlisting criteria of 1,000 birds in both northern and southern Guam then 8,236 ac (3,333 ha) (1,000 birds/0.3 birds per ha) of appropriate habitat would be needed in both northern and southern Guam.

Delineation of Recovery Habitat
Guam rails were predominately observed using scrubby secondary growth areas and the edges of mixed forest areas (Jenkins 1979, Engbring and Ramsey 1984). Jenkins (1979) reports that they were seldom observed in the interior of mature limestone forests or savanna areas and did not occur in wetlands. The Forest Service vegetation map of Guam includes the following vegetation types: 1) Limestone Forest, 2) Ravine Forest, 3) Palma Brava Grove, 4) Scrub Forest, 5) Leucaena Stand, 6) Casuarina Thicket, 7) Acacia Plantation, 8) Coconut Plantation, 9) Savanna Complex, 10) Strand Vegetation, 11) Other Shrubs and Grasses, 12) Agricultural Field, 13) Urban Builtup, 14) Urban Cultivated, 15) Barren Land, and 16) Wetlands (Liu and Fischer 2006a). Of these vegetation types, only Scrub Forest, Other Shrubs and Grasses, and Urban Cultivated were considered primary Guam rail habitats because they include shrubby edge habitats. The remaining forested areas were excluded because rails were less common in interior forested areas. Rails are thought to use the edges of these vegetation types, however, these areas are likely bordered by secondary scrub, shrub, and urban cultivated vegetation types which are included. Savanna complex also was not included though they may use the edge of this habitat types. Wetlands and barren lands were not included because the available data does not list these vegetation types being used by rails. Guam rails may use agricultural fields however there was no data available indicating they use these areas. Finally, Urban Builtup was excluded because

rails were not reported in urban areas and these areas likely do not contain appropriate habitat for the species.

In addition to vegetation type, patch size and proximity or distance between patches also were considered in the delineation of recovery habitat for the Guam rail. No information is available on the average size of a Guam rail territory. A related species, Lord Howe woodhens (*Gallirallus sylvestris*) have an average territory size of one to four ha (NSW National Parks and Wildlife Service 2002) while the weka (*Gallirallus australis*) have an average territory size of two or five ha depending on location (Beuchamp 1987). If we are conservative and assume the maximum territory of a Guam rail is similar to the weka then any patch less than 10 ha (the average territory size of two weka pairs [5 ha x 2]) and over one kilometer away from the nearest patch is likely too small and isolated to be viable habitat for rail recovery. In addition, all patches less than one ha (the minimum territory size of a Lord Howe woodhen) and 125 meters (the approximate radius of a five ha territory) from the nearest patch above one ha is considered too isolated and small to be viable habitat for rail recovery. Finally, any patch less than 10 ha and completely isolated by the nearest patch by lands classified as Urban Builtup (excluding roads) by the Forest Service is considered too isolated to be viable rail habitat due to the potential for urban developed areas to impede movement of rails. The remaining recovery habitat for the Guam rail is shown in Figure 8.

Estimated Recovery Habitat Needed
Based on the density information and the population goal of 5,000 individuals on Guam to achieve conservation of the Guam rail, we would need 41,184 ac (16,667 ha) (5,000 birds/0.3 birds per ha) of appropriate habitat on Guam. In addition, to meet the downlisting criteria of 1,000 birds in both northern and southern Guam then 8,236 ac (3,333 ha) (1,000 birds/0.3 birds per ha) of appropriate habitat would be needed in both northern and southern Guam.

Remaining Recovery Habitat on Guam

Based on the above, there are approximately 24,698 ac (9,995 ha) and 24,886 ac (10,063 ha) of recovery habitat in northern and southern Guam, respectively, for the Guam rail. However, very little of this habitat is protected for the conservation of the Guam rail. Although a quantitative habitat assessment of the protected areas for use by Guam rails has not been conducted, approximately 500 acres have been protected for the Mariana crow and Guam Micronesian kingfisher in northern Guam (USFWS 2015c, p. 3). Rails would be expected to use much of the edges of forest patches, secondary forest and scrub within the approximately 500 acres of protected habitat. No recovery habitat in southern Guam is set aside for conservation.

In 2012, the GNWR proposed approximately 125 acres of habitat on the GNWR's fee simple land to be managed for Guam rails. This area would eventually support the reintroduction of Guam rails within the GNWR. However, this proposal was put on hold in 2014 because of the DON's proposed establishment of the LFTRC surface danger zone within the fee simple land. The GNWR is in the process of evaluating the feasibility of this proposal and whether to move forward with it, in consideration of the proposed action and the future access constraints to the GNWR (J. Schwagerl, USFWS, pers. comm. 2015).

Lands set aside for conservation on Guam and recovery habitat needs to be managed for threats including brown treesnakes and other predators, invasive species, and ungulates. Most of the lands set aside for conservation are not currently managed to reduce threats. In addition, the loss, degradation, and fragmentation of recovery habitat due to urban development continues to threaten the Guam rail.

Environmental Baseline for the Mariana fruit bat

Mariana fruit bat population on Guam

Other than a few isolated periods of increase, Mariana fruit bats have been declining on Guam since the early 1900's (Wiles 1987b, p. 1; USFWS 2009d, pp. 6–7 and references cited therein). Although the decline of the fruit bat was likely initiated by the introduction of firearms and increased hunting efficiency in the early 1900's, predation by the brown treesnake contributed to continued decline (Wiles et al. 1987, p.148; Lemke 1992, p. 137; Wiles et al. 1995, p. 32; Janeke 2006, p. 3; Brooke 2008, p. 2; USFWS 2009d, p. 19, 30). By 1995, nearly all of Guam's remaining fruit bats were located on AAFB (Wiles et al. 1995, p. 39). In 2006, the only known maternity colony on Guam was located on AAFB at Pati Point and had less than 100 individuals (Janeke 2006, p. 4). By 2010 the Pati Point colony no longer existed, and no other colonies are known to currently exist on Guam (SWCA 2012, p. 20, DON 2014c, p. 2).

As described below, individual bats have been detected at multiple locations on Guam in the past seven years (Figure 9):

Northern Guam (GNWR, AAFB, Finegayan, and Haputo)

- In July 2014, a large-scale survey throughout AAFB resulted in an estimate of 8-21 bats (DON 2014c, p. 2).
- Surveys on AAFB in 2012 recorded 50 detections of bats at 84 stations, some of which could be the same individuals. Bats were primarily recorded along the cliffline extending from above the Combat Arms Training and Maintenance (CATM) Range east to Pati Point, in the MSA, and in the vicinity of the HMU (SWCA 2012, p. 58).
- In 2011, three bats were observed flying west along the beach in front of the headquarters at GNWR (Schwagerl, pers. comm., 2015).
- Extensive surveys throughout AAFB from December 2010 to December, 2011, resulted in a conservative estimate of approximately 25 fruit bats (DON 2014c, p. 48)
- From 2010-2013, a single bat was observed flying across Route 3A on six occasions; four observations of a bat flying into the HMU from Finegayan, and two observations of a bat flying out of the HMU into Finegayan in the late afternoon (J. Schwagerl, USFWS, pers. comm. 2015). Fruit bats from AAFB may use forested areas of Finegayan for foraging and roosting.
- During 10 observation days in 2008, one fruit bat was observed in the Haputo ERA and one in the northeastern portion of Finegayan (Brooke 2008, p. 1). The Haputo ERA contains some of the best remaining fruit bat habitat on the DON-managed lands (Brooke 2008, p. 2; DON 2010c; DON 2013b).

Naval Magazine, Naval Base Guam, and Southern Guam

- In August, 2014, two observations of a Mariana fruit bat in flight occurred at Fena Reservoir within the NMS (L. Takano, USFWS, pers. comm. 2014).
- In May and June of 2012 seven detections of a single fruit bat were recorded during surveys on six separate occasions at four locations on the NMS; it could not be determined whether observations were of a single individual or multiple individuals (DON 2014a, p. 48).
- In 2012, fruit bat surveys were conducted within the NMS and a private lands site located in southern Guam (DON 2013b). Seven observations were recorded of a solitary fruit bat in flight at NMS, but it could not be determined if these observations represent one, or multiple bats (DON 2013b, p. 11). These observations supplement fruit bat sightings previously documented in the vicinity of the NMS where foraging and roosting habitat is present (Brooke 2008, pp 1-2). No observations were recorded at the private lands site where suitable fruit bat roosting and foraging habitat is limited. However, known food plants of Mariana fruit bats are present in the vicinity and fruit bats may use the area for roosting, foraging, and commuting (DON 2013b, p. 12).
- One bat was sighted on NBG lands in 2008 during 90 hours of fruit bat surveys at 14 survey locations on or near NBG lands. (DON 2014a, p. 48).

Threats to the Mariana fruit bat on Guam

In addition to the threats described in the General Environmental Baseline section, the following threats also affect Mariana fruit bat populations on Guam.

Hunting
Humans have been using Mariana fruit bats as a food source since human arrival in the Mariana Islands, and consumption of bats represents a significant Chamorro cultural tradition (Lemke 1992, p. 135; Sheeline 1991, p. 14). Demand for fruit bats for human consumption is clearly demonstrated by the large commercial trade in bats that existed in the Marianas in the late 1960's until it became illegal through the Convention on International Trade of Endangered Species of Wild Fauna and Flora (CITES; Wiles and Payne 1986, p. 143; Stinson et al. 1992, p. 63-66; Wiles et al. 1997, p. 204; CITES 2015). It is estimated that approximately 221,000 fruit bats were imported to Guam between 1975 and 1989 (Wiles 1992, p. 54). Illegal hunting appears to be the key reason for the fruit bat's dramatic decline on Guam (Wiles 1987b, p. 154; Wiles and Brooke 2009; USFWS 2009d, p. vii).

Currently, although bats are protected by law on Guam, they are probably still hunted opportunistically on private property when they transit the island, and by deer hunters on AAFB (GNWR, unpublished data, 2005). For example, in 2007, construction of approach lighting at the north field on AAFB began, and included clearing of native limestone forest near Pati Point. During the construction period, reports were made of construction workers illegally hunting fruit bats at the Pati Point colony. The number of fruit bats at the colony declined from 55 bats (summer 2007) to 21 bats (December 4, 2008 survey) (PEER 2009). A recreational public hunting program has been in effect on AAFB since 1964, is still in effect (D. Lujan 2015, pers. comm.), and is managed by a small group of hunters known as the Volunteer Conservation Officers (VCOs). The public is authorized to hunt on weekends in designated areas, and VCOs may hunt after regular working hours during the week. All hunting effort is documented by the

VCOs. Currently, archery-only hunting is allowed in four areas (D. Lujan 2015, pers. comm.); shotgun and muzzle loading hunting is no longer allowed. Elimination of shotgun and muzzle-loading hunting is likely to reduce the chance of fruit bat hunting on AAFB; however, it is possible that fruit bats are still hunted opportunistically on AAFB. SWCA (2012, p. 58) reported that roosting fruit bats were approached by observers as close as 16 ft (5 m), and suggested that hunters could, without difficulty, shoot and kill a roosting bat.

Opportunistic hunting of fruit bats is suspected to occur during hunting of ungulates (Wiles 1987b, p. 154; Janeke 2006, p. 67; USFWS 2009d, p. 24; SWCA 2012, p. 60). In 2007, the Chief Conservation Officer (CCO) of the AAFB Hunting Program reported that poaching of deer was occurring in areas where hunting was not authorized. This same CCO issued Letters of Suspension to four VCOs, and a Removal from Program letter to one VCO for violations against Guam hunting regulations, Base Instructions and program depredation policies (PEER 2009).

Noise

Currently air traffic is the primary source of noise disturbance for fruit bats on Guam (SWCA 2008, p. 2-3; SWCA 2012, p. 23, 37). The first known study examining the effects of aircraft overflights on Mariana fruit bats on AAFB was conducted when a colony of approximately 400 bats still roosted at Pati Point (Morton 1996). During this study, roosting fruit bats responded to some low-altitude aircraft overflights with distress and flushing, which increased time spent in alert, aggression, and maintenance behaviors. Four-engine carriers and bombers generally elicited a greater response from roosting bats than fighter aircraft. Morton (1996, p. iii) suggested that higher levels of air-traffic volume would result in increased energy expenditure and perhaps roost abandonment by some or all of the bats.

In 2006, the effects on fruit bats from noise resulting from increased jet aircraft and helicopter use at AAFB were analyzed in the ISR Strike Biological Opinion (USFWS 2006b). In that consultation, noise effects were expected to adversely affect the Mariana fruit bat to the extent that the nearby Pati Point colony would be abandoned, and fruit bats relocating from Pati Point to other, less-protected areas on the island likely would be shot opportunistically by hunters (USFWS 2006b, p. 49). In the ISR Strike Biological Opinion, we concluded that fruit bats on Guam would be taken as a result of the proposed action, but that this take would not jeopardize the continued overall existence of the Mariana fruit bat (USFWS 2006b, pp. 49–52).

In 2007-2008, another study was conducted to document potential effects of aircraft noise on fruit bats at AAFB (SWCA 2008). During this period, the number of fruit bats at the Pati Point colony had decreased to an average of 40 bats. Aircraft noise affected the Mariana fruit bats by increasing maintenance behaviors following overflights compared to no overflights. However, the proportion of bats displaying maintenance behavior following an overflight was variable. Overflights did not appear to affect active thermoregulation. Six percent of overflights resulted in flushing events, and all flushing events were at noise levels exceeding 106 dBC, the highest reading being 122.6 dBC (SWCA 2008, pp. 2-3).

In 2010, another study was conducted to assess the effects of aircraft noise on Mariana fruit bats at AAFB (SWCA 2012). By 2010, the colony at Pati Point no longer existed. Although up to eight individual fruit bats were observed roosting there at any one time, most departed the site by

the end of each sampling period, indicating the site was no longer used as a colonial roost (SWCA 2012, p. 2). Increases in active thermoregulation (32 percent), maintenance (14 percent), locomotion (74 percent), and alertness (62 percent) were recorded during aircraft overflights. All flush events were at recorded peak noise levels above 90 dBA/101 dBC; the highest reading at 124.9 dBA/125.5 dBC (two F-15 aircraft). The observed flush events were associated with fighter, bomber, transport, and helicopter aircraft overflights (SWCA 2012, p. 23, 37).

In 2015, the MITT Biological Opinion was signed (USFWS 2015b) and the Service found that implementation of the MITT program, including aircraft overflights and other training, was compatible with a fruit bat roost site at Pati Point, but noise caused by nighttime training activities would adversely affect the foraging behavior of fruit bats at AAFB and NMS.

Some evidence suggests that fruit bats may also be affected by artillery noise at the existing CATM range at Tarague. When the fruit bat colony was still roosting at Pati Point, a DAWR Wildlife Biologist observed fruit bats avoiding the firing range area as they left the roost to fly to their foraging grounds. Some flew away from land over the ocean, and returned to land by the Tarague beach area. Others flew up to the cliff line heading towards MSA I (ISR Strike area). These observations occurred while the firing range was active around on two different days. During the time period between the two observations, the number of bats in the colony dropped from approximately 40 to less than 20 individuals. When the firing range was inactive, bats were observed to fly along the cliff line near the range (J. Quitugua, DAWR, pers. comm. 2015).

Typhoons

Mariana fruit bats evolved in the presence of typhoons, the principal natural disturbance in the archipelago, but today these storms are a threat to the species because they can exacerbate the effects of the anthropogenic threats listed above (USFWS 2009d, p. 34). Evidence from Rota suggests that typhoons may not be a substantial source of direct mortality for fruit bats (Stinson et al. 1992, p. 65; Esselstyn et al. 2006, p. 536). However, the synergistic effect of illegal hunting and severe storms on Mariana fruit bats is documented on Rota (e.g., Stinson et al. 1992; Esselstyn et al. 2006). Severe storms can alter fruit bat foraging and roosting behavior by decimating food resources, removing protective foliage cover, temporarily modifying forest structure, and changing vegetation composition, especially by facilitating encroachment of non-native species. Loss of food resources can drive bats to forage on the ground, during daylight hours, and closer to areas of human activity; thereby increasing their vulnerability to illegal hunting (Stinson et al. 1992, p. 65; Esselstyn et al. 2006, p. 532).

Recovery Criteria

A draft revised recovery plan for the Mariana fruit bat (USFWS 2009d) addressed actions needed for the survival and recovery needs of the Mariana fruit bat. Since publication of the draft revised recovery plan, new information on the Mariana fruit bat has resulted in changes to how we look at recovery for the species. We now consider recovery in terms of stable or increasing subpopulations of sufficient size distributed across Guam and the Mariana Islands. To meet recovery objectives, stable or increasing fruit bat subpopulations should at a minimum be distributed on the islands that currently have extant populations (USFWS *in review*). Actions

that reduce or eliminate the potential for self-sustaining populations of resident fruit bats on Guam may hamper or preclude recovery of the species. The reduction or elimination of this potential may take many forms: degradation or loss of habitat and resources required by the fruit bat for foraging, roosting, and reproduction; increased exposure of fruit bats to illegal hunting and other sources of human disturbance; and introduction of non-native predators that prey upon fruit bats. In order for the Mariana fruit bat's population to recover on Guam, sufficient amounts of functional habitat will need to be protected and restored on Guam (USFWS 2009d).

Guam contains a large proportion of the remaining native limestone forest in the southern inhabited Mariana Islands, and most of that habitat is located within DOD lands. Habitat loss and degradation, illegal hunting, predation by non-native predators, and human disturbance currently impact fruit bats within the action area. If threat levels increase within fruit bat habitat in the action area, it may further inhibit the potential for the species to recover.

Mariana fruit bat survival and recovery habitat

Although Mariana fruit bats have been observed in a variety of habitat types, they are more likely to occur in native primary or secondary limestone forest (see Status of the Species above). Mariana fruit bat populations that have been subject to intense hunting pressure (e.g., populations on Saipan, Tinian, Rota, and Guam) are sensitive to human presence, and in recent history, maternity roosts are not known to occur in close proximity to areas inhabited by humans (Wiles 1987b, p. 151; J. Boland, unpublished data 2008-2014). However, fruit bats may forage on or near human-inhabited lands, in spite of hunting pressure (Wiles 2006, pers. comm. as cited in USFWS 2006b; Boland 2008-2015, pers. obs.). Therefore, for this assessment, we assumed that all areas identified as limestone and ravine forests on the 2006 Forest Service landcover maps (Liu and Fisher 2006a) are potential habitat for the fruit bat on Guam. We then updated the amount of available habitat on Guam by removing all forested areas cleared since the landcover map was completed using 2011 satellite imagery of Guam (Metevier 2014, unpubl. data). Although primary limestone forest is higher quality habitat that secondary limestone forest, habitat quality was not accounted for in these calculations due to mapping challenges, and habitat quality as it relates to hunting and predation threats was also not accounted for. As such, our estimate of available survival and recovery habitat (hereafter, referred to as habitat) on Guam is likely inflated.

Using the methods above, the total area of potential fruit bat habitat on Guam was estimated to be 27,096 acres (Figure 9). In order for native limestone forest to serve as habitat for the fruit bat, it will need to be managed for threats to the species, including brown treesnakes, illegal hunting, invasive plant species, and ungulates. Only 576 acres of this habitat is set aside for conservation. Most of the lands set aside for conservation are not currently managed to reduce threats. Therefore, it is urgent that habitat protection and management of Guam's forests begin immediately to allow for recovery of the Mariana fruit bat. If habitat is degraded enough to no longer provide the ecological services necessary to support the fruit bat, then this habitat will need to be removed from baseline calculations.

Mariana fruit bat densities

Estimates of bat density have been calculated for each of the Mariana Islands (DON 2013d, p. 46). The highest bat density is found on the most protected island, Asuncion Island, and is 1.81 bats per forest hectare. Rota has the highest bat population density in the southern part of the archipelago with 0.36 bats/hectare. Using calculations established by DON 2013d (p. 26, 45), and our estimate of 27,096 acres of existing fruit bat habitat, the estimated carrying capacity for fruit bats on Guam is 14,970 bats.

Environmental Baseline for *Serianthes nelsonii*

Rationale for delineation of recovery habitat

Recovery of the *Serianthes nelsonii* requires the permanent protection of sites that contain individuals of this species (USFWS 1994, p. 27). The target for delisting *S. nelsonii* (as described above) requires augmenting existing populations and reestablishing this plant in its former range (USFWS 1994, pp. 33-36). The conservation of recovery habitat is essential, not only to reaching this target, but to ensuring the continued survival and recovery of this species.

Methods for Recovery Habitat Calculation for *Serianthes nelsonii*

On Guam and Rota, *Serianthes nelsonii* trees were reported at elevations ranging from 120 to 420 meters (USFWS 1994, p. 7) and were found primarily in native dominated forests on limestone or volcanic substrates (Raulerson and Rinehart 1991, p. 42; USFWS 1994, pp 6-7; Wiles et al. 1996, p. 229). We therefore assumed that all remaining limestone and ravine forest, as classified by the U.S. Forest Service (Liu and Fisher 2006a), between 120 and 420 meters elevation were potential habitat for the species. Therefore, approximately 11,668 acres of habitat for *S. nelsonii* remains on Guam (Figure 10).

Status of the Species in the Action Area

The action area encompasses the entire adult population of *Serianthes nelsonii* on Guam, and is comprised of one adult tree of unknown age. The last remaining adult tree continues to produce seeds, but the structure and health of the tree itself is precarious due to a variety of factors (DON 2014a, p. 58; AAFB 2015, p. 4). The tree has begun to lean in recent years (AAFB 2015, p. 4), and there has been historical storm damage, including snapping and loss of branches (J. McConnell, UOG, pers. comm. 2014). It is at further risk of toppling due to termite damage, which is visible along the trunk, and a large amount of saprophytic or epiphytic ferns which have concentrated growth within a shallow cavity on the trunk (AAFB 2015, p. 4). In addition, the canopy of the tree has experienced recent extensive defoliation, probably due to insect herbivory from *E. blanda* butterflies (AAFB 2015, p. 4).

The area surrounding the fenced tree is comprised of rugged primary limestone karst forest. Although the area around the tree is currently fenced to prevent ungulate access, researchers are trying to understand why seedling mortality around this adult is close to 100 percent mortality (DON 2014, p. 11). Ungulate incidence and browsing is evident outside the small exclosure around the tree, as are nearby areas of past disturbance from military activities (e.g., clearings, ordnance). However, the heavily forested area around the adult tree is diverse

with native plant species characteristic native limestone forests in the Marinas including, but not limited to, *Ochrosia mariannensis*, *O. oppositifolia*, *Eugenia reinwardtiana*, *Syzygium thompsonii*, *Macaranga thompsonii*, *Guamia mariannae*, and *Pisonia grandis*. Despite the presence of some pest species and habitat disturbance, the cliffline area surrounding the adult *S. nelsonii*, especially the forested karst outcrops, is relatively undisturbed, high quality, diverse habitat suitable for multiple protected species, including *S. nelsonii*.

A large portion of the LFTRC footprint is in habitat currently being managed to eradicate ungulates. This area was designated as mitigation for a previous DoD action (USFWS 2006b), and falls within the Overlay Refuge. In addition, the DoD has several current projects and projects in the near future that may affect *S. nelsonii* habitat (refer to General Environmental Effects section).

As mentioned above, several recovery actions have been initiated recently for this species. However, the adult within the footprint of this action remains the sole reproducing tree on the island of Guam. The Guam adult tree is particularly important for maintaining the genetic diversity within this species (USFWS 1994, p. 21). In addition, the individuals outplanted at the GNWR within the proposed SDZ, are offspring of the Guam adult tree. They constitute much of the entire Guam genetic lineage of *S. nelsonii*, and all are within the proposed project's footprint. Their survival is crucial to maintaining genetic diversity of this species. The 31 outplanted individuals on GNWR, four months after outplanting, have 100 percent survival and all have experienced physical growth. However, daily monitoring, netting to exclude large insects, regular watering, small insect removal by hand, and other protective treatments were applied (E. Demeulenare, pers. comm. 2015).

F. STATUS AND ENVIRONMENTAL BASELINE OF CRITICAL HABITAT

Status and Environmental Baseline of Guam Micronesian Kingfisher Critical Habitat

Approximately 376 ac (152 ha) were designated as critical habitat for the Guam Micronesian kingfisher on Guam (USFWS 2004, 46 pp). Critical habitat for the kingfisher was identified using guidelines from the Guam forest bird recovery plan (USFWS 1990a). Because the kingfisher does not exist in the wild and all suitable habitat presently is unoccupied, inclusion of unoccupied areas is essential to the conservation of this species. Recovery to the point where the protection afforded by listing is no longer necessary will require restoration of the kingfisher through release of captive birds and subsequent natural dispersal into areas of Guam that formerly were inhabited.

Primary Constituent Elements

The primary constituent elements required for the Guam Micronesian kingfisher for the biological needs of foraging, sheltering, roosting, nesting, and rearing of young are found in areas that support limestone, secondary, ravine, swamp, agricultural, and coastal forests

containing native and introduced plant species. These forest types include the primary constituent elements of:

1. Closed canopy and well-developed understory vegetation; large (minimum of approximately 17 in (43 cm) dbh), standing dead trees (especially *Tristiropsis obtusangula*, *Pisonia grandis*, *Artocarpus* spp., *Ficus* spp., and *Cocos nucifera*); mud nests of *Nasutitermes* spp. termites; and root masses of epiphytic ferns for breeding;
2. Sufficiently diverse structure to provide exposed perches and ground surfaces, leaf litter, and other substrates that support a wide range of vertebrate and invertebrate prey species for foraging kingfishers; and
3. Sufficient overall breeding and foraging area to support kingfisher territories of approximately 25 ac (10 ha) each.

Guam Critical Habitat Unit

The Guam critical habitat unit consists of approximately 376 ac (152 ha) of land in the fee simple portion of the GNWR. The vegetation in this designated unit consists of coastal, limestone, and secondary forests composed of native and introduced species that contain the full range of primary constituent elements required for the long-term conservation of the Guam Micronesian kingfisher in northern Guam. This unit includes forested areas along the northwestern coasts of the island that were occupied by kingfishers in the 1970s and early 1980s (USFWS 2004, p. 62951). This unit also encompasses essential conservation areas identified in the forest bird recovery plan for northern Guam (USFWS 1990a, p. 49), and areas identified for recovery in the revised recovery plan for the kingfisher (USFWS 2008a).

Current threats to Guam Micronesian kingfisher critical habitat in the action area include habitat loss, degradation, and fragmentation due to development, military training, and fire, human disturbance, introduced ungulates, invasive plants, and non-native predators. Actions that exacerbate these threats or result in new threats, individually or in combination, may result in appreciably decreasing habitat value or quality of habitat necessary for the recovery and survival of kingfishers on Guam.

Recent conservation actions in the Guam critical habitat unit include construction of a multi-species exclosure fence at the GNWR at Ritidian Point, brown treesnake trapping and ungulate removal within the exclosure fence; and outplanting of native trees.

Status of Mariana Crow Critical Habitat

In 2004, the Service designated approximately 376 ac (152 ha) on Guam, and 6,033 ac (2,552 ha) on Rota, as critical habitat for the Mariana crow (USFWS 2004, 46 pp). Critical habitat for the Mariana crow on Guam was identified using the recommendations provided by the Mariana crow recovery team for the draft revised recovery plan (USFWS 2004). The Service also used the recommendation of the recovery team to identify one unit for the Mariana crow on Rota (USFWS 2004). For the conservation of the Mariana crow, recovery recommendations and the draft revised recovery plan (USFWS 2005a) call for established populations in northern Guam, in southern Guam, and on Rota.

The Service included unoccupied habitat in the designated critical habitat for the Mariana crow on Guam because the occupied habitat (as of 2004) alone was not sufficient to provide for the conservation of the species. Mariana crows are territorial; each pair defends an area of a size determined by forest type and structure (Morton et al. 1999). The maximum density or carrying capacity of crow pairs in a particular area depends on both habitat quality (for foraging and breeding) and the spatial arrangement of territories. Because of the territorial nature of the Mariana crow, its small total population size, limited range, vulnerability to environmental threats, and recovery goals drafted for the species, inclusion of unoccupied areas on Guam is essential to the conservation of the species. Recovery to the point where listing is no longer necessary will require restoration of Mariana crows on Guam through natural dispersal, translocation, and/or release of captive birds in areas that were formerly inhabited but that are not currently occupied. For this population to persist over the long term, it must expand onto adjacent lands that now are unoccupied.

The critical habitat unit for the Mariana crow on Rota reflects the goal of establishing and maintaining a population of at least 75 territorial breeding pairs on Rota and the estimation of the areas necessary to meet this goal (USFWS 2004). However, a recent assessment of population viability indicated that 75 territorial breeding pairs may not be viable over the long-term and that 100 territorial breeding pairs may be a more appropriate recovery target (Amidon 2012, unpubl. data). Therefore, we currently 100 territorial breeding pairs as our recovery target for the Rota population; however the critical habitat unit has not yet been revised to reflect this.

Primary Constituent Elements

The primary constituent elements required by the Mariana crow for the biological needs of foraging, sheltering, roosting, nesting, and rearing of young are found in areas that support limestone, secondary, ravine, swamp, agricultural, and coastal forests composed of native and introduced plant species. Guam and Rota experience a high frequency of severe storms, and these regularly and significantly alter forest structure. Therefore, sufficient habitat area is necessary to absorb the variable impacts of these natural disturbances and still maintain the integrity of the primary constituent elements to support crow populations. These forest types provide the primary constituent elements of:

1. Emergent and subcanopy trees with dense cover for breeding such as *Neisosperma oppositifolia*, *Macaranga thompsonii*, *Intsia bijuga*, *Premna obtusifolia*, *Eugenia reinwardtiana*, *Ficus* spp., *Elaeocarpus joga*, and *Tristiropsis obtusangula*;
2. Sufficient area of predominantly native limestone forest to allow nesting at least 950 ft (290 m) from the nearest road and 203 ft (62 m) from the nearest forest edge and to support Mariana crow breeding territories (approximately 30 to 91 ac (12 to 37 ha)) and foraging areas for nonbreeding juvenile crows; and
3. Standing dead trees and plant species for foraging, such as *Aglaia mariannensis*, *Artocarpus* spp., *Cocos nucifera*, *Neisosperma oppositifolia*, *Hibiscus tiliaceus*, *Intsia bijuga*, *Leucaena*, *Ochrosia mariannensis*, *Pandanus tectorius*, *Neisosperma oppositifolia*, *Ficus* spp., and *Elaeocarpus joga*.

Threats

Threats to Mariana crow critical habitat on Rota and Guam include development, habitat clearing, human disturbance, habitat fragmentation and degradation, introduced ungulates, invasive plants, and non-native predators.

Environmental Baseline for Mariana Crow Critical Habitat

The Guam critical habitat unit consists of approximately 376 ac (152 ha) of land in the fee simple portion of the GNWR. This unit includes limestone, secondary, and coastal forests composed of native and nonnative plants and contains the full range of primary constituent elements needed for long term conservation of the Mariana crow on Guam. This area includes lands in the 1994 historical distribution of Mariana crows in northern Guam (Wiles et al. 1995) and areas that contained crows in northern Guam in 1981 (Engbring and Ramsey 1984). This unit was also identified by the Mariana crow recovery team as important recovery habitat in the draft revised Mariana crow recovery plan (USFWS 2005a).

Current threats to Mariana crow critical habitat in the action area include habitat loss, degradation, and fragmentation due to development, military training, and fire, human disturbance, introduced ungulates, invasive plants, and non-native predators. Actions that exacerbate these threats or result in new threats, individually or in combination, may result in appreciably decreasing habitat value or quality of habitat necessary for the recovery and survival of Mariana crows on Guam.

Recent conservation actions in the Guam critical habitat unit include construction of a multi-species exclosure fence at the GNWR at Ritidian Point, brown treesnake trapping and ungulate removal within the exclosure fence; and outplanting of native plants.

Status and Environmental Baseline of Mariana Fruit Bat Critical Habitat

Approximately 376 ac (152 ha) were designated as critical habitat for the Mariana fruit bat on Guam (USFWS 2004, 46 pp). Critical habitat was identified using the guidelines provided by the Mariana fruit bat recovery plan (1990). Although the current population of Mariana fruit bats on Guam is small, and most bats roost in a limited area, the foraging behavior and diverse diet of the fruit bats cause them to use most of the island for foraging, as documented by Wiles et al. (1995). Thus, all of the designated critical habitat for this species is used for foraging and/or roosting and is considered occupied.

Primary Constituent Elements

The primary constituent elements required by the Mariana fruit bat for the biological needs of foraging, sheltering, roosting, and rearing of young are found in areas supporting limestone, secondary, ravine, swamp, agricultural, and coastal forests composed of native and introduced plant species. These forest types provide the primary constituent elements of:

1. Plant species used for foraging, such as *Artocarpus* spp., *Carica papaya*, *Cycas circinalis*, *Ficus* spp., *Pandanus tectorius*, *Cocos nucifera*, and *Terminalia catappa*; and

2. Remote locations, often within 328 ft (100 m) of clifflines that are 260 to 590 ft (80 to 180 m) tall, with limited exposure to human disturbance and that contain mature *Ficus* spp., *Mammea odorata*, *Casuarina equisetifolia*, *Macaranga thompsonii*, *Guettarda speciosa*, *Neisosperma oppositifolia*, and other tree species that are used for roosting and reproductive activity.

Guam Critical Habitat Unit

The Guam critical habitat unit consists of approximately 376 ac (152 ha) of land in the fee simple portion of the GNWR. The vegetation in this unit consists of coastal, limestone, and secondary forests composed of native and introduced plant species and contains the full range of primary constituent elements needed for the conservation of the Mariana fruit bat. This area is important because it contains areas used for foraging by the last known Mariana fruit bat colony (currently abandoned) on Guam. This area also contains roosting and foraging sites historically and currently used by bats (USFWS 2004, p. 62951; J. Schwagerl, Service, pers. comm. 2015). This unit also encompasses essential conservation areas identified in the Mariana fruit bat recovery plan (USFWS 1990b); the draft revised recovery plan (USFWS 2009d) does not contain specific areas for recovery.

Current threats to Mariana fruit bat critical habitat in the action area include habitat loss, degradation, and fragmentation due to development, military training, and fire, human disturbance, introduced ungulates, invasive plants, and non-native predators. Actions that exacerbate these threats or result in new threats, individually or in combination, may result in appreciably decreasing habitat value or quality of habitat necessary for the recovery and survival of fruit bats on Guam.

Recent conservation actions in the Guam critical habitat unit include construction of a multi-species exclosure fence at the GNWR at Ritidian Point, brown treesnake trapping and ungulate removal within the exclosure fence; and outplanting of native plants including *Serianthes nelsonii*.

G. EFFECTS OF THE ACTION

Exposure Analysis Approach

The Service has developed an analysis framework for section 7 consultations that incorporates the general structure, primary concepts, and nomenclature of the U.S. Environmental Protection Agency's ecological risk assessment framework (USFWS 2005c). Factors causing adverse effects are called "stressors" and beneficial effects are called benefits. In this approach, the Service determines the resources that will be exposed to the proposed action's stressors and benefits by evaluating the location, timing, duration, frequency, and intensity of potential exposure to each stressor and benefit, and identifying the physical, chemical, and biotic features that will be directly and indirectly exposed. Then the causal relationships between sources of stressors and benefits and the response of listed resources are analyzed. The exposure analysis

also estimates future changes in the abundance or distribution of listed species expected to result from exposure to stressors and benefits.

The proposed action's stressors and benefits may include the following actions:

- Construction and operation of the main cantonment at Finegayan
- Construction and operation of family housing on AAFB
- Construction and operation of the LFTRC
- Utilities and site improvements
- Construction of well field and associated AAFB distribution system
- Roadway projects
- Training at NMS
- Construction of facilities at Apra Harbor
- Construction of new facilities at AAFB
- Hand grenade range at Andersen South
- Aviation training at NMS and AAFB
- Forest enhancement project at Finegayan
- Brown treesnake exclosure projects
- Invasive species planning

For purposes of this analysis, the term of effects associated with the permanent destruction of listed species habitat caused by the above construction projects and associated with the operation of the above facilities is considered to be indefinite.

NOTE: As mentioned above, although not part of the project description, an MOA between the DON and the Service regarding conservation of the Guam Micronesian kingfisher recovery habitat in northern Guam was signed on June 11, 2015. The purpose of the MOA is to ensure that a sufficient amount of suitable survival and recovery habitat is conserved and managed in accordance with Federal agency obligations under section 7(a) of the ESA in northern Guam to support the reintroduction of the Guam Micronesian kingfisher and to ensure that the DON meet the purpose and need for the proposed action (DON and Service 2015c, p. 1). Because of the signatory level of the MOA, it provides a high level of assurance that commitments in the MOA will be carried forward to benefit the kingfisher and its habitat on Guam. However, in the absence of implementation of the MOA, our analysis in this Biological Opinion may need to be revisited.

General Effects of the Action

The following section discusses the likely effects of the proposed action on listed species and habitats. The analysis is followed by an assessment of how those effects will specifically affect the Mariana fruit bat, Mariana crow, Guam Micronesian kingfisher, Guam rail, and *Serianthes nelsonii*, and their habitats.

Habitat Loss, Degradation, and Fragmentation (All Species)

The proposed action will result in habitat loss, degradation, and fragmentation (including edge effects) from clearing, indirect and induced development, fire, and noise. Definitions and descriptions of habitat fragmentation and edge effects are described above in the Environmental Baseline section. The habitat loss, degradation, and fragmentation will decrease the amount of suitable habitat for recovery of listed species on Guam. Habitat suitable for the survival and recovery of the Guam Micronesian kingfisher, Guam rail, Mariana crow, Mariana fruit bat, and *Serianthes nelsonii* has been delineated on Guam (Amidon *in litt*., 2012). The amount of habitat for each species that will be cleared by the proposed action is shown in Table 6.

Table 6. Anticipated loss of listed species habitat on Guam resulting from project-related development.

	Habitat Cleared (acres)			
PROJECT	***Serianthes nelsonii***	**Mariana Crow**	**Guam Rail**	**Guam Micronesian Kingfisher & Mariana fruit bat**
North				
2010 ROD Related Project Areas	43.41	50.39	345.58	51.53
Communication Utilities	19.32	17.53	68.05	17.47
Electrical and Water Off Site Utilities	6.40	11.42	34.91	11.32
LFTRC Northwest Field	160.27	183.77	40.17	186.66
LFTRC Northwest Field Off Site Utilities and Access Road	15.19	7.23	18.89	7.40
LFTRC Stand Alone Hand Grenade Range	0.00	0.00	8.91	0.00
MC/FH Finegayan/AAFB	596.43	640.31	436.42	640.50
MC/FH Finegayan/AAFB Off Site Utilities	9.02	10.12	12.01	10.14
Water Well Development Area	90.00	90.00	90.00	90.00
Total for Northern Guam	940.05	1010.77	1054.93	1015.01
South				
2010 ROD Related Actions	4.99	5.09	37.35	5.96
Communication Utilities	0.00	0.00	50.83	0.05
Guam High School Expansion	0.00	0.00	2.08	0.00
Total for Southern Guam	4.99	5.09	90.26	6.01
Total	**945.05**	**1015.86**	**1145.19**	**1021.02**

The most severe effects on listed species habitat from habitat fragmentation and edge effects will be on AAFB near Ritidian point from construction of the LFTRC. This area currently contains a

large expanse (over 350 acres) of high-quality primary limestone forest that serves as occupied habitat for the Mariana fruit bat and *Serianthes nelsonii*, and unoccupied habitat for the Mariana crow, Guam rail, and Guam Micronesian kingfisher (see figures 11 and 12). This primary limestone forest is also adjacent and contiguous with the Guam National Wildlife Refuge, providing an even larger forested area serving as habitat for listed species. In total approximately 90 acres of primary limestone forest and 91 acres of secondary limestone forest would be cleared for construction of the LFTRC (DON 2014b, p. 5-339).

In addition to the approximately 194 acres of listed species habitat that will be cleared for the LFTRC (Table 6), approximately 10,000 m (6 mi) of new edge will be created (Figure 12). As discussed in the Environmental Baseline, edge effects have deleterious effects to wildlife populations and ecological processes (Murcia 1995, p. 58; Laurance 2000, p. 134). Edge effects can affect avian density up to 60 meters into the forest, and affect the forest canopy up to 150 m (Murcia 1995, p. 59), and may affect forests at larger landscape scales (Laurance 2000, p. 134). In combination with the effects of increased noise from operation of the LFTRC and additional overflights from AAFB (see below), we expect that the habitat quality of some of the remaining primary limestone forest near Ritidian point will be degraded and no longer provide the same ecosystem services it currently does. This will have an adverse effect on the potential for the remaining habitat to serve as habitat for listed species. As discussed in Environmental Baseline, there is little remaining primary limestone forest on Guam. The result of construction of the LFTRC is habitat degradation and permanent loss of some of the best remaining primary limestone forest on Guam.

In total, approximately 1,020 ac of habitat will be cleared and permanently lost as a result of the proposed action in both north and south Guam. The loss of limestone forest and listed species habitats furthers the long-term trajectory of loss of native forested habitat on Guam, and threatens the future potential for recovery of listed species on Guam. Given the small amount of habitat left on Guam off-setting measures to protect remaining limestone forest and listed species habitats is needed. The effects of habitat degradation and loss are further discussed in the species-specific sections below

Habitat Conservation and Management
Under the proposed action, the DON will implement a forest enhancement project on approximately 1,000 ac in Finegayan to offset loss of listed species habitats. This project could lead to enhanced and better-quality habitat for listed species at the forest enhancement project site. However, there is some level of uncertainty that the forest enhancement site would be protected in the long term because the DON has a history of proposing military development within established mitigation sites. For example, as part of this proposed action, the DON will clear primary limestone forest that was intended to be conserved for listed species and demolish the surrounding ungulate fence built by the USAF as mitigation in the ISR Strike BO (USFWS 2006b) and NWF Beddown (USFWS 2006c).

In addition, as part of DON 2010 (USFWS 2010a, p. 64), the DON also planned to develop a portion of the Federal Aviation Administration (FAA) Mitigation Area on Tinian developed for the Tinian monarch (*Monarcha takatsukasae*). This mitigation area (936 acres) was designated in a Biological Opinion (1-2-98-F-06) for the Federal Aviation Administration dated

January 4, 1999. The DON also entered into agreement with the CNMI to designate this mitigation area as a conservation area for the protection of the endangered and threatened species, particularly the Tinian monarch. This agreement and assurance of protection of the conservation area is further discussed in the final rule to delist the Tinian monarch (USFWS 2004, pp. 56360-56371). However, the DON's upcoming CNMI Joint Military Training (CJMT) EIS also contains alternatives which would develop a portion of the FAA mitigation site (DON 2015d). Further, as described above in the Environmental Baseline, the DON did not follow through on agreements to conduct brown treesnake research and control at Area 50 on AAFB after years or work at the site.

The DON's history of planning for development in previously established mitigation sites required by Biological Opinions, or at long-term research sites, leads us to question the certainty as to whether this forest enhancement site will still be present when listed species addressed in this Biological Opinion are reintroduced to Guam. However, recent discussions with DON and the recently signed MOA by Deputy Assistant Secretary reaffirms DON's commitment for listed species recovery on Guam. We expect the conservation measures in the proposed action to be implemented fully and the MOA to have a long-term beneficial effect to listed species.

Under the MOA, the DON will protect and manage approximately 5,234 acres of Guam Micronesian kingfisher habitat on DON lands in northern Guam for conservation and restoration of kingfisher habitat (DON and USFWS 2015). While the MOA that was signed to protect these lands focuses on kingfisher habitat, the protection and management of these lands may also benefit the Mariana crow, Guam rail, Mariana fruit bat, and *Serianthes nelsonii*.

Under the MOA, the DON will work cooperatively with the Service to identify, develop and implement specific management activities and projects on the 5,234 acres to support the following: 1) brown treesnake control and suppression to facilitate the larger goal of suppressing snake population levels that will ultimately support kingfisher survival and recovery; 2) support for brown treesnake control and eradication methods development, focusing on tools and techniques needed for landscape level survival and recovery of the kingfisher; 3) ungulate fencing and eradication; 4) control of small mammalian predators; 5) invasive plant control and eradication; 6) native plant restoration; and, 7) localized control of introduced invertebrates that may negatively impact kingfisher nesting/fledging. The DON has funded and initiated a number of projects to support the seven focal activities identified above. The DON will continue these activities with items (2) and (3) prioritized for continued funding (DON and USFWS 2015, p. 3) The level of funding for these activities may vary depending on the activities to be implemented in a given year, but will not exceed $2 million annually for the first ten years (starting in fiscal year 2016) (DON and USFWS 2015, pp. 4-5). Upon the expiration of the ten-year period, the DON and Service would reassess the progress of recovery efforts pursuant to the MOA.
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DoD Civilian Employee and Indirect/Induced Development (All Species)
The proposed action will result in a population increase on Guam. Between the years 2021 and 2023 the population with the proposed action is projected to be 5.6 percent higher than it otherwise would have been without the proposed action (DON 2014b, page 4-419). During the construction period, additional off-island workers will move to Guam to fill non-Federal non-

construction jobs such as teacher and food service worker. The DON refers to this population increase as "indirect" or "induced" growth. There would be a maximum estimated population increase of 1,082 persons from indirect/induced growth; the number of indirect/induced population growth ranges from 89 people in 2015 to 1,082 people in 2021, and decreases to a steady-state of 453 people by 2028 (DON 2014b, page 4-126).

We derived the area that will be developed by the new civilian population within each U.S. Census Subdivision on Guam by calculating the current development footprint per person within each Census subdivision and applying that to the Census subdivision's anticipated increase in population. We assumed the induced population size would remain at 453 people (DON 2014b, p. 4-126) past 2028. Based on the U.S. Forest Service 2002 land cover map (U.S. Forest Service 2002) and 2008 U.S. Census Bureau data (U.S. Census Bureau 2008), we calculated that each person has a development footprint of 0.09 ac. We applied this anticipated new development evenly across areas zoned for development based on current Government of Guam land use plans (Government of Guam 2009, p. 2-14 and 2007, p.1) on slopes less than 30 percent and calculated anticipated effects of development resulting from the indirect/induced population. Based on this, we calculated that no more than three acres of habitat in north Guam for the kingfisher, crow, *Serianthes* tree, and fruit bat and no more than 17 acres for the rail will be lost as a result of induced population growth. In addition, the induced population growth will increase human disturbance throughout the island of Guam to wildlife and their habitats.

Wildfire (All Species)
The proposed action may result in wildfires burning listed species habitat. Fires could start from live-fire training (including use of tracers), bivouacking with campfires, arson, barbeques, debris burning, cigarette smoking, aircraft mishaps, and vehicular malfunctions. Between 1991 and 2002, an average of 28 fires per year burned on DON lands on Guam (DON 2013e, p. 4-8), with 429 ac (174 ha) burned per year. Most of the area burned was savanna grasslands (DON 2013e, p. 4-8). This is approximately double the average annual number of fires on DON lands from 1979 to 1989, though the burned acreage on DON lands was similar (425 ac per year (172 ha per year)). Arson and debris burning account for approximately 70 percent of fires, and 87 percent of area burned, on DON lands from 1979 to 2002. Smoking (8 percent), unknown (3 percent), and miscellaneous causes (including children, campfires, and equipment) account for approximately 4 percent of fires on DON lands on Guam (Nelson 2009, Ch. 3 p. 4).
Fires can lead to a variety of direct, indirect, and interrelated affects to wildlife and their habitats. Fire can burn habitat resulting in habitat loss, fragmentation, and degradation, and loss of foraging and breeding habitat. Fires could expose Mariana fruit bats to smoke, resulting in respiratory distress.

To minimize the effects to listed species resulting from fire burning listed species habitats, the DON proposes to develop and implement a fire management plan, a component of the Range Management Plan,at the LFTRC. The fire management plan will be prepared to minimize fire threat associated with the firing ranges on surrounding habitat and listed species, specifically the adult *Serianthes nelsonii* tree. The fire management plan will be developed and implemented to ensure that any fire sparked during training will not spread beyond the firing range and into forested habitat. Because the LFTRC is surrounded by recovery habitats, the development and

implementation of this fire management plan will be critical to ensure that the *S. nelsonii* tree, and listed species habitat, is not lost due to training activities.

In addition, the DON proposes to develop and implement a comprehensive Wildland Fire Management Plan for JRM lands (DON 2013e, p. 4-8). The goal of the plan is to protect high-value natural resource areas and operational facilities from catastrophic wildfire while conserving resources and military operational flexibility (DON 2013e, p. 5-66). The fire management plan will minimize the effects of fire from arson, debris burning, cigarette smoking and other activities from JRM operations on Guam. Additionally, the stationing of additional large helicopters on Guam, as part of the proposed action, may facilitate increased DON contributions to the suppression of fires threatening forest habitat on Guam.

Because a comprehensive Wildland Fire Management Plan for JRM lands and a fire management plan for the LFTRC will be developed, as described above in the Conservation Measures section, we anticipate that no additional habitat will be lost due to wildfires igniting as a result of the proposed action. Although the DON's comprehensive fire management plan may also minimize fire impacts on DoD lands on Guam by instituting fire prevention, detection, and suppression programs as well as implementing landscape-level fuel modifications in the Naval Munitions Site, the beneficial effects of this DON action are difficult to assess because these projects have not been adopted by DON at this time.

Ungulates (All Species)
As described in the Environmental Baseline, non-native ungulates have caused severe damage to Guam's native limestone forests. Construction of the main cantonment at Finegayan and the LFTRC at Ritidian Point will clear a large area of limestone forest currently used by ungulates and would displace and concentrate ungulates into adjacent areas, resulting in even higher densities and potentially greater habitat damage. These adjacent areas are often habitats for listed species. Therefore, increased ungulate density in adjacent habitats will degrade the habitat quality of these areas and reduce their suitability to serve as habitat for listed species. The JRM INRMP (DON 2013e, Appendix L) includes an Ungulate Management Plan for AAFB. The plan's objectives are to reach and maintain a sustained reduction of deer and pigs in 23 unfenced areas of the AAFB, and to completely remove ungulates from fenced management areas (DON 2013e, p. ES-1); however, this action has not yet been fully implemented and ungulates are still prevalent across AAFB.

National Wildlife Refuge Overlay

In 1993, a Cooperative Agreement (Agreement) was established between the Air Force, DON, and the Service for purposes of establishing and managing the GNWR Overlay on DOD lands. The Refuge includes approximately 152 hectares of fee simple Service land and 9,106 hectares of Overlay Refuge on land owned by DOD. The Agreement, which is still in effect, affirms the parties commitment to "provide habitats essential to the survival and recovery of endangered species" on Guam and to "develop and implement a long-term, comprehensive program to conserve and recover endangered and threatened species… not limited to brown treesnake control and eradication, wildlife habitat and ecosystem protection, endangered and threatened species recovery and reintroduction…". Notably, all signatory parties to the Agreement agreed

to consult under section 7 of the Endangered Species Act (ESA) on proposed Federal actions that are funded, authorized, or carried out by the Federal government within the Refuge, inclusive of Overlay Refuge lands, "that may impact habitat of endangered or threatened species even if those species are extirpated from the affected area, but are not extinct."

To date, only a limited amount of critical habitat has been designated on Guam - for the kingfisher, crow, and the Mariana fruit bat – all on lands owned and administered by the Guam National Wildlife Refuge (GNWR). Department of Defense lands on Guam include a substantial percentage of the total habitat available for recovery of the kingfisher, rail, and the crow. Seventy-two to seventy-five percent of the critical habitat proposed in 2002 was within the Overlay Refuge land (67 FR 63738 63772); however, only the 152 hectares of fee simple GNWR land were ultimately designated for the kingfisher, crow, and bat in 2004 (69 FR 629447 629446). In recognition of the commitments made by the DON and the Air Force under the Agreement, the Service exempted DOD lands from the designation of critical habitat on Guam in 2004.

Approximately 1,400 ac (567 ha) of the proposed action's project footprint within Guam National Wildlife Refuge Overlay boundaries are in the areas that were proposed as critical habitat for the Guam Micronesian kingfisher, Mariana crow, and Mariana fruit bat (67 FR 63738-63764). These areas were excluded from critical habitat designation pursuant to the Sikes Act (16 USC 670a-670o, 74 Stat. 1052, Public Law 86-797), as amended. These 1,400 ac will be cleared as part of the proposed action, and over 300 ac will lose their conservation function due to noise (see analysis below).

Surface Danger Zone over the Guam National Wildlife Refuge (All Species)

The proposed action will create a SDZ over approximately 68 percent of the GNWR at Ritidian Point during operation of the LFTRC. The SDZ will cover the GNWR access road, visitor center, offices, and other facilities and thereby limit access to the GNWR while firing occurs at the LFTRC. The limited access that GNWR staff will have to the refuge property during the 39 weeks per year the LFTRC is active will limit the amount of management that can occur at the GNWR. This could have an adverse effect on listed species by 1) preventing maintenance of the predator exclusion fence at the GNWR, 2) restricting brown treesnake efforts below what is necessary to remove brown treesnakes from the fenced exclosure, 3) limiting maintenance of native outplantings, 4) limiting invasive plant control, 5) limiting effective ungulate control, and 5) restricting the ability to manage the re-introduction of the Guam Rail. Per Section 2822 (Establishment of surface danger zone, Ritidian Unit, Guam National Wildlife Refuge) in the 2015 National Defense Authorization Act, the Service and the DON may enter into an agreement to establish and operate a SDZ over the GNWR. The agreement may include relocation and reconstruction of GNWR facilities, mitigation for impacts to wildlife species, and use of DoD personnel to complete GNWR conservation actions; however, this agreement is not in place yet. Therefore, we assume that the operation of the LFTRC will have an adverse effect on listed species by preventing the management, research, and monitoring that would have otherwise occurred at GNWR.

Noise (Guam Micronesian kingfisher, Mariana crow, Guam rail, Mariana fruit bat)

Overview of Noise Resulting From the Proposed Action
The proposed action will generate noise from the use of a variety of vehicles (construction equipment, trucks, fixed-wing aircraft, helicopters, , and other convoy vehicles) and weapons (small arms, demolitions, and other ammunition), and loud voices. Noise resulting from weapons training and construction on Guam will affect areas occupied by listed species and affect their habitat. Increased jet and helicopter aircraft traffic at Andersen Air Force Base will regularly expose the Mariana fruit bat to high levels of noise. Portions of the habitat for the Guam Micronesian kingfisher, Guam rail, Mariana crow, and Mariana fruit bat are in areas where elevated noise from jet and helicopter aircraft traffic, and weapons firing, will occur.

Below is a general overview of effects of noise on avian species; detailed species-specific accounts are provided in the effects analysis to each species.

Noise review
Studies on the effects of noise on wildlife report a wide range of reactions depending on the biology of the species, its previous exposure to the source noise, whether the species is breeding, the type of noise, and the lateral distance between noise source and the species. The variability in these reactions and their specific circumstances make it difficult to be certain how a particular species will react to noise from the proposed action.

A recent review of noise studies found that many, but not all, species abandon noisy areas (Francis 2015, p. 2). This review found that birds across all locations tended to avoid noisy areas, but that there were trait-specific differences including vocal frequency, nest placement, diet, and foraging location (Francis 2015, p. 1). Omnivorous species and species with animal-based diets were more sensitive to noise then birds with plant-based diets, potentially because noise interferes with prey detection (Francis 2015, p. 1). The review concluded that anthropogenic noise is an important ecological force that shapes the distribution of species by disrupting an organisms' ability to acoustically interact with its environment (Francis 2015, p. 11).

Avian responses to noise may range from flushing and body shifting to physiological responses such as an increase in heart rate or hormone balance (Brown 2000, p. 11; Barber et al. 2010, p. 181). Specific reactions will vary by species and by an individual's previous exposure to noise disturbance (Manci 1998, p. 15). Individuals with previous exposure to the noise may display less reaction to it then individuals without previous exposure (Andersen et al. 1989, Conomy et al. 1998a). This reduced reaction is believed to be a sign of habituation; however, the habituation may be individual or species specific. In general, a species can often habituate to human-generated noise when the noise is not followed by an adverse effect. Even when a species appears to be habituated to a noise, the noise may produce a metabolic or stress response (increased heart rate results in increased energy expenditure) though the response may or may not lead to changes in overall energy balance. Anthropogenic noise disturbance is known to alter animal behavioral patterns and lead to population declines (Barber et al. 2010, p. 181). Species that are commonly hunted often demonstrate behavioral (e.g., flushing, startle response) or physiological responses (e.g., increased heart rates, increased respiration rates) to gunshot sounds Larkin et al. (1996, pp. 21-52). Conomy et al. (1998a, p. 1,135-1,142) found that black ducks

(*Anas rubripes*) did not become habituated to noise. Larkin (1996, p. 1) in a review of noise effects on wildlife, reported that decreased responsiveness from wildlife after repeated noise is frequently observed and attributed to habituation. However, the degree of disturbance to which a species can habituate may be limited (National Park Service 1994, p. 5.17). Francis et al. (2011a, pp. 6-7) state that overall most species, even urban-adapted species, respond negatively to noise.

Habitat Degradation

There are multiple ways for anthropogenic noise to cause habitat degradation including noise pollution, masking of avian acoustic signals, changes in predation risk, and reduction in reproductive success. Noise pollution is defined as undesirable human noise, and has increased in most environments over the last century (Ortega 2012, p. 7). Noise pollution can affect birds in numerous ways including physical damage to ears; stress, fright and avoidance responses; changes in reproductive success and in vocal communication; and interference with ability to hear predators and other sounds (Ortega 2012, p. 8). Anthropogenic noise could be a factor driving bird species out of urban areas, even when other habitat requirements are still sufficient (Slabbekoorn and Ripmeester 2007, p. 73).

Most studies on habitat degradation from noise have focused on highways and gas drilling compressor pads, and these studies demonstrate that habitat near a noise source is less suitable than habitat farther away. Francis et al. 2011b (p. 1269 and 1278) found that compressor noise at gas wells caused a five percent lower occupancy of avian species near the pads. Bayne et al. (2008, p. 1190) found that passerine density was significantly influenced by chronic anthropogenic noise from gas compressors, and that noise levels from compressor stations affected birds up to 700 meters into the surrounding forest. The willow warbler (*Phylloscopus trochilus*) had a much lower density of territorial males within 0-200 meters from a highway compared to habitat farther away, yearling males were found 50 percent more often in the road zone, and the study indicated that the road zone probably serves as a sink for young males due to reduced habitat quality from noise (Foppen and Reijnen 1994, p. 99). These studies generally show that noise pollution can cause habitat degradation.

Masking

Anthropogenic noise that drowns out vocal communication between birds is called masking. Masking can have serious consequences because birds communicate vocally to attract mates and defend territories (Slabbekoorn and Ripmeester 2007, p. 1; Barber et al. 2010, p. 180; Ortega 2012, p. 10). Masking of communication necessary for territory defense and mate attraction may have a negative impact on reproductive success and exclude birds from otherwise suitable habitat (Halfwerk et al. 2011, p. 210). Halfwerk et al. (2011, pp. 217-218) suggest four mechanisms related to masking that could reduce avian reproductive success: (1) female birds interpret male songs masked by high noise as of lower quality and put less energy into the breeding cycle; (2) a noisy territory may be perceived of as being a lower quality and avoided, reducing the number of available territories for breeding; (3) increased noise levels cause physiological stress due to reduced foraging opportunities if prey are less easy to detect or because the bird has to spend more time scanning for predators; and, (4) noise could have a negative impact on parent-offspring communication.

Breeding
Anthropogenic noise can have negative effects on avian breeding (Slabbekoorn and Ripmeester 2007, p. 2; Halfwerk et al. 2011, p. 210; Ortega 2012, p. 10). Noise may affect egg production, incubation, brooding and nest abandonment (Ortega 2012, p. 10). Halfwerk et al. (2011, p. 210) found that females laid smaller clutches in noisier areas, and that noise recorded in April had a negative effect on the number of great tit fledglings independent of clutch size, compared to noise in March. High noise levels could lead females to breed later, allocate less energy to care of eggs and chicks, and cause communication difficulties between parents and offspring (Halfwerk et al. 2011, pp. 217-218).

Habib et al. (2007, p. 176) found that ovenbird pairing success was reduced, and more inexperienced birds were breeding for the first time, near noisy compressor sites compared to noiseless sites. This reduction in ovenbird pairing success near compressor sites was likely caused by noise interfering with a male's song, thereby inhibiting communication with females and reducing pair success (Habib et al. 2007, p. 176). Foppen and Reijnen (1994, p. 95) found that the zones nearest to a highway served as a sink for male willow warblers, and that the proportion of successful yearling males was 50 percent lower in the road zones compared to zones farther away from the highway. Delaney et al. (2002, p. 54) found that the nesting success of red-cockaded woodpeckers (*Picoides borealis*) near Fort Stewart, Georgia, was not significantly affected by experimental and passive military training noise. However, red-cockaded woodpeckers did flush from their nests repeatedly due to nearby (less than 100 meters) artillery and blank fire events, but returned to their nests quickly and without impact to nesting success (Delaney et al. 2002, p. 59).

In a study of the effects of helicopter noise from the Marine Corps Air Station Miramar (MCAS) on California gnatcatcher (*Polioptila californica californica*) reproduction, Hunsaker and Rice (2006, p. 101) found that noise levels at MCAS did not affect reproductive success. California gnatcatchers found and inhabited suitable nesting sites in spite of the noise environment, and the factors affecting nest success were habitat, topography, and rainfall. Awbrey and Hunsaker (1997, p. 3177) found that fixed-wing aircraft noise at Naval Air Station Miramar was correlated with fewer California gnatcatcher nest attempts and eggs laid, but that once a nest was established with eggs in it, military aircraft noise had no detectable influence on reproductive success. In Hawaii, Vanderwerf (2000, p. 9) studied the response of Oahu elepaio (*Chasiempis sandwichensis ibidis*) at eight nests to military noise (artillery blasts ranging from 89-116 dB). No elepaio flushed from a nest in response to artillery noise. A mild response was only observed twice by the same incubating male who raised his head and scanned the area after an artillery blast then resumed preening after 1-2 seconds (Vanderwerf 2000, p. 38).

There may be differences between the effects of chronic noise and intermittent loud noise in the responses of breeding birds. Birds that select nest sites with chronic noise may "accept" the noisy conditions and not abandon nests in response to the noise. However, birds that select nest sites during quiet times, and then become disturbed by noisy conditions later, may abandon nests (Ortega 2012, p. 10).

Hearing (for avian species, see Mariana fruit bat section below for bats)

Birds may also suffer physical damage to their ears from loud noise (Barber et al. 2010, p. 181). Damage can occur from single blasts (>140 dBA), multiple blasts (>125 dBA) or continuous exposure to noise at greater than 110 dBA (Ortega 2012, p. 9; Dooling and Popper 2007, p. 23). Birds are able to regenerate the sensory cells of the inner ear providing a way for them to recover from physical damage to the ear from loud noise, and so do not suffer permanent hearing loss like mammals (Dooling and Popper 2007, p. 5 and p. 25). However, in their review, Dooling and Popper (2007, p. 27) state that the effects of short, intermittent, and high intensity sounds on avian hearing are much less known than that from highway noise. Many birds appear to tolerate noise that can cause pain in humans, for example: seabirds at airports, wild turkeys (*Meleagris gallopavo*) near a rocket testing plant in Florida, and ospreys (*Pandion haliaetus*) at the Naval Surface Warfare Center, Dahlgren (Larkin et al. 1996, p. 31, and references within).

Noise from Construction (for avian species, see Mariana fruit bat section below for bats)
Noise from construction may affect habitats for listed birds. Construction as part of the proposed action will occur from 2015 to 2028; however, construction will be phased and will not occur at all places at once, or for the entire construction time period. Construction equipment will include standard heavy equipment including bulldozers, graders, haulers, large trucks. No blasting or use of dynamite will occur as part of the proposed project. The use of heavy equipment can reach noise levels of 96 dB (USFWS 2006a, p. 15). Based on ambient noise studies conducted above the cliff line at AAFB (DON 2014a, p.66), we expect that noise within the listed species habitats in Guam to range from 55 to over 65 dB. Therefore, noise from the construction of the proposed action may reach between 20-40 dB above ambient conditions.. Noise from construction of the proposed action would be temporary and intermittent. Construction noise reaching listed species habitats may rise above the disturbance threshold for listed species; however, this noise will be short-term in duration and will not lead to a permanent reduction in the capability of adjacent habitat to support the future survival and recovery of listed birds.

Noise from Aircraft (Guam Micronesian kingfisher, Mariana crow, Guam rail, Mariana fruit bat)
Studies on the impacts of aircraft overflights to wildlife have been primarily limited to work on ungulates (e.g., Krausman et al. 1998; Maier et al. 1998; Frid 2003; Landon et al. 2003; Krausman et al. 2004; Lawler et al. 2005), birds of prey (e.g., Andersen et al. 1989; Watson 1993; Trimper et al. 1998; Delaney et al. 1999; Palmer et al. 2003), and waterbirds (e.g. Ward et al. 1999; Conomy et al. 1998 a,b; Komenda-Zehnder et al. 2003). These studies report a wide range of reactions to overflights depending on the biology of the species, its previous exposure to overflights, whether the species is breeding, the type of aircraft, the altitude of the aircraft, and the lateral distance between aircraft and the species. The variability in these reactions and their specific circumstances make it difficult to be certain how a particular species will react to aircraft overflights.

Noise from aircraft is complex and wildlife response may depend on the type of aircraft and the species involved. In a literature review of waterfowl response to aircraft, avian response to aircraft was (cautiously) generalized as more intense with helicopters than fixed-wing aircraft, and stronger with slower fixed-wing aircraft than fast fixed-wing aircraft (Plumpton 2006, p. 3-1, 3-2). The proposed action will result in an increase in aircraft overflights over listed species

habitat. Therefore, we conclude that noise disturbance over listed species habitat in the flight paths will increase; however, the effects will be species-specific and are discussed further below.

Noise from LFTRC (Guam Micronesian kingfisher, Mariana crow, Guam rail, Mariana fruit bat)
Upon operation of the LFTRC, live-fire operations would occur between 7:00am and 7:00pm for up to 39 weeks per year, plus night operations (two nights per week over 39 weeks per year) would occur between 7:00pm and 10:00pm or 6:00am to 7:00am. The noise disturbance from the training will be impulse noise with very intense sounds of short duration (e.g., the discharge of a weapon). Firing noise from single shots merged in bursts, machine gun burst, and concurrent firing of multiple weapons would result in short periods of intense firing followed by periods of silence. Live-fire operations may occur for hours at a time, for 5 days a week, or not occur for multiple weeks in a row.

The DON conducted a noise study at AAFB at three sampling sites near the LFTRC and found that ambient noise was never below 50 dB, and on some days was above 65 dB almost 100 percent of the time (DON 2014a, p. 66). The DON provided averaged daily noise level (ADNL) in the Biological Assessment (DON 2014a, p. 68) and SEIS (DON 2014b, p. 5-356) for areas surrounding the LFTRC. In the areas closest to the training ranges the ADNL would increase approximately 20 to 25 dB over baseline conditions, with average daily sound levels rising above 85 dB.

However, peak noise is a more appropriate measure of noise for wildlife, and the U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM) recommends using peak decibel levels when discussing impulsive noise (USACHPPM 2005 in MCB Hawaii 2014, p. 33). The DON provided the Service with peak noise levels for the MPMG range using a formula to calculate peak noise levels at a specified distance from the source. Because the peak noise calculation did not account for sound attenuation from the directional nature of the noise generated by the muzzle blast, terrain, ambient noise, vegetation, temperature, humidity, and other factors, the Service developed a model to estimate peak noise from the LFTRC (USFWS 2015a).

The loudest noise would occur at the firing point, which in a worst-case scenario is at the MPMG firing line at 160 dB. Overall, we do not anticipate that the firing range will be able to be heard on most days outside the 65 dB line (though what is heard will vary based on a species' hearing range); and if it is heard we expect it to be a soft distant noise. It is known that at distances of several kilometers, received noise level can vary by as much as 50 dB above and below the mean due to changes in meteorological conditions (Delaney et al 2002, p. 57); however it is not possible for us to model those conditions at this time. A species-specific noise model is presented for each species below. This conclusion relies heavily on the noise modeling outcomes described above, and if noise from the LFTRC is different than expected, the conclusions described below must be revisited.

Effects from noise
We do not expect any listed birds to be close enough to the firing ranges' firing lines to be exposed to noise levels that cause physical damage to their ears, and therefore we do not expect hearing loss in birds to occur due to the proposed action. The DON will not begin, or continue,

firing at the LFTRC if a fruit bat is present in the area, and therefore we do not expect fruit bats to be exposed to noise levels that cause physical damage to their ears. However, we do expect that listed species habitat adjacent to the firing lines will be adversely affected by operation of the firing ranges. Species-specific details can be found in the sections below.

ISR Strike Ungulate Fence at Ritidian Point (Guam Micronesian kingfisher, Mariana crow, Mariana fruit bat)

As described above, the proposed action will demolish the ungulate fence built as mitigation required under the ISR Strike Biological Opinion (USFWS 2006b) to offset effects to the kingfisher, crow, and fruit bat. The DON proposed three alternatives for the fence. The first alternative, in Finegayan, was in much lower quality habitat than the primary limestone forest at Ritidian Point. The second two alternatives were located at Ritidian Point, adjacent to the LFTRC. As described below, most of this area will be too loud from operation of the LFTRC to support the kingfisher, crow, and fruit bat. Therefore, these locations cannot be considered adequate alternatives to the current ungulate fence at Ritidian Point.

Invasive Species (All species)

Implementation of the proposed project is likely to increase the risk of introducing or spreading non-native terrestrial and aquatic invasive species including plants, animals, and microbes. Pathways associated with anthropogenic activities have a relative risk of introducing and dispersing non-native invasive species. Hulme et al. (2008) described three broad mechanisms for non-native species introductions: importation as a commodity (e.g., purposeful importation as biocontrol, pet trade), arrival via transport vector, and natural dispersal. Of these mechanisms, Hulme et al. (2008) further described a framework for introductions that is supported by six principal pathways of which two could potentially occur via the implementation of DON: contaminant of a specific commodity and stowaway (independent of a commodity, like ballast water or airfreight). The pathways of contaminant and stowaway include, but are not limited to species transported via: construction equipment, personal protective equipment, delivery of supplies, materials, goods, foot traffic, vehicles or vessel traffic. Invasive species introduced as contaminants and stowaways could occur as a result of inadequate sanitation and inspection during and prior to movement. The repeated or routine movement of equipment and people increases the risk of introduction and establishment of a non-native invasive species.

It is important to understand that the "risk" of introduction and establishment of invasive species is highly variable across taxa and habitats. Identifying and analyzing risk for all the species that could be moved via DON-related activities is not practicable. Instead, a more efficient approach is to address pathways where numerous species from different taxa may be inadvertently introduced and implement prescriptive measures to control risks from the pathways. A pathway risk assessment will provide a structure for assessing where the greatest "risk" for a non-native species introduction occurs and locations where managing ingress or egress of these species is most efficient for control. Pathways must be controlled because repetition of an action has a direct effect on propagule pressure which as stated above increases the likelihood of a species to become established.

To address pathways and encourage a more holistic approach to managing invasive species, the DON funded the development of a Regional Biosecurity Plan (RBP) for Micronesia and Hawaii (formerly referred to as the Micronesia Biosecurity Plan). Individual activities for various species will continue, but the DON and others agree it is more efficient to manage pathways and prescribe corrective measures for a suite of species that will be monitored at discrete control points over time. The RBP will provide stakeholders in Micronesia and Hawaii with a platform for coordination and integration of inter-agency invasive species management efforts such as control, interdiction, eradication, and research. Several of the recommendations of the RBP are incorporated into the project action, and are detailed in the Conservation Measures to Minimize the Effects of Invasive Species section.

The DON is also committed to a comprehensive brown treesnake interdiction program, also detailed in the Conservation Measures section, to ensure that military activities, including the transport of civilian and military personnel and equipment to and from Guam, do not contribute to the spread of brown treensnakes (DON 2014a, p. 38). Brown treesnake interdiction requirements (e.g., trapping and inspections at ports, cargo facilities, and aircraft, inspections of household goods, biosecurity plans for training events) are specific in DoD instructions (i.e., 36 Wing Instruction 32-7004, *Brown Tree Snake Control Plan* and COMNAVMAR Instruction 5090.10A, *Brown Tree Snake Control and Interdiction Plan*) as well as the annual Work Financial Plan that is developed in cooperation with USDA Wildlife Services (DON 2014a, pp. 38-39).

In addition, the DON will fund any increase of current federally funded brown treesnake interdiction measures (in Guam, CNMI, and Hawaii) where the increase is related to direct, indirect and induced growth caused by the USMC relocation to Guam. The fiscal year (FY) 2010 level of funding for the Federal interagency brown treesnake interdiction effort on Guam, CNMI, and Hawaii and 2010 transportation levels associated with outbound cargo from Guam for the U.S. or U.S. territories will be used as the baseline. That funding will continue and become part of the DON's brown treesnake interdiction funding under authority of the Brown Tree Snake Control and Eradication Act (7 USC § 8501 note). The Service agrees that it is not DON's responsibility to fund increased interdiction measures *that are identified* more than one year after the end of the fiscal year both USMC relocation construction has ended and the permanent non-transient USMC military units have relocated to Guam. However, the Service understands the DON will continue to provide a baseline level of interdiction funding related to the direct, indirect, and induced-growth effects of its proposed action beyond one year.

Because of the DON's commitment to the RBP and brown treesnake interdiction and with full implementation of the biosecurity measures proposed as part of this action, we anticipate that the proposed action will prevent the introduction and spread of invasive species both within the action area, and beyond the borders of Guam.

Conservation Measures Associated with the Action (All Species)

In addition to measures to minimize the risk of invasive species described above, the proposed action also includes other measures, listed below and described in the Conservation Measures section, which will have a beneficial effect on listed species.

- Forest enhancement project in Finegayan
- Funding of selected projects identified as priorities in the Brown Treesnake Technical Working Group Strategic Plan
- Measures to minimize effects of construction including contractor education, following the Guam Landscaping Guidelines, contract specifications to avoid unintended clearing of habitat, and monitoring of implementation of conservation measures.

Effects of the Action – Guam Micronesian kingfisher

The Guam Micronesian kingfisher was once distributed throughout Guam, but significant population declines, resulting primarily from predation by the brown treesnake, resulted in their extirpation from Guam by 1988 (Wiles et al. 2003, USFWS 2008a). Currently, the kingfisher survives only in captivity. The Service is planning for the reintroduction of the kingfisher to Guam during the term of the proposed action. The success of the reintroduction is dependent on the protection and management of suitable habitat essential to kingfisher's survival and recovery in the wild on Guam. Kingfisher habitat is very limited on Guam and has been severely degraded by habitat fragmentation and loss, lack of management, introduced ungulates, invasive species, typhoons, and forest conversion due to the loss of birds that function as pollinators, seed dispersers, and frugivores in the forest.

In addition to the general effects of the action discussed above, a species-specific effects analysis for the Guam Micronesian kingfisher is provided below.

Noise

Aircraft
As detailed in the general effects of the action section, birds tend to avoid noisy areas but their response to noise may vary depending on the traits of the species or individual. There is no information on the effects of chronic and peak aircraft noise levels on Guam Micronesian kingfisher. The effect of aircraft noise on the kingfisher is likely similar to other Guam native species; frequent loud over-flights may alter behavior, impair reproduction, and change habitat use in habitat next to the airfields at AAFB (Wiles et al. 1995, p. 46), although the extent of these effects are unknown for the kingfisher.

Potential effects of aircraft overflights have been conducted on Mariana crows (Morton 1996) another Guam bird species and another cavity-nesting bird, the red-cocked woodpecker (*Picoides borealis*). Morton (1996, p. 62) found no evidence that aircraft overflights contributed directly to nest abandonment or nest failure during the study. However, Morton (1996, p. 61) did report three observations of Mariana crows reacting to aircraft. The most severe of these interactions was a pair leaving their nest several times in response to a helicopter flying less than or equal to 400 ft (120 m) above the ground. In general, the observations of Mariana crows flushing from nests were all due to aircraft below 1,000 ft (305 m) above the ground (Morton 1996, p. 61). Delaney et al. (2002, p. 42) determined that breeding red-cocked woodpeckers did not flush from their nests during incubation or early brooding phase when military helicopters were greater than 98.4 ft (30 m) from nests.

Operation of the LFTRC

As described in the Environmental Baseline, the Service has delineated habitat on Guam to provide a sufficient amount of habitat for the Guam Micronesian kingfisher so the species can be reintroduced to Guam once threats are controlled. The forest within the footprint of LFTRC and adjacent areas is habitat for the kingfisher (Figure 6) and includes some of the most pristine primary limestone habitat in northern Guam. In order to serve as suitable habitat for kingfishers, the area must be free of threats that would preclude kingfishers from using the habitat as a nesting territory (for example, brown treesnakes and human disturbance). The noise pollution from operation of the LFTRC would cause disturbance to breeding kingfishers during courtship and nesting stages. As stated in the Status of the Species, the nest excavation and courtship stages are crucial to successful reproduction for the kingfisher. During the breeding season, it is important to minimize disturbance within the territorial range of breeding pairs. Based on experience with the managed population, Guam kingfishers are especially sensitive to stress which would likely be increased by noise and disturbance, and compounded during the breeding season (B. Bahner, Philadelphia Zoo, pers. comm. 2015). The noise from the LFTRC would result in the habitat degradation within the footprint and immediately adjacent to the LFTRC, and therefore make the habitat unsuitable for breeding kingfishers.

Guidance on potential effects of noise on endangered wildlife was taken from USFWS (2006a), Pater et al. (2009), and Dooling and Popper (2007). The Service guidance for noise disturbance to spotted owls (*Strix occidentalis caurina*) and marbled murrelets (*Brachyramphus marmoratus*) state that noise disturbance will reach the level of take when 1) project-generated sound exceeds ambient nesting conditions by 20-25 decibels (dB) and 2) project-generated sound, when added to existing ambient conditions, exceeds 90 dB (USFWS 2006a, p. 1). Noise from operation of the LFTRC meets both these criteria for disturbance reaching the level of take. In addition, for the purposes of noise disturbance, extreme noise is defined as 101-110 dB, and any noise above that level is not covered by the guidance (USFWS 2006a, p. 5). For extreme sound levels of 101-110 dB (the highest analyzed in the guidance document) disturbance of spotted owls or marbled murrelets is expected up to 400 m (1320 ft) from the source noise (USFWS 2006a, p. 8). In addition, Delaney et al. (2000, 2001) and Pater et al. (1999) developed noise response thresholds for the red-cockaded woodpecker based on a number of military noise sources. Their results showed that woodpeckers did not flush during the nesting season when the sound exposure levels (SEL) for .50-caliber blank fire was less than 82 dB and for small-caliber live fire events were less than 79 dB (Delaney et al. 2002, p 18).

As stated above, the habitat adjacent to the LFTRC would likely become unsuitable for breeding Guam Micronesian kingfishers (in the future when kingfishers are reintroduced to Guam). Based on the Service guidance above, disturbance reaching take could occur at 20 dB above ambient conditions (ambient is 60 dB) or when noise exceeds 90 dB. Given the sensitivity of breeding kingfishers to noise and disturbance, the Service's guidance, Delaney et al. 2002 study (*e.g.* woodpeckers did not flush at nose levels less 79 dB), we have chosen the 80-dB threshold for noise disturbance of kingfisher as a conservative estimate that would preclude them from using suitable habitat for breeding. Based on the 80-dB threshold and the Service's noise modeling (Figure 13), approximately 319 acres of kingfisher habitat will be degraded by noise from the LFTRC and not suitable habitat for the kingfishers once the LFTRC becomes operational.

Habitat Loss, Degradation, and Fragmentation

There is currently 14,997 ac and 13,314 ac of kingfisher habitat in northern and southern Guam, respectively. The proposed action will directly and permanently remove approximately 1,015 ac in northern Guam and three ac will be lost to induced growth. Furthermore, as stated above, we estimate 319 ac will be exposed to noise at levels that will likely prevent Guam Micronesian kingfisher breeding activities, for a total habitat loss of 1,334 ac of kingfisher habitat in northern Guam. The 1,334 acres of habitat lost would have been able to support 63 breeding kingfisher pairs (1,334 ac ÷ 21 ac per breeding pair) or approximately 12 percent of the 500 pairs needed in northern Guam for recovery. In southern Guam, the proposed action will directly remove six acres of mostly low quality kingfisher habitat.

For northern Guam, the removal and degradation of habitat includes some of the best remaining primary forest on Guam, at Ritidian Point on AAFB. As discussed in the General Effects section, the most severe effects on recovery habitat from habitat fragmentation and edge effects will be on AAFB at Ritidian Point from construction of the LFTRC. This area currently contains a large expanse (over 350 acres) of high-quality primary limestone forest within the Overlay Refuge. This primary limestone forest is also adjacent and contiguous with critical habitat for the kingfisher within the fee simple land of the GNWR, together providing an even larger forested area serving as habitat for the kingfisher. This area will be further fragmented by the presence of over six miles of additional habitat edges on AAFB alone, and three acres will be lost to induced growth (as detailed in the General Effects section).

Other Human Disturbance

The proposed training at the NMS in southern Guam and the operation of the main cantonment facilities at Finegayan will increase human presence and noise in kingfisher habitat in these areas. The cantonment is near the Haputo ERA and other areas of kingfisher habitat (Figure 6). Increased human disturbance in these areas could deter kingfishers, when reintroduced back to Guam, from utilizing these areas for sheltering, foraging and breeding.

Conservation Measures for the Kingfisher
The DON has proposed to offset, in part, these adverse effects by implementing conservation measures. Risks will be minimized by best management practices regarding spread of non-native species and fire. The DON also has proposed to implement biosecurity conservation measures including landscape-level brown treesnake eradication and control, recommendations from the RBP, HACCP planning, and brown treesnake interdiction program, which will be beneficial to the kingfisher because it will help reduce the current brown treesnake population and potentially prevent other invasive species from becoming established on Guam.

As part of the proposed action, the DON also proposes to implement a forest enhancement project at Finegayan, in low-quality secondary forest, to benefit listed species, including the kingfisher. This forest is not currently usable by kingfishers and will likely require a decade or more of growth and management before it can support kingfishers. However, the DON has proposed the enhancement of the site to include installation of ungulate exclusion fences around

the 1,000 acres; active removal of ungulates (i.e. trapping, snaring, shooting) with the goal of eradication within the fenced areas; invasive plant removal; and the propagation, planting, and establishment of dominant and rare species characteristic of native limestone forest habitats. Therefore, although this site would not fully compensate for the loss of primary limestone forest, the enhancement of forest and protection of the site is expected to provide some benefit to the kingfisher.

Summary

As described in the Status of the Species and Environmental Baseline sections, habitat fragmentation and loss, lack of management, introduced ungulates, invasive species, typhoons, and forest conversion have continued to negatively affect forest habitat on Guam to an extent that the current amount of remaining forest habitat suitable for the kingfisher is severely degraded and nearly at the minimum needed for its survival and recovery in the wild. The loss of 1,334 ac of habitat that could support 63 breeding kingfisher represents a loss of approximately nine percent of remaining kingfisher habitat in northern Guam and the capacity to support approximately 12 percent of the 500 breeding pairs needed for recovery. Although the six ac of habitat in southern Guam would not support a breeding pair, the loss of six ac would reduce the overall amount of kingfisher habitat in southern Guam.

Among the adverse effects to the kingfisher as detailed above and in the General Effects section, the habitat loss and degradation of the limestone forest in northern Guam, including the loss of the habitat to support 63 breeding kingfishers in Guam, is the most significant, persistent, and adverse effect to the kingfisher as a result of the proposed action. In addition, the increased human disturbance within the action area could deter kingfishers, when reintroduced back to Guam, from utilizing these areas for sheltering, foraging and breeding. However, implementation of the conservation measures and DON's protection and management of approximately 5,234 acres of kingfisher habitat in northern Guam per the MOA will mitigate for the loss of kingfisher habitat, and will help ensure that kingfisher habitat will be available for the survival and recovery of the species on Guam.

Effects of the Action – Mariana Crow

In addition to the general effects of the action discussed above, a species-specific effects analysis for the Mariana crow is provided below.

Noise

Aircraft
From 1994 to 1995 a study was conducted at AAFB on the potential effects of aircraft overflights on Mariana crows (Morton 1996). No evidence was found that aircraft overflights contributed directly to nest abandonment or nest failure during the study (Morton 1996, p. 62). In fact, one nest was constructed within one km (0.6 mi) of the north runway during a large aircraft training exercise (Tandem Thrust). However, Morton (1996, p. 61) did report three observations of Mariana crows reacting to aircraft. One observation was of alarm calling and an increase in vigilant, alert, and standing behavior from an adult attending a nest after an unknown

aircraft (76-92 dBA, > 1,000 ft (305 m) above ground level) flew over the nest. Another observation was of a Mariana crow returning to a nest while an unidentified cargo aircraft flew overhead. The adult remained standing at the nest and alarm calling for the duration of the overflight (approximately two minutes). No sound levels or altitude was reported for the aircraft. The final observation was of a pair of Mariana crows responding to six F-16s and four KC-135s (≤ 86 dBA, no altitude reported) departing the base. The pair was observed alarm calling and flying for 12 minutes after the overflights. In addition to these observations, Morton (1996, pp. 60-61) also summarized previous observations of Mariana crow and aircraft interactions by other biologists on Guam. The most severe of these interactions was a pair leaving their nest several times in response to a helicopter flying less than or equal to 400 ft (120 m) above the ground. Other observations also included adults flushing from the nest and leaving eggs unattended. In general, the observations of Mariana crows flushing from nests were all due to aircraft below 1,000 ft (305 m) above the ground (Morton 1996, p. 61). Mariana crows reacting to aircraft by alarm calling and other minor behaviors occurred when aircraft were above this elevation.

The proposed action will increase the frequency and duration of aircraft noise on Guam and the increased noise may affect the potential for habitat to be suitable in the future for Mariana crows. Current and previous DoD consultations have implemented flight restrictions in the Northwest Field area of AAFB (USFWS 2010a, p. 63; USFWS 2015b, Appendix B, p. 10) to minimize noise disturbance to listed species and their habitats. Because the proposed action has no flight restrictions in this area, there will be an increase in the frequency and duration of aircraft noise above that currently in operation at AAFB, and this may affect the suitability of crow habitat in the area. As noted above, Mariana crows have been observed to flush from their nests in response to aircraft below 1,000 ft (305 m) (Morton 1996, p. 61). Therefore, we expect that habitat in the NWF area of AAFB may be unsuitable in the future if Mariana crows are reintroduced and flight restrictions not implemented. We do not anticipate that the increase use of aircraft will preclude the use of habitat by the Mariana crow elsewhere on Guam.

Operation of the LFTRC

Mariana crows are known to be highly susceptible to disturbance from human activities (Morton 1996, p. 60, 62, 72; Ha 2015, pers. com.; Ha et al. 2011, p. 5). Based on observations of disturbance of crow nests on Guam, Morton (1996, p. 72) recommended a 300-meter radius for a buffer zone around active crow nests; Morton's recommendations were based on observations of crows reacting to facility/grounds maintenance, brown treesnake trapping, research activities, loud music, and human voices. One Mariana crow nest on Guam was abandoned due to disturbance from maintenance activity and from radio noise coming from a sound system 150 meters away (Morton 1996, p. 62). Ha et al. (2011, p. 236) found that nest sites were always greater than 300 meters from any buildings, and that actual nest sites were almost twice as far from roads and buildings as random sites. Captive Hawaiian crows (Alala, *Corvus hawaiiensis*) exhibited signs of distress, including pathological auto-plucking, distress calling, and reduced food intake, in response to military activities at Pohakuloa Training Area in Hawaii (Morton 1996, p. 60).

As described in the Environmental Baseline, the Service has delineated habitat on Guam to provide a sufficient amount of habitat for the Mariana crow so the species can be reintroduced to Guam once threats are mitigated. The forests adjacent to the LFTRC are classified as Mariana

crow habitat (Amidon 2012, *in litt*.). In order to serve as suitable habitat for the Mariana crow, the area must be free of threats that would preclude the crow from using the habitat as a nesting territory (for example, brown treesnakes and human disturbance). The noise pollution from operation of the LFTRC could lead to habitat degradation adjacent the LFTRC, and make the habitat unsuitable for nesting Mariana crows. The habitat may still be suitable for foraging or dispersing juvenile crows.

Guidance on potential effects of noise on endangered wildlife was taken from Service (2006a), Pater et al. (2009), and Dooling and Popper (2007). The Service guidance for noise disturbance to spotted owls (*Strix occidentalis caurina*) and marbled murrelets (*Brachyramphus marmoratus*) says that noise disturbance will reach the level of take when 1) project-generated sound exceeds ambient nesting conditions by 20-25 decibels (dB) and 2) project-generated sound, when added to existing ambient conditions, exceeds 90 dB (USFWS 2006a, p. 1). We used the spotted owl and marbled murrelet guidance as a surrogate for the Mariana crow as it is the best available noise disturbance framework for listed species.

Noise from operation of the LFTRC meets both these criteria for disturbance reaching the level of take. In addition, for the purposes of noise disturbance, extreme noise is defined as 101-110 dB, and any noise above that level is not covered by the guidance (USFWS 2006a, p. 5). For extreme sound levels of 101-110 dB (the highest analyzed in the guidance document) disturbance of spotted owls or marbled murrelets is expected up to 400 m (1320 ft) from the source noise (USFWS 2006a, p. 8). In addition, Delaney et al. (2000, 2001) and Pater et al. (1999) developed noise response thresholds for the red-cockaded woodpecker based on a number of military noise sources. Their results showed that woodpeckers did not flush during the nesting season when the sound exposure levels (SEL) for.50-caliber blank fire was less than 82 dB (Delaney et al. 2002, p 21).

Unlike the spotted owl or marbled murrelet example above, no disturbance take of Mariana crows is currently expected as they are extirpated from Guam. However, the habitat adjacent to the LFTRC may be unsuitable for Mariana crows in the future when crows are reintroduced to Guam. Based on the Service guidance above, disturbance that meets the definition of take could occur at 20 dB above ambient conditions (ambient is 60 dB) or when noise exceeds 90 dB. Given the sensitivity of crows to noise both on Guam and Rota, we have chosen the 80 dB threshold for noise disturbance of crows that would preclude them from using suitable habitat for breeding. Based on the Service's noise modeling described above, approximately 319 acres of Mariana crow habitat will be degraded by noise from the LFTRC and not suitable habitat for Mariana crows once the LFTRC becomes operational (Figure 14).

As described above, a species can often habituate to human-generated noise when the noise is not followed by an adverse effect. However, even when a species appears to be habituated to a noise, the noise may produce a metabolic or stress response (increased heart rate results in increased energy expenditure) though the response may or may not lead to changes in overall energy balance. Based on our knowledge of Mariana crow behavior, we assume that reintroduced crows may habituate to noise levels below 80 dB, but not above it.

Habitat Loss, Degradation, and Fragmentation

There is currently 13,962 ac and 10,957 ac of potential Mariana crow habitat in northern Guam and southern Guam, respectively. The proposed action will directly and permanently remove approximately 1,010 ac of crow habitat and three ac will be lost to induced growth. Furthermore, as stated above, we estimate 319 ac will be exposed to noise at levels that will likely prevent Mariana crow breeding activities, for a total habitat loss of 1,332 ac of Mariana crow habitat. The 1,332 ac of habitat lost to the proposed action would have been able to support 24 territorial crow pairs or 24 percent of the 100 pairs needed in northern Guam for recovery. In southern Guam the proposed action will directly remove approximately five acres of low quality Mariana crow habitat.

In northern Guam, the removal and degradation of habitat includes some of the best remaining primary limestone forest on Guam, at Ritidian Point on AAFB. As discussed in the General Effects of the Action section, the most severe effects on crow habitat from habitat fragmentation and edge effects will be at Ritidian Point from construction of the LFTRC. This area currently contains a large expanse (over 350 ac) of high-quality primary limestone forest within the Overlay Refuge. This primary limestone forest is also adjacent and contiguous with critical habitat for the Mariana crow within the fee simple land of the GNWR, together providing an even larger forested area serving as habitat for the Mariana crow. This area will be further fragmented by the presence of over six miles of additional habitat edges on AAFB alone.

Habitat Conservation and Protection

The protection and management of approximately 5,234 acres of kingfisher habitat on DON lands in northern Guam per the MOA (DON and Service 2015c) will benefit the Mariana crow because habitat for crow habitat also would be protected and managed. Thus, adverse effects to the crow would be offset, in part, by implementing the actions in the MOA but also the conservation measures in this consultation. Risks will be minimized by best management practices regarding spread of non-native species and fire.

In addition, as part of the proposed action, the DON proposes to implement a forest enhancement project at Finegayan, in low-quality secondary forest, to benefit listed species, including the crow. This forest is not currently usable by crows and will likely require a decade or more of growth and management before it can support crows. However, the DON has proposed the restoration of the site to include installation of ungulate exclusion fences around the 1,000 acres; active removal of ungulates (i.e. trapping, snaring, shooting) with the goal of eradication within the fenced areas; invasive plant removal; and the propagation, planting, and establishment of dominant and rare species characteristic of native limestone forest habitats. Therefore, although this site would not fully compensate for the loss of primary limestone forest, the restoration of forest and protection of the site is expected to provide some benefit to the crow.

Other Human Disturbance

The proposed training at the NMS in southern Guam and the operation of the main cantonment facilities at Finegayan will increase human presence and noise in crow habitat. The cantonment is near the Haputo ERA and other areas of crow habitat (Figure 15). Increased human

disturbance in these areas could deter Mariana crows, when reintroduced back to Guam, from utilizing these areas for sheltering, foraging and breeding.

Summary

As described in the Status of the Species and Environmental Baseline sections, habitat fragmentation and loss, lack of management, introduced ungulates, invasive species, typhoons, and forest conversion have continued to negatively affect forest habitat on Guam to an extent that the current amount of remaining forest habitat suitable for the Mariana crow is severely degraded and close to the minimum needed for its survival and recovery in the wild. The loss of 1,332 ac of habitat represents a loss of approximately 10 percent of remaining crow habitat in northern Guam. The proposed action will adversely affect the Mariana crow by permanently clearing areas of crow habitat which, in the absence of the project, would have remained intact to provide for the future recovery of the species. In addition, project-related noise will further reduce the amount of crow habitat suitable for this species' breeding, feeding and sheltering. However, the DON's protection and management of 5,234 acres of crow habitat in northern Guam will off-set the loss of Mariana crow habitat from project construction, and will help ensure that crow habitat will be available for future survival and recovery of the species on Guam. The DON also has proposed to implement biosecurity conservation measures including landscape-level brown treesnake eradication and control, recommendations from the RBP, HACCP planning, and brown treesnake interdiction program, which will be beneficial to the crow because it will help reduce the current brown treesnake population and potentially prevent other invasive species from becoming established on Guam.

Effects of the Action – Guam Rail

The Guam rail was once distributed throughout Guam, but significant population declines, resulting primarily from habitat loss and predation by the brown treesnake and feral cats, resulted in their extirpation from Guam by 1987 (Wiles et al. 1995, p. 38). The Guam rail is now found only in captivity and in one experimental population on Rota consisting of between 60 to 80 birds (Wenninger 2008, pers. comm.). The Rota population is a designated non-essential experimental population under section 10 of the Act. As of June 2008, there were approximately 158 Guam rail in captivity on Guam and in mainland zoological institutions (USFWS 2008c, p. 5). Because the Guam rail is extirpated from the wild on Guam, no adverse effects to individual rails are expected to be caused by the proposed action. However, recovery of the species on Guam will depend on the re-establishment of a wild population on Guam and sufficient habitat to support a recovered population, as summarized in the Status and Baseline section. Project impacts to recovery habitat, effects of brown treesnake introduction to Rota, and beneficial effects of project conservation measures are detailed below.

Noise

Aircraft
As detailed in the General Effects section, birds tend to avoid noisy areas but their response to noise may vary depending on the traits of the species or individual. There is no information on the effects of chronic and peak aircraft noise levels on Guam rails. However, the effect of

aircraft noise on the Guam rail is likely similar to other Guam native species; frequent loud over-flights may alter behavior, impair reproduction, and change habitat use in habitat next to the airfields at AAFB (Wiles et al. 1995, p. 46). In 1981, surveys were conducted within habitats adjacent to runways at AAFB and NWF on Guam. Results from the surveys indicated that Guam rails were absent in these areas (Engbring and Ramsey 1984, p. 13-16). Although there could be factors other than aircraft noise that attributed to their absence in these areas, a review of noise studies indicates that many species abandon noisy areas (Francis 2015, p.2).

The proposed action will increase the frequency and duration of aircraft noise on Guam and the increased noise may affect the potential for habitat to be suitable in the future for Guam rails. Current and previous DoD consultations have implemented flight restrictions in the Northwest Field area of AAFB (USFWS 2010a, p. 63; USFWS 2015b, Appendix B, p. 10) to minimize noise disturbance to listed species and their habitats. Because the proposed action has no flight restrictions in this area, there will be an increase in the frequency and duration of aircraft noise above that currently in operation at AAFB, and this may affect the suitability of rail habitat in the area. Because of the lack of information on rail response to aircraft overflights, it is difficult to know if an increase in aircraft overflight noise will preclude the use of habitat by Guam rails in the NWF area in the event rails are reintroduced. We do not anticipate that the increase use of aircraft will preclude the use of habitat by the Guam rail elsewhere on Guam..

Operation of the LFTRC
As described above, Guam rails are secretive and wary, and respond to disturbance from human activity. At the Guam DAWR captive facility, Guam rails negatively respond to bushcutters, which produce a noise level of 87 db (http://www.makita.biz/mm4.html). In response to this noise disturbance, captive rails destroy their nests (S. Medina, DAWR, pers. comm. 2015). Captive Guam rails also destroy their eggs and chicks (less than 10 days old) in response to human disturbance within 11 to 15 m (36 to 49 feet) of their nest. However, this behavior may be attributed to a combination of the disturbance and the stress of breeding in captivity (S. Medina, DAWR, pers. comm. 2015). On Rota, wild Guam rails have been observed to flush from their nest in response to an approaching human, but would return to incubate the eggs in a short period of time. In other instances, incubating birds would remain on their nests when approached by a person (P. Wenninger, DON, pers. comm. 2015).

The LFTRC will be in operation during day and night hours for 39 weeks out of the year, with thousands of DoD personnel using the ranges throughout the year. The total annual ammunition usage at the LFTRC is 6,719,190 rounds. The noise disturbance from the live-fire training will result in impulse noise with very intense sounds of short duration (e.g., the discharge of a weapon). Given the intensity and frequency of human activity and noise levels at the LFTRC, we anticipate that Guam rails would avoid the LFTRC and surrounding area completely while the ranges are in operation. Although there is limited information on Guam rail's tolerance to noise, based on the best available information, we know that Guam rails negatively respond to noise levels of 87 db. Therefore, we have chosen 85 dB as a conservative threshold for noise disturbance that would preclude Guam rails from using recovery habitat for breeding, foraging, or sheltering. We can reasonably expect that all recovery habitat within a 85-db noise contour would be avoided by rails. Therefore, we predict that approximately 51 acres of Guam rail

recovery habitat surrounding the LFTRC will be unsuitable for Guam rails because of the noise (Figure 16).

Habitat Loss and Degradation Caused by the Proposed Action

There are approximately 24,698 ac and 24,886 ac of recovery habitat in northern and southern Guam, respectively, for the Guam rail. Approximately 1,055 ac of recovery habitat in northern Guam and 90 ac in southern Guam will be developed within the project vegetation clearing footprint as a direct result of the proposed action (Table 6, Figure 16). Therefore, there will be 23,643 ac of potential recovery habitat in northern Guam and 24,796 in southern Guam remaining after implementation of the proposed project.
In addition, approximately 17 ac of Guam rail recovery habitat on Guam are expected to be cleared through indirect or induced development impacts of the action throughout the island. After implementation of development directly and indirectly related to the proposed project, the project will result in the loss of 1,162 ac of rail habitat or two percent of the remaining rail habitat on Guam.

Although the degradation and loss of habitat, lack of management, introduced ungulates, invasive species, typhoons, and forest conversion continue to negatively affect habitat for rails on Guam (as described in the General Effects) and the proposed project will contribute to this declining habitat baseline, the amount of habitat loss is not expected to appreciably reduce the likelihood that the remaining habitat would support the recovery and survival of the Guam rail. Furthermore, this area will be fragmented by the presence of over six miles of additional habitat edges on AAFB alone, however, negative effects to rails from fragmentation would be minimal because this species is able to use edge habitat. Similarly, because the Guam rail utilizes shrubby vegetation and edges, fires caused by training in the vicinity of the Andersen South and Route 15 Range Complex and other training areas are not expected to result in loss of habitat for the Guam rail.

Conservation Measures to Benefit the Guam Rail

Recovery habitat remaining on DoD lands comprises a substantial percentage of the total habitat available for the recovery of the Guam rail. The DON's proposed conservation measures are intended to support reintroduction of native endangered or threatened species on DoD lands on Guam consistent with species recovery plans. In further support of such recovery efforts, the DON intends to actively participate in recovery committees for endangered or threatened species on Guam.

The DON has committed to provide sustained funding throughout the construction phase of the project for the development of methods to eradicate or significantly suppress brown treesnakes island-wide to facilitate the recovery of listed species on Guam. If successful, landscape-level implementation of brown treesnake suppression on DoD and other lands will facilitate reintroduction of the Guam rail. This in turn is expected to reduce the rate of nest predation and adult bird mortality.

In addition, as part of the proposed action, the DON proposes to implement a forest enhancement project at Finegayan, which will benefit the rail. The DON has proposed the restoration of the site to include installation of ungulate exclusion fences around the 1,000 acres; active removal of ungulates (i.e. trapping, snaring, shooting) with the goal of eradication within the fenced areas; invasive plant removal; and the propagation, planting, and establishment of dominant and rare species characteristic of native limestone forest habitats.

The protection and management of approximately 5,234 acres of kingfisher habitat on DON lands in northern Guam per the MOA (DON and Service 2015c) may benefit the rail because an undetermined amount of habitat for the rail also would be protected and managed within the 5,234 acres. Thus, adverse effects to the rail would be offset, in part, by implementing the actions in the MOA but also by implementing the conservation measures in this consultation.

Summary

As described in the Status of the Species and Environmental Baseline sections, the degradation and loss of habitat, lack of management, introduced ungulates, invasive species, typhoons, and forest conversion have continued to negatively affect habitat for the Guam rail. Noise from the operation of the LFTRC will diminish the value of the surrounding recovery habitat for Guam rails. This disturbance, combined with the loss of (1,162 ac + 51 ac) 1,213 ac recovery habitat on Guam, further degrades and decreases the amount of habitat that would be available to recover the Guam rail. The increased human disturbance in the NMS, Haputo ERA, and habitat within the Finegayan area would likely result in these areas becoming less suitable for Guam rails.

The DON's implementation of biosecurity conservation measures including landscape-level brown treesnake eradication/control, recommendations from the RBP, HACCP planning, and brown treesnake interdiction program, will be beneficial to the Guam rail because it will help reduce the current brown treesnake population and potentially prevent other invasive species from becoming established on Guam. In addition the DON will protect and managed approximately 5,234 ac in northern Guam and conduct a forest enhancement project on approximately 1,000 acres in Finegayan of habitat, which also will provide some benefit to the rail.

Effects of the Action – Mariana Fruit Bat

In addition to the general effects of the action discussed above, a species-specific effects analysis for the Mariana fruit bat is provided below.

The Service proposes that recovery of the Mariana fruit bat will require subpopulations on each island where they are currently extant, and those subpopulations must be of sufficient size to avoid genetic and demographic risks associated with small populations (USFWS *in review*). Less than 50 wild fruit bats are estimated to remain on Guam (USFWS 2009d, p. 8 and references therein; SWCA 2012, p. 32; USFWS *in review*, p. 7-8 and references therein). Resilience of the Guam fruit bat population is expected to be low given the critically small

starting population, the species' slow reproductive rate (USFWS 2009d, p. 17 and references therein), infrequent and unpredictable immigration from other islands (DON 2013d, p. 78), and abundant, widespread, and uncontrolled threats (USFWS 2009d, p. 19-33 and references therein). Based on our estimate of 27,096 acres of existing survival and recovery habitat for the Mariana fruit bat (Metevier 2014, unpubl. data), the estimated carrying capacity for fruit bats on Guam is 19,847 bats (DON 2013d, p. 26, 45).

Given the small population of Mariana fruit bats remaining on Guam, recovery will likely depend on immigration or translocation of fruit bats from Rota (Esselstyn et al. 2006, p. 531) and long-term conservation and maintenance of fruit bat habitat on Guam. The Mariana fruit bat has high energetic demands associated with flight and year-round breeding, and as such depends on a steady and ample supply of fruiting and flowering plants that are distributed patchily through space and time (Wiles and Fujita 1992, pp. 26-31; USFWS 2009d, p. vi,; Amitai et al. 2010, p. 2693; Downs et al. 2012, p. 344). To meet requirements for breeding, feeding, and sheltering, a self-sustaining population of Mariana fruit bats will rely on threat-managed, native limestone forest habitat containing diverse food resources that are available throughout the year.

Noise

Most of the bat species in the genus Pteropus do not echolocate, and less information is available about their hearing than for bats that echolocate. We have no specific information on hearing for the Mariana fruit bat. The available literature indicates that fruit bats are most sensitive to noise frequencies between 10 and 20 kHz, insensitive to frequencies below one kHz, and able to detect frequencies 40 kHz or greater (DON 2014a, p. 64 and references within). From approximately four kHz to just under 20 kHz the fruit bats have more sensitive hearing than humans (DON 2014a, p. 64). Overall, fruit bat audiograms are similar to humans (DON 2014a, p. 64), and it is possible that noise from the proposed action would be heard by fruit bats as it would be heard by humans.

There is limited understanding of what sound levels may adversely affect Mariana fruit bats, and most information is from observations of fruit bat reactions to aircraft overflights. The following reactions to aircraft noise have been reported:

- Fruit bats have been reported to flush at noise levels exceeding 106 dBC (SWCA 2008, pp. 2-3) and at peak noise levels above 90 dBA/101 dBC (SWCA 2012, p. 23, 37).
- Fruit bats at a maternity colony on Rota flushed when a helicopter was within 200 m and a military jet aircraft (type unknown) flew overhead within 300 m (J. Boland, pers. obs., 2009 and 2010).
- Successive launches of F-14 repeatedly flushed 50 bats from a roost site and F-14s (95, 106 dBA) also caused agitated vocalization and flushing (Grout 1993 in Morton 1996, p. 67).
- Increases in active thermoregulation (32 percent), maintenance (14 percent), locomotion (74 percent), and alertness (62 percent) of Mariana fruit bats were recorded after aircraft overflights (SWCA 2012, p. 23, 37).

Based on this information, we can assume that aircraft overflights resulting in noise over 90 dB may flush roosting Mariana fruit bats. However, flush rates may not adequately reflect a

species' sensitivity to human disturbance (Peters and Obis 2006, p. 1383). Effects to individual Mariana fruit bats are only documented in the SWCA (2012) study, which occurred after the Pati Point colony site was no longer used; however, this study did not report noise levels of overflights that may have disturbed (other than flushing) individual fruit bats. Therefore, we do not have direct data on how an individual fruit bat on Guam will react to noise disturbance from the proposed action. For the purposes of this consultation, we will assume that, at a minimum, noise over 90 dB may flush a roosting Mariana fruit bat. Noise levels above ambient levels and below 90 dB are likely to cause other stress reactions, including increases in active thermoregulation, maintenance, locomotion, and alertness.

Stress reactions caused by human disturbance can have an adverse effect on fruit bats by increasing energetic demands, disrupting hormonal balance, and forcing relocation to lower quality habitat (Klose et al. 2006, p. 347, and references therein; CNMI 2010, p. 7). All of these factors can lead to reduced time foraging, sheltering, or breeding and adversely affect survival. When a disturbance is experienced by a Mariana fruit bat colony, individuals may disperse on their own or in smaller groups (CNMI 2010, p.6). In some cases, the degree of colony dispersal (i.e., how many individuals leave the main colony) may be related to the degree and/or type of human disturbance. For example, if hunters are frequently targeting bats along commuter flyways near the colony roost site, some individuals may disperse away from the roost site temporarily, but eventually return. However, if hunters fire directly into a colony at their day roost, the entire colony abandons the site (CNMI 2010, p. 7). When fruit bats on Rota are forced to disperse from colonies as a result of human disturbance, infant mortality may increase because dependent, non-volant pups that are too big for the mother to carry are likely abandoned. Forced dispersal may negatively affect the reproductive potential of the population because access to mates is compromised (CNMI 2010, p. 7). Even without dispersal, high levels of stress from any disturbance can disrupt reproductive cycles and/or lead to miscarriage (Wingfield et al. 1998, p. 192-193, Heideman 2000, p. 169-199, Klose et al. 2006, p. 347).

Construction noise

Noise from construction of the proposed action may affect Mariana fruit bats in the vicinity of the construction. Construction of the proposed action will occur from 2015 to 2028; however, construction will be phased and will not occur at all places at once, or for the entire construction time period. Construction equipment will include standard heavy equipment including bulldozers, graders, haulers, large trucks. No blasting or use of dynamite will occur as part of the proposed action. The use of heavy equipment can reach noise levels of 96 dB (USFWS 2006a, p. 17). "Based on ambient noise studies conducted at AAFB (DON 2014a, p. 66), we expect that ambient noise in fruit bat habitats on Guam to range from 55 to above 65 dB. Ambient noise levels at clifflines is likely louder than ambient noise inside the forest (DON 2015a). We expect that noise from construction of the proposed action will rise, at times, above ambient conditions, and above the disturbance thresholds discussed above for the Mariana fruit bat.".

Mariana fruit bats in the vicinity of construction could be disturbed or harassed by noise and human presence. In order to avoid disturbance to Mariana fruit bats in the vicinity of construction, the DON will conduct surveys for Mariana fruit bat one week prior to onset of construction in areas within or in the vicinity of fruit bat habitat. If a fruit bat is present within

492 ft (150 m) of the project site, the work will be postponed until the bat has left the area (DON 2014a, p. 33). The DON clarified that this conservation measure does not mean that work will halt if a fruit bat enters the vicinity of a construction site while construction is on-going (C. Cobb, DON, 2015, pers. comm.). In general, Mariana fruit bats are likely to avoid construction sites due to human presence and noise disturbance, and seek other locations to roost and forage. If a fruit bat is present near a construction site and not seen (for example, roosting below a cliffline) then it may be harassed or harmed by the proposed action.

Noise from construction of the proposed action would be temporary and intermittent. Construction noise reaching fruit bat habitat may rise above the disturbance threshold for the Mariana fruit bat; however, this noise will be short-term in duration and will not lead to a permanent reduction in the capability of the habitat to serve as suitable habitat for the Mariana fruit bat.

Aircraft

As described above, and in the Environmental Baseline, most of the disturbance information for Mariana fruit bats is based on studies from aircraft overflights. The proposed action will result in an increase in military jet traffic and helicopter operations over occupied Mariana fruit bat habitat on AAFB. Based on the documented effects of noise on Mariana fruit bats and other wildlife (described above and in the "General Effects" section) and the best available information about the response of Mariana fruit bats to aircraft noise (USFWS 2006b, pp. 35-39 and references cited therein; Morton 1996; SWCA 2008; SWCA 2012; SWCA 2013), the adverse impacts of noise caused by the proposed action on the Mariana fruit bat on AAFB are expected to be substantial.

Noise effects were reviewed under the ISR Strike Biological Opinion (USFWS 2006b) and were determined to adversely affect the Mariana fruit bat to the extent that the remaining colony site would be abandoned. Ongoing and anticipated noise resulting from jet aircraft and helicopter use of the main runways at AAFB (actions analyzed in the ISR Strike Biological Opinion) was expected to result in the incidental take of the remaining bats at Pati Point, due to harassment from aircraft noise (USFWS 2006b, p. 49). In addition, harassed bats moving from Pati Point to less protected areas were expected to be lost to opportunistic hunting (USFWS 2006b, p. 37). The Pati Point colony has been abandoned, and only scattered bats remain on AAFB (DON 2014c, p. 2). These remaining bats are likely to be further harassed from the increase in aircraft overflights from the proposed action. Because noise from the ISR Strike Biological Opinion and this Biological Opinion will occur contemporaneously, it would not be possible to attribute the take to a single project.

Mariana fruit bats are suspected to migrate from Rota to Guam periodically following typhoons, and the migrants are suspected to return to Rota when the effects of the storm have subsided (Wiles and Glass 1990, p. 3; Esselstyn et al. 2006, p. 536). Migrants from Rota are thought to have occupied the Pati Point roost site on Guam in the past (Esselstyn et al. 2006, p. 535-536; Wiles and Glass 1990, p. 2-3). We suspect that if Rota migrants are greeted by unacceptable levels of noise disturbance from increased air traffic at AAFB, it may cause them to return to Rota prematurely. A premature return to Rota under post-typhoon conditions may expose bats to high levels of hunting and decreased food and habitat availability.

It is also possible that the increased noise near Pati Point, and on AAFB in general, will preclude the reestablishment of a fruit bat colony in northern Guam. If the fruit bat population on Guam were to increase, individuals and colonies are not likely to establish roost sites in areas with high levels of human foot, vehicular, or aircraft traffic, due to hunting-induced sensitivities to human-presence (i.e., humans are predators), and sensitivity to loud noise and vibration from aircraft (see data presented above and in Environmental Baseline).

Operation of the LFTRC
As described above, Mariana fruit bats are known to be highly susceptible to disturbance from human activities, including from firing ranges. Mariana fruit bats have been observed avoiding the CATM range while it is active, by flying out to sea or in the opposite direction (J. Quitugua, pers. comm. 2015). Operation of the LFTRC is expected to be louder than the CATM range, and therefore we anticipate that fruit bats will avoid the LFTRC while it is active.

Species that are commonly hunted often demonstrate behavioral (e.g., flushing, startle response) or physiological responses (e.g., increased heart rates, increased respiration rates) to gunshot sounds (Larkin et al. 1996). Knight et al. (1987; p. 175) found that American crows nesting in urban areas were less wary of people than American crows nesting in rural habitat and attributed the difference to the hunting of rural crows. Barron et al. (2012; p. 915) found that American crows avoided areas with live-fire exercises in a similar fashion and suggested that species hunted by humans will be more adversely affected by human activity, including military training (e.g., live-fire training) than species that are not hunted. As stated by Morton and Wiles (2002, p. 161), "Poaching is a particularly insidious activity because not only does it impact fruit bats through mortality, it reinforces behavioral avoidance of humans. Consequently, roosting or foraging fruit bats that might not otherwise be disturbed by some human activities … may become unduly sensitized to them because of illegal hunting." Based on observations Rota, fruit bat colonies on Rota have abandoned areas where they were hunted and have not returned to occupy those areas in recent history (CNMI 2010; J. Boland 2015, pers. comm.). In addition, anecdotal evidence from numerous individuals who have conducted fruit bat research on Guam and the CNMI for many years indicate that fruit bats do avoid areas that have been previously subjected to hunting and also areas that experience live-fire activities (G. Wiles, Washington Department of Fish and Wildlife, personal communication, 2014; T. Mildenstein, University of Montana, personal communication, 2014; D. Janeke, HDR, Inc., personal communication, 2014). Further, in one study on AAFB, 84 percent of fruit bat observations during station counts were in areas without hunting or limited access hunting (SWCA 2012, p. 6).

There have been only three fruit bat observations within the proposed site for the LFTRC on AAFB since 2005 (DON 2014b and references therein, p. 5-332). Recent surveys by SWCA did not detect any Mariana fruit bats in the vicinity of the LFTRC (SWCA 2012, p. 27). However, Mariana fruit bats have been observed at the GNWR below the cliffline of the LFTRC, and the cliffline below the LFTRC is likely used by bats commuting between roosting areas and foraging grounds. Most fruit bats will depart from roost sites to foraging areas from one hour before to one hour after sunset (J. Boland unpublished data, 2008-2011). Therefore the range will be operational when bats can be expected to be commuting to foraging areas. We expect that any Mariana fruit bats that are able to hear that LFTRC in operation will avoid the area and seek out

a less disturbed area. While bats are capable of flying outside the disturbance zone, bats seeking alternate commuting corridors and/or foraging areas may be forced into lower quality habitat or exposed to increased risks of poaching and harassment. In addition, bats in the vicinity of the LFTRC when firing begins will likely flush and flee the area. As mentioned above, if reproductive females are exposed to stressors that cause flushing and dispersal, it can disrupt reproductive cycles, cause miscarriage, and cause abandonment of non-volant young (Wingfield et al. 1998, p. 192-193, Heideman 2000, p. 169-199, Klose et al. 2006, p. 347). Under current conditions, we would not anticipate that fruit bats will be close enough to the firing line to suffer any hearing damage; however an increase in bat populations on Guam could result on the presence of more bats near the firing lines of the LFTRC.

In addition, the forested habitats surrounding the LFTRC are classified as habitat for the Mariana fruit bat. In order to serve as suitable habitat for the Mariana fruit bat, the area must be free of threats that would preclude bats from using the habitat for foraging, roosting, or breeding (for example, brown treesnakes and human disturbance). The noise pollution from operation of the LFTRC will likely lead to habitat degradation in habitat adjacent the LFTRC, and make the habitat unsuitable for Mariana fruit bats.

Given the sensitivity of Mariana fruit bats to noise and human disturbance both on Guam and Rota, and because of the reaction of Mariana fruit bats to hunting disturbance (i.e. gunshots), we anticipate that Mariana fruit bats will avoid the LFTRC and surrounding areas completely while it is in operation. For this reason, we have conservatively chosen a 65 dB threshold for noise disturbance of Mariana fruit bats that would preclude them from using habitat for breeding, foraging, or sheltering. The 65 dB threshold is based on the high-end of current ambient noise levels; we can reasonably expect that all habitat with noise louder than 65 dB would be avoided by fruit bats given the level and type of noise (i.e., gunshots). Therefore, we predict that approximately 309 acres of Mariana fruit bat habitat in the vicinity of the LFTRC will be unsuitable for Mariana fruit bats (Figure 17).

Other Human Disturbance

The proposed construction of the main cantonment at Finegayan will increase human presence and noise in the area. The cantonment is near the Haputo ERA, which contains high-quality fruit bat habitat, where fruit bats have been observed in the past. Increased use of the Haputo ERA by humans could deter fruit bats from utilizing these areas for foraging or roosting.

Training will also occur at the NMS in southern Guam, where fruit bats are routinely observed. Training will include company-level patrolling, jungle training, land navigation, and air-ground operations on five to seven consecutive days, 12 weeks per year, day and night, for a total annual throughput at the NMS of 1,440 Marines. Training at the NMS will also include terrain flight, ground threat reaction, defensive maneuvering, confined area landing, and external load training. These training activities will result in an increase in noise and other human disturbance at the NMS. Solitary bats flushed as a result of project noise may travel to another area where the likelihood of poaching or harassment is greater overall than it is on DoD lands. Flight restrictions will limit low-level flights over much of the NMS and this will minimize, but not completely avoid, adverse noise impacts to the bat in this area.

Habitat Conservation and Protection

The protection and management of 5,234 acres of kingfisher habitat on DON lands in northern Guam per the MOA will have a beneficial effect on the survival and recovery of the Mariana fruit bat in Guam because these two species use similar habitat.

As part of the proposed action, the DON also proposes to implement a forest enhancement project at Finegayan, in low-quality secondary forest, to benefit listed species, including the fruit bat. The DON has proposed the enhancement of the site to include installation of ungulate exclusion fences around the 1,000 acres; active removal of ungulates (i.e. trapping, snaring, shooting) with the goal of eradication within the fenced areas; invasive plant removal; and the propagation, planting, and establishment of dominant and rare species characteristic of native limestone forest habitats. Although this site would not fully compensate for the loss of primary limestone forest in northern Guam, the enhancement of forest and protection of the site is expected to provide some benefit to the fruit bat

Summary

The proposed action is likely to adversely affect the Mariana fruit bat on Guam. Noise from construction, aircraft, operation of the LFTRC, and other military training activities will harm and harass fruit bats in the vicinity of the actions. This disturbance, combined with existing threats to the fruit bats in the Action Area (as described in the Environmental Baseline), will make reestablishment of a Mariana fruit bat colony at Pati Point unlikely. Increased human disturbance at AAFB, Finegayan and Haputo and the NMS may alter fruit bat behavior, increase stress reactions, or preclude use of high-quality foraging areas. Based on the increased disturbance throughout AAFB, shere bats are most common, it is likely that individual bats may be harassed repeatedly by the proposed action. Because AAFB was the last refuge for Mariana fruit bats on Guam, the increased human disturbance in this area will substantially inhibit future efforts for recovery of the Mariana fruit bat.

Further, any bats migrating from Rota to Guam after a typhoon or hunting event, may encounter unsuitable habitat and return to Rota prematurely. A premature return to Rota under post-typhoon conditions may threaten their survival through exposure to high levels of hunting and decreased food and habitat availability. Since the timeframe of the action is indefinite, it is reasonable to assume that a migration event will occur during the timeframe of this action.

In addition, roughly four percent of the remaining Mariana fruit bat habitat on the island will be lost or degraded directly or indirectly as a result of the proposed action (see Table 6) and induced growth. The areas of fruit bat habitat that are permanently cleared are areas which, in the absence of the project, would have remained intact to provide for the future survival recovery of the species. Although this loss will not preclude the recovery or survival of the Mariana fruit bat, it will reduce the total number of bats the island can support. The proposed action will reduce the current estimate for the carrying capacity of fruit bats on Guam (see Environmental Baseline above) by approximately 983 bats.

However, the DON's protection and management of 5,234 acres of fruit bat habitat in northern Guam will off-set the loss of Mariana fruit bat habitat from project construction, and will help ensure that fruit bat habitat will be available for survival and recovery of the species on Guam. In addition, the DON's implementation of the forest enhancement project at Finegayan and the biosecurity conservation measures including landscape-level brown treesnake eradication/control, recommendations from the RBP, HACCP planning, and brown treesnake interdiction program, will be beneficial to the Mariana fruit bat because it will reduce the snake population on Guam and also help prevent spread of brown treesnakes to Rota and other Mariana islands.

Effects of the Action – *Serianthes nelsonii*

Records on the distribution and abundance of *Serianthes nelsonii* indicate that although never abundant, it was historically more abundant and more widely distributed than it is now. Surveys and samples from the early part of the 20th century had been taken from a number of trees both in northern and southern Guam, and subsequent records exist of trees both in the northern and southern parts of the island (USFWS 1994, p. 8). No individuals exist at the sites of Nelson's original collections, which today are the eastern portion of AAFB in northern Guam and Mt. Tenjo and Mt. Alutom in central/southern Guam. Since the 1970's, six mature trees have been recorded in the wild in Guam: three at Ritidian Point, one at Pati Point, and two others near the Tarzan River in the Government of Guam Cotal Conservation Area in south-central Guam (USFWS 1994, p. 8). All have since been cut down or have died with no surviving offspring except for the one remaining mature tree within the project's action area. Surveys in 1995 estimated 121 trees in 16 subpopulations on the island of Rota (Wiles et al. 1996, p. 232). However, current estimates indicate only about 40-50 of these trees have survived (J. Manglona CNMI DLNR, pers. comm. 2015). In addition, successful regeneration in the wild has not been documented since more widespread inventories began in approximately the 1970's (USFWS 1994, p. 8; J. Manglona, DLNR, pers. comm. 2015; AAFB 2015, pp. 4-5). Genetic studies are needed to determine population differences or similarities between the Guam and Rota trees. Current research and recovery efforts have kept *S. nelsonii* seeds from the two islands separate until future genetic work can determine how distinct the Guam tree is from the Rota trees.

Habitat Loss and Degradation Caused by the Proposed Action

This project will clear 945 acres of *S. nelsonii* recovery habitat and result in the loss of three acres from induced human population growth, out of approximately 11,668 acres available on Guam, leaving approximately 10,720 acres of recovery habitat. To construct the MPMG firing range, DON proposes to clear approximately 65 acres of limestone karst forest around the only adult *S. nelsonii* in Guam, leaving a minimum 100-ft buffer of forested area. An approximate 100 acres will be cleared for smaller ranges. The proposed action will clear limestone karst forest with historical locations of *S. nelsonii* near the adult tree.

Effects from Land Clearing and Training Activities

The proposed construction of the MPMG range will convert 65 acres of limestone karst habitat around the adult *S. nelsonii* tree to a cleared area with sparse vegetation, which may require

outside fill. To construct the LFTRC small ranges, DON will grade the limestone karst substrate, and move fill from an outside location for ground cover (DON 2014a, p. 18). Accidental additional clearing of habitat around the adult *S. nelsonii* and the introduction of potentially harmful species through personnel and equipment to *S. nelsonii* habitat will be minimized through best management practices outlined in Table 2-2 of the BA (DON 2014a). As part of the proposed action, ungulate eradication is also planned for this area (See Conservation Measures section). Ungulates can damage seedlings and surrounding habitat by uprooting, herbivory, or trampling; and they can damage adult trees by rubbing. If carried out in a timely fashion, eradication will prevent damage and mortality to the adult *S. nelsonii* and seedlings from ungulates.

The construction and maintenance of the LFTRC will convert the forest immediately surrounding the adult *S. nelsonii* tree from contiguous primary limestone karst forest habitat to fragmented edge habitat, which has implications for abiotic features such as microclimate and humidity, as well as biotic features such as species composition and frequency of interaction with animal species (Murcia 1995, pp. 59-60; Laurance 2000, p. 134). The specific changes and their extent into edge habitat are largely site specific (Murcia 1995). However, most empirical studies indicate that edge effects happen in up to 492 ft (150 m) of the created edge, and in a few cases, will extend further (Laurance et al. 1997, p. 1118; Laurance 2000, p. 135). This measurement is at least four times greater than the total width of the fragment of forest habitat containing the last *S. nelsonii* adult tree on Guam that will remain after the area is cleared for the LFTRC. Most studies indicate that the effects from created forest edges are largely negative, including increases in damaging wind penetration, decreased biomass, and increased susceptibility to fires and invasive species (Murcia 1995, pp. 59-60; Laurance et al. 1997, p. 1118; Nascimento and Laurance 2004, p. S136; Holway 2005, p. 565). Therefore, the proposed project will likely result in edge affects to the *S. nelsonii* tree, although the extent of the effects is unknown at this time.

Most of the area with modification and vegetation clearing for the MPMG range will be to the east of the adult *S. nelsonii*, increasing the tree's, and the remaining fragmented forest's, exposure to wind. The dominant wind direction in Guam is from the east or northeast (Guard et al. 1999, p. 2-6), and storms often approach from the east or southeast (Mendehlson et al. 2012, p. 206). Keeping the area east of the *S. nelsonii* buffer clear of vegetation will increase the tree's exposure to stronger winds such as those in tropical storms and typhoons, as well as persistent lower-speed winds, which can desiccate the tree and surrounding vegetation (Chen et al. 1995, p. 83; Gelhausen et al. 2000, p. 31; Laurance et al. 2002, p. 608). This effect will likely be exacerbated by decreased biomass characteristic of forest fragments and edges (Laurance 1997, p. 1118; Nascimento and Laurance 2004, p. S134). Because the structure of the tree has been weakened by previous storms, termite damage, epiphyte load, and defoliation due to insect damage (DON 2014a, p. 58; AAFB 2015, p. 4), increasing wind load to this tree could result in mortal structural damage. In addition, the adult *S. nelsonii* is taller than most surrounding canopy that would remain in the fragment. Larger trees and areas near unimpeded spaces, such as the firing range, are more susceptible to storm damage (Brokaw and Walker 1991), meaning the adult tree will be particularly susceptible to damage from future storms. To minimize adverse effects to the adult Guam *S. nelsonii*, the DON proposed bracing the tree. However, because of the tree's current structural condition, it is possible that this could do more damage

than help, and the Service has advised against this measure. Typhoon data for Guam collected since 1959 indicates that on average four typhoon events (sustained winds greater than or equal to 74 mi per hour (119 km per hour)) could occur each decade (DON JTWC pers. comm. 2010). Therefore, typhoons are likely to occur during the life of this project. Given that a cleared area would be maintained directly east of the *S. nelsonii* adult, there is an increased likelihood that high wind during a typhoon would break tree limbs or the trunk, causing mortal damage to the tree.

In addition to mechanical wind effects, conditions in the fragment containing the adult *S. nelsonii* will likely exhibit a decrease in humidity, increased evapotranspiration, and an increase in solar radiation to the understory (Laurance 2000, p. 134; Gelhausen, et al. 2000, p. 31). It is difficult to predict how this would affect adult and seedling survival and species composition within the *S. nelsonii* fragment in the action area. However, natural conditions in limestone karst forests are shaded, and Guam, as a whole, is normally very humid (greater than 70 percent humidity) (Guard et al. 1999, pp. 2-5). Seed crop, seedling germination, and growth increase during the rainy season (AAFB 2015, p. 9; Wiles et al. 1996, p. 233), implying moisture is important for seedling germination and growth. Preliminary results from light experiments on *S. nelsonii* seedlings showed higher growth in shade conditions greater than 50 percent (AAFB 2015, p. 4). This research also showed very high seedling turnover at the site of the mother tree (AAFB 2015, p. 4), but research is ongoing to pinpoint the causes. If methods for improving seedling survival are developed, conditions within the forest fragment may not be ideal for implementing them when the humidity, radiation, and wind conditions are less favorable as a result of the fragmentation. The health of the adult tree itself may also be compromised by drier conditions within the fragment.

Although measures to prevent invasion are proposed in best management practices, the increased invisibility of edges, especially those created through human modification, is well documented in other systems (Holway, 2005, pp. 561-565; Cadenasso and Pickett, 2001, p. 95; Didham et al. 2007, p. 490). Further, the edges and gaps that currently exist in the proposed action area are comprised of mostly invasive plants such as *Miscanthus* grasses, *Bidens alba*, and other weeds (A. Gawel, USFWS, pers. obs. 2011 – 2015). Plant invasions in the fragment will likely inhibit seedling growth, and invasive vines or epiphytes could increase structural damage or smother the *S. nelsonii* adult tree and seedlings. Invasive insects and other animals are also likely to increase in disturbed edge habitat (Holway, 2005, pp. 563; Laurance, et al. 2002, p. 608). Insect pests are one of the major threats to *S. nelsonii* (USFWS 1994, p. 15-19), and increased insect disturbance is expected on the adult and seedlings when edge habitat is created from this project.

In addition to increased vulnerability to invasive species, fragmented habitat may lead to a decrease in native species composition, including use by beneficial animals such as pollinators and seed dispersers. When habitat is fragmented, wide-ranging species, such as fruit bats, known to be important pollinators and seed dispersers (Banack 1998, pp. 1959-1960; Shilton et al. 1999, p. 222; Hodgkison et al. 2003, p. 498), are likely to decline (Woodroffe and Ginsberg 1998, p. 2127). The pollinators and seed dispersers of *S. nelsonii* are unknown, although records exist of Mariana fruit bats visiting *S. nelsonii* flowers in Rota (USFWS 1994, p. 13). Aside from fragmentation, the operation of the LFTRC may discourage fruit bats from using the area, even as a corridor between feeding and roosting sites (see analysis above). Even when the LFTRC is

not in operation, fragmented and disturbed habitat is less likely to be used by other native species such as Mariana crows (NRC 1997, p. 6) and possibly native seed-dispersers.

Fire management guidelines for the LFTRC and the hand grenade complex are described in the BA (DON 2014a, pp. 21-22). Implementation of these fire prevention measures will decrease the risk of wildlife fire and destruction near the adult *S. nelsonii*. Regardless, while savannah and other non-forest cover types of habitat are at greatest risk for fire in Guam (Guam Department of Agriculture 2010, p.22), forest edge areas experience considerable damage, even if fires do not penetrate far into forests (Guam Department of Agriculture 2010, p.33). Therefore, fire presents a risk to both the area with the adult tree and *S. nelsonii* habitat within and near this project area, especially the edges. Over 6.7 million rounds of ammunition are anticipated to be fired in the LFTRC annually, over 1.4 million of which are anticipated in the MPMG (DON 2014b, p. 2-9). With persistent gunfire, tracers, and rotating personnel smoking cigarettes, there will be constant risk of igniting a fire. Each incident that burns forest edges will create more opportunities for future fires to penetrate deeper into forest areas, and may decrease the buffer area within the fragment containing the adult *S. nelsonii* tree.

Effects to Research and Recovery

The proposed project will limit access to the adult *S. nelsonii* tree and seedlings for research, monitoring, and recovery. Currently, although the tree is located on a military installation, researchers with base approval have regular access to the adult tree. While DON proposes to allow access during the operation of this project, the additional process of coordinating access to an area that will have increased safety and security concerns, and that is proposed to be active for an estimated 39 weeks out of the year, will limit regular access. The LFTRC will likely have an unpredictable schedule that will adapt to the training needs of multiple DoD entities. This will have implications for regular monitoring of and potential response to threats to the adult tree and seedlings. It is also will likely limit the kinds of research that can be done on the tree and seedlings.

In addition, the proposed MPMG will require establishing a SDZ over the GNWR fee simple land, which will limit access to this area for research and recovery. The GNWR is currently an outplanting site for *S. nelsonii* because of its status as a conservation area, the availability of suitable habitat, and the Refuge's leadership in *S. nelsonii* recovery through a national grant that implements recovery actions for this species. Outplanting and maintenance of *S. nelsonii* seedlings has begun and is planned to continue in a number of suitable areas within the Refuge that fall within the SDZ (J. Cruce, USFWS, pers. comm. 2015). Limestone karst habitat suitable for *S. nelsonii* on the Refuge is mostly located within the SDZ. Areas of the Refuge fee simple that would fall outside of the SDZ are mostly comprised of strand, coconut plantation, or other habitats that would not be suitable for *S. nelsonii* outplanting. Operation of the MPMG may limit access to these outplanting sites. Seedling survival has been extremely limited in previous outplanting efforts, and the causes are still being investigated, but is likely due, in large part, to damage from insect herbivory and boring for egg-laying (J. McConnell, GPEPP, pers. comm. 2014; AAFB 2015, p.10). A large amount of time and labor are required to ensure seedling establishment, control for insect pests, and monitoring and response to any health changes (E. Demeulenaere, GPEPP, pers. comm. 2015). When the operation of the MPMG begins in 2021,

most of the seedlings outplanted on the Refuge will be between seven and five years old. As evidenced by the Tarague outplantings from 1999 (AAFB 2015, p. 6), the lack of regular maintenance, even when trees are over five years old, may result in mortality. Although DON proposes to coordinate access to the adult tree, the Refuge fee simple area will be closed during operation of LFTRC ranges, estimated at 39 weeks of the year (DON 2014b, p. 3-58). Unless regular access is coordinated for management actions, this will negatively affect the outplanted individuals on the Refuge, thereby adversely affecting the largest recovery action for this species in Guam thus far.

Summary

The proposed action will adversely affect the last remaining adult *S. nelsonii* tree in Guam and result in the loss of 948 acres of recovery habitat for this species. It also will negatively impact recovery efforts by limiting access to the adult tree, the wild seedlings around it, and outplanted *S. nelsonii* saplings at the Refuge. The fragmentation of habitat will cause ecological degradation that extends beyond the proposed vegetation clearing due to edge effects. As detailed above, the proposed action will likely damage the adult tree and seedlings by creating abiotic conditions less favorable to growth and survival, increasing fire risk, increasing invasability, increasing wind load, and decreasing the likelihood of pollination and seed dispersal. Of the impacts detailed above, increased wind load is likely the most significant, persistent, and unmitigated adverse effect. In the event of a severe wind storm, with the clearance of forest vegetation to the east of the adult tree that would otherwise act as a buffer to strong winds, structural damage or injury to the adult tree is highly likely, resulting in mortality. The adult tree and its descendants comprise the entire Guam genetic representation of *S. nelsonii*. Studies have not been done on its distinction, if any, from the Rota *S. nelsonii* trees, but the loss of this tree and its seedlings may significantly impact the genetic diversity of the species. These impacts will be offset, in part, by the conservation measures (see Conservation Measures section above).

The conservation measures, as well as continuing recent recovery efforts, will help to ensure the survival of the Guam population of *S. nelsonii*. The DON has proposed to outplant and maintain into adulthood 30 individuals parented from the Guam adult tree in a protected area. Therefore, adverse effects from the loss of genetic diversity, such as inbreeding depression, would be minimized. Because of new methods being employed and their success so far on outplanted seedling survival, these 30 individuals will have a high likelihood of survival if properly maintained, and if the area that they are outplanted to is truly protected from threats. DON has also proposed to fund seed storage and viability research, which will help preserve the genetic stock of the Guam population. Multiple ongoing interagency efforts, such as the maintenance of outplanted individuals at the GNWR, innovations in seedling and adult protection, and recent outplanting efforts in Rota will help ensure the continued survival of this species. The implementation of these conservation measures and best management practices, combined with the existence of adult trees in Rota, the existence of over 200 individuals in nurseries, and improved seedling survival strategies on both islands, make it unlikely that this project will preclude the recovery and survival of *S. nelsonii*. This determination is contingent on the full implementation of the conservation measures described above. If these conservation measures are not fully implemented, if new information suggests that the Guam population is distinct from

S. nelsonii in Rota, or if the baseline for this species experiences an unforeseen major decline, this determination will need to be reconsidered.

Effects of the Action – Guam Micronesian Kingfisher Critical Habitat

The Guam Micronesian kingfisher critical habitat on Guam was designated to support the recovery of the kingfisher by including unoccupied habitat that kingfishers can be translocated or released into when threats are managed (USFWS 2004). Critical habitat for the kingfisher was identified using guidelines from the Guam forest bird recovery plan (USFWS 1990a). Because the kingfisher does not exist in the wild and all suitable habitat presently is unoccupied, inclusion of unoccupied areas containing the primary constituent elements is essential to the conservation of this species. Survival and recovery of the kingfisher will require reintroduction of the kingfisher through release of captive birds and subsequent natural dispersal into areas of Guam that formerly were inhabited. Actions that affect the ability of the critical habitat unit to provide the conservation function for which it was designated may adversely affect critical habitat, regardless of whether the habitat features are actually physically altered.

The proposed project will not clear any designated critical habitat for the Guam Micronesian kingfisher.

The proposed LFTRC will be constructed immediately adjacent to, and above the cliff from, the Guam critical habitat unit at the Guam National Wildlife Refuge (Figures 11 and 12). The critical habitat unit is approximately 400 ft (122 m) below the nearest edge of the MPMG firing range. As discussed in the Effects of the Action – Guam Micronesian kingfisher, above, the noise from the firing range will rise substantially above ambient levels, and may preclude adjacent habitats from use by kingfishers in the future due to noise disturbance.

Noise from Construction of LFTRC

Construction of the MPMG range will take place over approximately three years beginning in 2021. Construction equipment will include standard heavy equipment including bulldozers, graders, haulers, large trucks. No blasting or use of dynamite will occur as part of the proposed project. The use of heavy equipment can reach noise levels of 96 dB (USFWS 2006a, p. 15). Noise levels within critical habitat, at the base of the cliff below the MPMG firing range, are anticipated to be 5-15 dB less than that above the cliff line (personal communication, M. Downing, Blue Ridge Research and Consulting, February 2014 in DON 2014b, p. 5-230). Therefore, we anticipate that noise from construction of the LFTRC would range between 81-91 dB within the critical habitat unit (without accounting for noise attenuation due to vegetation, humidity or other factors). Ambient noise within the critical habitat unit will depend on wind and surf conditions, and distance from the ocean. Based on ambient noise studies conducted above the cliff line at AAFB (DON 2014a, p. 66), we expect that ambient noise within the critical habitat unit is at least 60 to 65 dB. Therefore, noise from the construction of the MPMG firing range on AAFB may reach between 16 to 26 dB above ambient conditions in the critical habitat unit.

Noise from construction will not be heard within the entire critical habitat unit. While it is difficult to estimate what portions of the critical habitat unit will be affected, we assume that the noise above ambient levels would be heard in the portions of critical habitat immediately below the MPMG cliff line. In a conservative scenario, construction noise may be heard in a 100 ac (41 ha) portion of the 376 ac (152 ha) critical habitat unit (or 27 percent of the critical habitat unit).

Noise from construction of the MPMG would be temporary and intermittent. Noise reaching the critical habitat unit would likely only come from construction activities at the far north end of the MPMG range, which might occur for a few months to a year of the total construction time.

Construction noise within the critical habitat unit (81-91 dB) may rise above the disturbance threshold for the Guam Micronesian kingfishers of 80 dB (described in the Effects of the Action – Guam Micronesian kingfisher section). However, this noise will be short-term in duration and will not lead to a permanent reduction in the capability of the critical habitat unit to support recovery and survival of the kingfisher within the critical habitat unit.

Noise from Operation of LFTRC

The only noise from operation of the LFTRC that is likely to be heard within the Guam Micronesian kingfisher critical habitat unit is that from weapons firing at the MPMG range. Noise from the MPMG range will be long-term, intermittent, and high intensity noise occurring over multiple years for an indefinite period of time.

Based on the noise data shown in Figure 13, approximately two acres of Guam Micronesian kingfisher critical habitat, along a cliffline, will be exposed to noise levels above 80 dB. Therefore, we anticipate that noise from the MPMG range will only reach a small portion of the critical habitat unit. However, if environmental conditions are right (i.e. low surf and high winds blowing west) it is possible that firing at the range will be heard over a broader area; however we expect the sound would be very soft and barely above ambient levels. Therefore, operation of the MPMG range will not lead to a permanent reduction in the capability of the critical habitat unit to support recovery and survival of the kingfisher.

Effects of the Action – Mariana Crow Critical Habitat

Mariana crow critical habitat on Guam was designated to support the recovery of the Mariana crow by including unoccupied habitat that Mariana crows can be translocated or released into when threats are managed (USFWS 2004). Recovery of the Mariana crow requires restoration of a Mariana crow population on Guam (USFWS 2004; USFWS 2005a). Because the Mariana crow does not exist in the wild and all suitable habitat presently is unoccupied, inclusion of unoccupied areas containing the primary constituent elements is essential to the conservation of this species. Survival and recovery of the crow will require reintroduction of the crow through release of captive birds and subsequent natural dispersal into areas of Guam that formerly were inhabited. Actions that affect the ability of the critical habitat unit to provide the conservation function for which it was designated may adversely affect critical habitat, regardless of whether the habitat features are actually physically altered.

The proposed project will not clear any designated critical habitat for the Mariana crow.

The proposed LFTRC will be constructed immediately adjacent to, and above the cliff from, the Guam critical habitat unit at the Guam National Wildlife Refuge (Figures 11 and 12). The critical habitat unit is approximately 400 ft (122 m) below the nearest edge of the MPMG firing range. As discussed in the Effects of the Action – Mariana Crow, the noise from the firing range will rise substantially above ambient levels, and may preclude adjacent habitats from use by Mariana crows in the future due to noise disturbance.

Noise from Construction of LFRTC

Construction of the MPMG range will take place over approximately three years beginning in 2021. Construction equipment will include standard heavy equipment including bulldozers, graders, haulers, large trucks. No blasting or use of dynamite will occur as part of the proposed project. The use of heavy equipment can reach noise levels of 96 dB (USFWS 2006a, p. 15). Noise levels within critical habitat, at the base of the cliff below the MPMG firing range, are anticipated to be 5-15 dB less than that above the cliff line (personal communication, M. Downing, Blue Ridge Research and Consulting, February 2014 in DON 2014b, p. 5-230). Therefore, we anticipate that noise from construction of the LFTRC would range between 81-91 dB within the critical habitat unit (without accounting for noise attenuation due to vegetation, humidity or other factors). Ambient noise within the critical habitat unit will depend on wind and surf conditions, and distance from the ocean. Based on ambient noise studies conducted above the cliff line at AAFB (DON 2014a, p. 66), we expect that ambient noise within the critical habitat unit is at least 60 to 65 dB. Therefore, noise from the construction of the MPMG firing range on AAFB may reach between 16 to 26 dB above ambient conditions in the critical habitat unit.

Noise from construction will not be heard within the entire critical habitat unit. While it is difficult to estimate what portions of the critical habitat unit will be affected, we assume that the noise above ambient levels would be heard in the portions of critical habitat immediately below the MPMG cliff line. In a conservative scenario, construction noise may be heard in a 100 ac (41 ha) portion of the 376 ac (152 ha) critical habitat unit (or 27 percent of the critical habitat unit).

Noise from construction of the MPMG would be temporary and intermittent. Noise reaching the critical habitat unit would likely only come from construction activities at the far north end of the MPMG range, which might occur for a few months to a year of the total construction time.

Construction noise within the critical habitat unit (81-91 dB) may rise above the disturbance threshold for Mariana crows of 80 dB (described in the Effects of the Action – Mariana Crow section). However, this noise will be short-term in duration and will not lead to a permanent reduction in the capability of the critical habitat unit to support recovery of the Mariana crow.

Noise from Operation of LFTRC

The only noise from operation of the LFTRC that is likely to be heard within the Mariana crow critical habitat unit is that from weapons firing at the MPMG range. Noise from the MPMG

range will be long-term, intermittent, and high intensity noise occurring over multiple years on end.

Based on the noise data shown in Figure 14, approximately two acres of Mariana crow critical habitat, along a cliffline, will be exposed to noise levels above 80 dB. Therefore, we anticipate that noise from the MPMG range will only reach a small portion of the critical habitat unit. However, if environmental conditions are right (i.e. low surf and high winds blowing west) it is possible that firing at the range will be heard over a broader area; however we expect the sound would be very soft and barely above ambient levels. Therefore, operation of the MPMG range will not lead to a permanent reduction in the capability of the critical habitat unit to support recovery of the Mariana crow.

Effects of the Action – Mariana Fruit Bat Critical Habitat

The proposed action may affect Mariana fruit bat critical habitat and its primary constituent elements (USFWS 2004). Although the current population of Mariana fruit bats on Guam is small, the foraging behavior and diverse diet of the fruit bats cause them to use most of the island for foraging, as documented by Wiles et al. (1995). Thus, all of the designated critical habitat for this species is used for foraging and/or roosting and is considered occupied. Recent sightings of Mariana fruit bats at the GNWR within the critical habitat unit confirm this. Actions that affect the ability of the critical habitat unit to provide the conservation function for which it was designated (serving as habitat for roosting and foraging bats) may adversely affect critical habitat, regardless of whether the habitat features are actually physically altered.

The proposed project will not clear any designated critical habitat for the Mariana fruit bat. However, the proposed action will create disturbance that may affect the PCE (described above) requiring remote locations on clifflines with limited exposure to human disturbance. As described below, this primary constituent element will be adversely affected by the proposed action.

Construction

Construction of the MPMG range will take place over approximately three years beginning in 2021. Construction equipment will include standard heavy equipment including bulldozers, graders, haulers, large trucks. No blasting or use of dynamite will occur as part of the proposed project. The use of heavy equipment can reach noise levels of 96 dB (USFWS 2006a, p. 15). Noise levels within critical habitat, at the base of the cliff below the MPMG firing range, are anticipated to be 5 to 15 dB less than that above the cliff line (personal communication, M. Downing, Blue Ridge Research and Consulting, February 2014 in DON 2014b, p. 5-230). Therefore, we anticipate that noise from construction of the LFTRC would range between 81-91 dB within the critical habitat unit (without accounting for noise attenuation due to vegetation, humidity or other factors). Ambient noise within the critical habitat unit will depend on wind and surf conditions, and distance from the ocean. Based on ambient noise studies conducted above the cliff line at AAFB (DON 2014a, p. 66), we expect that ambient noise within the critical habitat unit is at least 60 to 65 dB. Therefore, noise from the construction of the MPMG

firing range on AAFB may reach between 16 to 26 dB above ambient conditions in the critical habitat unit.

Noise from construction will not be heard within the entire critical habitat unit. While it is difficult to estimate what portions of the critical habitat unit will be affected, we assume that the noise above ambient levels would be heard in the portions of critical habitat immediately below the MPMG cliff line. In a conservative scenario, construction noise may be heard in a 100 ac (41 ha) portion of the 376 ac (152 ha) critical habitat unit (or 27 percent of the critical habitat unit). Noise from construction of the MPMG would be temporary and intermittent. Noise reaching the critical habitat unit would likely only come from construction activities at the MPMG range, which might occur for a few years of the total construction time.

Construction noise within the critical habitat (81-91 dB) will rise above the disturbance threshold for Mariana fruit bats (described in the Effects of the Action – Mariana Fruit Bat section). This noise will be short-term in duration and will not lead to a permanent reduction in the capability of the critical habitat unit to support recovery of the Mariana fruit bat. However, during construction, the critical habitat unit will not serve as a remote location with limited exposure to human disturbance and this will limit the fruit bat's use of the clifflines for roosting or reproductive activity. Construction noise at this time, and for a period of time after while fruit bats still avoid the area, may have an adverse effect on the critical habitat unit serving as a remote location.

Operation of the LFTRC and aircraft overflights

Noise disturbance from the LFTRC and aircraft overflights could expose the critical habitat unit to increased human disturbance and preclude Mariana fruit bat roosting and reproductive activity. Based on the noise data shown in Figure 17, approximately two acres of fruit bat critical habitat, along a cliffline, will be exposed to noise levels above 65 dB. This includes approximately 150 linear meters (492 linear ft) of cliffline. There are approximately 2,500 m (6,652 feet) of cliffline within the critical habitat unit. Therefore, the amount of cliffline critical habitat precluded from use by the Mariana fruit bat is small.

In addition, based on the map of noise contours for aircraft at AAFB from the 2010 DON EIS (DON 2010b, Vol. 2, p. 6-25), we do not expect aircraft noise over the critical habitat unit to rise above ambient conditions.

H. CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, tribal, local or private actions that are reasonably certain to occur in the action area considered in this Biological Opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA.

The extent to which future development is addressed as a cumulative effect in the following analysis excludes any such future development that is expected to be interdependent with or

interrelated to construction of federally-funded roads or is likely to be caused by other Federal actions that will be addressed in future section 7 consultations.

Overview of Cumulative Effects

Future state, local, or private actions that are reasonably certain to occur in the action area are listed below.

1) Development
    a. Civilian
        i. Commercial
        ii. Residential
        iii. Agriculture
    b. Territorial or local government
        i. Infrastructure projects
        ii. Other development
    c. Tourism
        i. Hotels and resorts
        ii. Roads and other infrastructure to support tourism
2) Wildfire
3) Invasive Species / Biosecurity
4) Natural Resource Management Projects

These actions may result in loss, fragmentation, or degradation of habitat for the listed species addressed in this Biological Opinion, or provide beneficial effects to listed species.

<u>Development</u>

The DON provided a list of known future projects lacking a Federal nexus on Guam in their Biological Assessment (DON 2014a, p. 85), and provided information on whether the future projects may affect terrestrial biological resources. No specific information was provided on whether the projects may potentially be located within habitats for the listed species addressed in this Biological Opinion. The DON presented fifteen reasonably foreseeable projects that may result in adverse cumulative effects to terrestrial biological resources on Guam. However, this list does not include projects deemed "present" and the Service assumes that some of these projects may be delayed into the future and thus contribute towards cumulative effects.

Guam's land use planning maps (Government of Guam 2009, p. 2-14) indicate housing and industrial development will be targeted to minimize effects to listed species habitat areas. However, development is likely to result in increased noise and predator densities in the vicinity of sites occupied by listed species. Population increases will result in increased human noise disturbance in urban areas as well as in outdoor recreation areas.

Civilian development

Because the information in the Biological Assessment did not provide data on how much listed species habitat may be lost from cumulative effects, we calculated an estimate based on population growth, density, and development zoning.

From 1950 to 2000, Guam's population grew at an average rate of 21 percent per decade (about 2.1 percent annually). However, population growth has slowed and is expected to stabilize over the next 20 years at around 1.5 percent per year (DON 2014b, p. 4-113). The population of Guam in 2010 was 159,358 (U.S. Census data in DON 2014b, p. 4-113). Using 2010 data, population density within developed areas on Guam (assuming all people live in the developed areas) was calculated to be 4.5 people per acre.

If we apply the projected annual growth of 1.5 percent to the next 20 years, the population of Guam, in the absence of the proposed project, would be 231,220 in 2035 (an increase of 71,862 people since 2010). Most future development will occur in north and central Guam (V. Torres, Government of Guam, pers. comm., 2010). Based on our analysis, if population density remains unchanged, the additional people will spread development into all the developable land in northern Guam zoned for non-tourist civilian development. Therefore, we estimate that 423 acres of remaining Guam Micronesian kingfisher habitat and 286 acres of remaining Mariana crow habitat would be developed in the absence of the proposed action by 2035.

Territorial or local government development
Many territorial or local government development projects may be funded by Federal monies, and therefore would not be included in this cumulative effects analysis. Based on the list of projects the DON provided that may affect terrestrial biological resources, such as a 60 MW power plant, a territorial prison, Guam airport expansion, and road projects, we expect that the majority of territorial and local government projects will be Federally funded and subject to a section 7 consultation.

Tourism development
Significant areas of listed species habitat are zoned for development as tourist/resort (Government of Guam 2009, p. 2-14). The Guam Tourism 2020 Plan calls for an increase in five-star luxury hotels and upgrades to existing private resorts (GVB 2014, p. 30). The Plan calls for growth of 1,500 hotel rooms by 2020, or six additional hotels (GVB 2014, p. 38). In 2012, Guam received 1,308,035 visitor arrivals and projects that by 2020 visitor arrivals could reach two million people, an increase of over 30 percent (GVB 2014, p. 34). The Plan also calls for tourism development to follow the World Tourism Organization's sustainable tourism principles that call for tourism to be developed in conjunction with maintaining essential ecological process and biological diversity (GVB 2014, p. 34).

It is our understanding that development of many of the tourist/resort areas will entail creation of federally-funded roadways and infrastructure; therefore these projects will be addressed in separate section 7 consultations. Other tourist/resort development may occur without Federal funding, but we are unable to project at this time how much listed species habitat will be lost due to these future developments.

Wildfire

The conversion of forest to savanna in southern Guam has been on-going for decades. Although there is ongoing debate regarding the formation of savannah areas in Guam (Hunter-Andersen 2009; Athens and Ward 2004), savannah areas have encroached into previously forested areas as a result of human-caused wildfires. Of the approximately 750 wildfires that burn on Guam each year, 80 percent are caused by arson (Guam Department of Agriculture 2010, p. 117). From 1979 to 2006 the number of acres burned by wildfire averaged 1.7 ha (4.2 ac) per year (Burdick et al. 2008, p. 471). We anticipate the area burned by wildfires will continue to decline as a result of efforts by the U.S. Forest Service, Federal Emergency Management Agency, and the DOI Office of Insular Affairs. The U.S. Forest Service, for instance, anticipates providing funds to develop a robust fire suppression force led by a skilled fire management officer on Guam (Mahoney 2010, pers. comm.).

To estimate the rate of historical forest conversion to savannah, Greenlee (2010) compared aerial photographs from 1975 and 2005 and estimated that 1,119 ac (453 ha) of forest has been converted to savannah in southern Guam since 1975. This estimate indicates the average rate of forest loss in southern Guam is approximately 37 ac/year (15 ha/year) (740 ha/20 years). However, the trend in annual area burned has been declining and we anticipate it will continue to decline as a result of ongoing and future Federal support of the development of local fire suppression resources. Therefore, we reduced the anticipated acreage burned over the next 20 years by 30 percent to 518 ha/20 years.

Invasive Species / Biosecurity

Guam is a central pass-through point for the transport of goods and people from Asia and North America, and represents the local consolidation hub for the rest of Micronesia (e.g. approximately 1.1 million people enter Guam per year and Guam is the primary shipment hub for cargo). As such, Guam is often the first island of introduction of non-native species entering Micronesia and represents the geographic first line of defense for invasive species prevention in many of the US-affiliated islands in the western Pacific as well as for preventing potential introduction pathways westward from Asia to Hawaii and North America. Over 1,000 species of introduced animals and plants are likely established on Guam, with dozens severely affecting the island's natural systems (Aubrey Moore pers. comm. in BTS TWG 2015). The most damaging alien invader to establish on Guam thus far is the brown treesnake, and the primary focus of biosecurity efforts on Guam has been preventing the spread of the brown treesnakes to other locations; however, other invasive species on Guam, such as the coconut rhinoceros beetle and little fire ant, also warrant attention. The Regional Biosecurity Plan (RBP), the Regional Invasive Species Council (RISC), and the Guam Invasive Species Advisory Committee (GISAC) have all been developed to reduce the risk of the introduction, establishment, and spread of invasive species to Guam. These comprehensive and collaborative efforts will reduce the risk of adverse cumulative effects from invasive species to the listed species covered in this Biological Opinion. The Department of Interior – Office of Insular Affairs (OIA) also funds brown treesnake suppression efforts for natural resource benefits, research on brown treesnake control, the implementation of brown treesnake barriers, and overall brown treesnake coordination efforts.

Natural Resource Management Projects

Most natural resource management projects that would benefit the listed species covered in this Biological Opinion will be federally funded. However, small scale projects may occur funded by the territorial or local governments. These projects may benefit listed species; however, their scale is likely to be insignificant compared to the loss of habitat from the proposed action or cumulative effects.

Species-Specific Cumulative Effects

Guam Micronesian kingfisher and Mariana crow
In northern Guam, habitat for the kingfisher and crow may be lost as a result of cumulative effects from civilian development. We estimate that 423 acres of remaining kingfisher habitat and 286 acres of remaining crow habitat would be developed in the absence of the proposed action by 2035. For the kingfisher this represents 3.6 percent of the potential remaining habitat in northern Guam. For the crow, this habitat loss represents 2.6 percent of the potential remaining habitat in northern Guam.

In southern Guam, habitat for the kingfisher and crow may be lost as a result of cumulative effects from wildfire. However, since the trend in annual area burned has been declining, and since we anticipate it will continue to decline as a result of ongoing and future Federal support of the development of local fire suppression resources, the amount of habitat lost to wildfire should decline.

Guam Rail
Habitat for the Guam rail may be lost from development or wildfire. Because the Guam rail utilizes edge habitat and shrubby areas, the effects of future development and human-caused wildfire (which increase the amount of edge habitat and shrubby areas) to the Guam rail on Guam are expected to be insignificant.

Mariana fruit bat and Serianthes nelsonii
In northern Guam, habitat for the Mariana fruit bat and *Serianthes nelsonii* may be lost as a result of cumulative effects from civilian development. Because the two species are not as habitat limited as the kingfisher and crow, we did not calculate the amount of remaining habitat for these species that would be lost as a result of cumulative effects; however we expect it to be in the range of what we estimated for the crow and kingfisher. We do not expect that the fruit bat or *Serianthes nelsonii* will become habitat limited as a result of cumulative effects.

In southern Guam, habitat for the fruit bat and *Serianthes nelsonii* may be lost as a result of cumulative effects from wildfire. However, since the trend in annual area burned has been declining, and since we anticipate it will continue to decline as a result of ongoing and future Federal support of the development of local fire suppression resources, the amount of listed species habitat lost to wildfire should decline.

I. CONCLUSION

After reviewing the current status of the listed species addressed in this Biological Opinion, the environmental baseline, the effects of the proposed action and the cumulative effects, it is the Service's biological opinion that the action, as proposed is not likely to jeopardize the continued existence of the Guam Micronesian kingfisher, Mariana crow, Guam rail, Mariana fruit bat and *Serianthes nelsonii*; and is not likely to adversely modify Guam Micronesian kingfisher critical habitat, Mariana crow critical habitat, and Mariana fruit bat critical habitat. The Service reached these conclusions based on the following findings, the basis for which is presented in the preceding sections of this document.

Guam Micronesian Kingfisher

The endangered Guam Micronesian kingfisher is endemic to Guam. The kingfisher is currently extirpated in the wild due to predation by the introduced brown treesnake, but a captive population is being maintained on the mainland for the purpose of reintroduction onto Guam. The reintroduction is dependent, in part, on protecting and managing 11,512 acres of kingfisher habitat to support a persistent population of 500 breeding pairs of the kingfisher in northern Guam where the proposed action is primarily located. A breeding population of 500 kingfisher pairs is also needed in southern Guam.

Currently, there are 14,997 acres of kingfisher habitat in northern Guam and 13,314 acres of kingfisher habitat in southern Guam that could potentially support 714 and 634 breeding pairs of the kingfisher, respectively. However, significant portions of this habitat are currently degraded and will require intensive management and restoration (e.g., ungulate and invasive plant control or eradication) before the habitat regains the capacity to effectively support kingfisher reproduction.

The proposed action will permanently destroy, fragment, or degrade approximately 1,334 acres of kingfisher habitat, including some of the best remaining primary forest in northern Guam. An additional 423 acres of kingfisher habitat in northern Guam is likely to be permanently destroyed by future, non-Federal actions reasonably certain to occur within the action area. The (1,334 ac + 423 ac) 1,760 ac of kingfisher habitat would have supported 83 pairs of breeding kingfishers or approximately 17 percent of the 500 breeding pairs needed for the recovery of this species in northern Guam. Therefore, the proposed action significantly reduces the potential for the remaining habitat in the north to support a subpopulation of kingfishers. Both subpopulations in northern and southern Guam are needed to ensure the survival and recovery of kingfishers.

Overall, the effect of the proposed action, when added to the environmental baseline for northern Guam, will significantly degrade and reduce the amount of kingfisher habitat in northern Guam. However, the protection and management of 5,234 ac of the kingfisher habitat in northern Guam pursuant to the MOA and implementation of conservation measures as detailed above will help ensure that sufficient amount of kingfisher habitat will be available for the survival and recovery of the kingfisher once the species is reintroduced to Guam. Therefore, the proposed action is not likely to appreciably reduce the likelihood of the survival and recovery of the Guam Micronesian kingfisher.

Mariana Crow

The Mariana crow is currently extirpated from the wild on Guam, and only is surviving outside the action area on the island of Rota. Therefore, direct impacts to individuals will not occur as a result of the proposed action. However, we have determined that the proposed project will adversely affect the Mariana crow by removing areas of Mariana crow habitat which, in the absence of the project, would have remained intact to provide for the feeding, breeding, and sheltering of this species once it is reintroduced to Guam. In southern Guam only six acres of Mariana crow habitat will be cleared by the proposed action, and thus the focus of our analysis in on northern Guam.

In northern Guam, potential crow habitat is limited relative to that needed to support a persistent crow population due to habitat loss and degradation, lack of management, and the presence of introduced ungulates, invasive species, and typhoons. Currently, there are potentially 13,962 acres of crow habitat in northern Guam that could potentially support 156 breeding crow pairs and 150 non-breeding crows. However, significant portions of this habitat are currently degraded and will require intensive management and restoration (e.g., ungulate, predator, and invasive plant control or eradication) before the habitat regains the capacity to effectively support crow reproduction.

The proposed action will permanently destroy, fragment or degrade approximately 1,332 ac of crow habitat, including some of the best remaining primary forest on Guam. An additional 286 acres of crow habitat is likely to be permanently destroyed by future, non-Federal actions reasonably certain to occur within the action area. About 8,590 acres of crow habitat is needed in northern Guam to support crow conservation in the wild. After the proposed action there will be approximately 12,344 ac or 87 percent of the remaining crow habitat in northern Guam. While 1,618 ac of habitat loss is substantial, considering the quality of habitat, there will be enough remaining crow habitat in northern Guam, after the proposed action and future non-Federal actions, to support the survival and recovery of the crow in northern Guam once the species is reintroduced.

The DON will protect and manage 5,234 ac of kingfisher habitat in northern Guam per the terms of the MOA. Within this 5,234-ac footprint, a large amount of habitat will be crow habitat. Therefore, the DON's protection and management of 5,234 acres of crow habitat in northern Guam will off-set the loss of Mariana crow habitat from project construction, and will help ensure that crow habitat will be available for the survival and recovery of the species on Guam. The DON also has proposed to implement a forest enhancement project and biosecurity conservation measures including landscape-level brown treesnake eradication and control, recommendations from the RBP, HACCP planning, and brown treesnake interdiction program, which will be beneficial to the crow because it will help reduce the current brown treesnake population and potentially prevent other invasive species from becoming established on Guam.

Overall, the effect of the proposed action, when added to the environmental baseline for northern Guam, will reduce the amount of Mariana crow habitat in northern Guam, but implementation of the conservation measures and the MOA would ensure an sufficient amount of crow habitat is

protected and managed to recover the crow in northern Guam. Therefore, the proposed action is not likely to appreciably reduce the likelihood of the survival and recovery of the Mariana crow.

Guam Rail

Although the proposed project will result in the loss and degradation of habitat for Guam rails, there will still remain an adequate amount of habitat to provide for recovery and survival of the species. Based on our analysis, there will be 23,643 ac of recovery habitat in northern Guam and 24,796 in southern Guam remaining after implementation of the proposed project. Approximately 48,439 ac of recovery habitat on Guam would be left to support the minimum Guam rail population size required to meet recovery goals.

The DON's implementation of biosecurity conservation measures including landscape-level brown treesnake eradication/control, recommendations from the RBP, HACCP planning, and brown treesnake interdiction program, will be beneficial to the Guam rail because it will help reduce the current brown treesnake population and potentially prevent other invasive species from becoming established on Guam.

The DON will protect and managed approximately 5,234 ac in northern Guam pursuant to the MOA and conduct a forest enhancement project on approximately 1,000 acres in Finegayan of habitat, which also will provide some benefit to the rail. In addition, the DON will implement brown treesnake control work to help prevent the spread to Rota (where an experimental population of rails are present) and reduce numbers of brown treesnakes on Guam.

Based on the above measures and our analysis, including the loss of habitat and increased human disturbance to habitat, and in consideration of cumulative effects (described above), the Service concludes that the effects of the proposed action, including the cumulative effects, are not likely to appreciably reduce the likelihood of both the survival and recovery of the Guam rail in the wild, because there will be enough remaining potential rail habitat on Guam, after the proposed action and future non-Federal actions, to support the survival and recovery of the rail once the species is reintroduced to Guam.

Mariana Fruit Bat

The proposed action will adversely affect the Mariana fruit bat on Guam. Roughly four percent of the remaining Mariana fruit bat habitat on the island will be lost or degraded directly or indirectly as a result of the proposed action, and although this loss will not preclude the recovery of the fruit bat, it will reduce the total number of bats that the island can support by approximately 983 bats. In addition, the proposed action will substantially increase disturbance levels at AAFB from construction projects, operation of the LFTRC, and an increase in aircraft overflights. This disturbance will result in take, in the form of harassment, of any Mariana fruit bats in the area, is likely to repeadtedly harass individual bats, and may preclude the future reestablishment of a maternal roost colony at AAFB.

The DON will protect and manage 5,234 ac of kingfisher habitat in northern Guam per the terms of the MOA. Because the habitat for kingfisher and fruit bats are similar, protection and

management of 5,234 ac pursuant to the MOA will have direct benefits to the fruit bat. In addition, the DON's proposed forest enhancement project may help enhance some of the available Mariana fruit bat habitat at Finegayan. The DON's brown treesnake interdiction and control work will help prevent the spread of brown treesnakes to other Mariana Islands that support the Mariana fruit bat, and the implementation of the brown treesnake exclosure projects will facilitate the future successful recolonization or reintroduction of the Mariana fruit bat to Guam. On the basis of these findings, the Service concludes that the effects of the subject action, taken together with cumulative effects, is not likely to appreciably reduce the likelihood of both the survival and recovery of the Mariana fruit bat in the wild because sufficient habitat and populations are likely to persist throughout its range at levels that retain the potential for recovery of this species.

Serianthes nelsonii

The proposed action will adversely affect the last remaining adult *Serianthes nelsonii* tree and its surrounding seedlings in Guam and result in the removal of 948 acres of habitat for this species. As detailed above in the Effects of the Action- *Serianthes nelsonii*, the proposed action will damage the adult tree and also negatively impact recovery efforts by limiting access to the adult tree at NWF, the wild seedlings around it, and outplanted *S. nelsonii* saplings at the GNWR. However, among the potential adverse effects to the tree, the increased wind load is likely the most significant, persistent, and unmitigated adverse effect. In the event of a severe wind storm, with the clearance of forest vegetation to the east of the adult tree that would otherwise act as a buffer to strong winds, structural damage or injury to the point of mortality of the adult tree is highly likely.

The DON has proposed to offset, in part, these adverse effects by implementing the conservation measures detailed above, including the Finegayan enhancement project. Although not included as a conservation measure, the MOA (DON and Service 2015c) also will provide a benefits to *Serianthes nelsonii* because a portion of the habitat within the 5,234-ac protected site would include habitat for *S nelsonii*. In addition, risks will be minimized by best management practices regarding spread of non-native species and fire. As stated above, seedling survival, both wild and outplanted, has been very low. However, research and renewed recovery efforts through recent projects are likely to improve survival in outplanted seedlings. The proposed outplanting of 30 individuals (seedlings from the Guam adult *Serianthes* tree to ensure the genetics of the Guam *Serianthes* population is maintained into the future) and maintaining these individuals to adulthood and the ability to continue to access (although potentially limited) the tree for research, seedling rescue, and seed collection will help to ensure the continued existence of this tree species in the wild on Guam.

Overall, the potential loss of the last remaining Guam adult *Serianthes* tree as a result of the proposed action is highly likely and cumulative effects are substantial. However, in consideration of the presence of adult *Serianthes* trees on Rota; the amount of remaining habitat on Guam to support outplanting efforts on Guam; the proposed enhancement and protected sites, and most importantly, the DON's proposal to maintain 30 individuals to adulthood on Guam, the Service concludes that the proposed action is not likely to appreciably reduce the likelihood of both the survival and recovery of the *Serianthes nelsonii* in the wild.

Guam Micronesian kingfisher critical habitat

The Guam critical habitat unit for the Guam Micronesian kingfisher consists of approximately 376 acres of land in the fee simple portion of the Guam National Wildlife Refuge. Upon operation of the LFTRC, noise from gunshots will reach a small portion (approximately two acres) of the critical habitat unit. Because only two acres of the critical habitat unit will be affected, this noise is unlikely to diminish the value of the critical habitat for the conservation of the species in the long-term. Therefore, we determine that the proposed action will not adversely modify the Guam critical habitat unit for the Guam Micronesian kingfisher.

This conclusion relies heavily on the noise modeling outcomes described above, and if noise from the LFTRC is heard over a greater area within the critical habitat unit, this conclusion must be revisited.

Mariana crow critical habitat

The Guam critical habitat unit for the Mariana crow consists of approximately 376 acres of land in the fee simple portion of the Guam National Wildlife Refuge. Upon operation of the LFTRC, noise from gunshots will reach a small portion (approximately two acres) of the critical habitat unit. Because only two acres of the critical habitat unit will be affected, this noise is unlikely to diminish the value of the critical habitat for the conservation of the species in the long-term. Therefore, we determine that the proposed action will not adversely modify the Guam critical habitat unit for the Mariana crow.

This conclusion relies heavily on the noise modeling outcomes described above, and if noise from the LFTRC is heard over a greater area within the critical habitat unit, this conclusion must be revisited.

Mariana fruit bat critical habitat

The Guam critical habitat unit for the Mariana fruit bat consists of approximately 376 acres of land in the fee simple portion of the Guam National Wildlife Refuge. The critical habitat unit is currently occupied, and is located at the base of the cliff below the LFTRC. Upon operation of the LFTRC, noise from gunshots will reach a small portion (approximately two acres) of the critical habitat unit. This noise may preclude the Mariana fruit bat from using this area for roosting as a remote place free of human disturbance. However, because only two acres will be affected, this noise is unlikely to diminish the value of the critical habitat for the conservation of the species in the long-term. Therefore, we determine that the proposed action will not adversely modify the Guam critical habitat unit for the Mariana fruit bat.

This conclusion relies heavily on the noise modeling outcomes described above, and if noise from the LFTRC is heard over a greater area within the critical habitat unit, this conclusion must be revisited.

J. INCIDENTAL TAKE STATEMENT

Section 9 of the Act and Federal regulations pursuant to section 4(d) of the Act prohibit the take of endangered or threatened species, respectively, without special exemption. Take is defined as harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct. Harm is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including, breeding, feeding, or sheltering. Harass is defined by the Service as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering.

Incidental take is defined as take that is incidental to, and not the purpose of, carrying out an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered a prohibited taking under the Act provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The measures described below are non-discretionary, and must be undertaken by DON so that they become binding conditions to the applicant for the exemption in section 7(o)(2) to apply. The DON has a continuing duty to regulate the activity covered by this incidental take statement. If DON (1) fails to assume and implement the terms and conditions or (2) fails to require contractors to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to contract documents, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, DON must report the progress of the action and its impact on the species to the Service as specified in this incidental take statement [50 CFR 402.14(i)(3)].

Amount or Extent of Take Anticipated

Based on our analysis presented in this Biological Opinion, the Service anticipates the following take may occur as a result of the proposed action:

1) The Service anticipates that, over the duration of the proposed action, up to 30 Mariana fruit bats at AAFB and Finegayan could be repeatedly taken in the form of harassment leading to injury from loud aircraft noise, operation of the LFTRC, construction noise, and other human disturbance resulting from the proposed action. We do not anticipate mortality from the proposed action. This take level was determined based on the following factors:

   a. The current population of Mariana fruit bats on Guam is less than 30 individuals, primarily found on AAFB.

   b. Mariana fruit bats can traverse large areas and therefore are likely to come into close vicinity to the proposed action (aircraft noise, operation of the LFTRC, construction, other military training or human disturbance) multiple times during their

life-span.

c. Disturbance from the proposed action could have an adverse effect on fruit bats by increasing energetic demands, disrupting hormonal balances, forcing relocation to lower quality habitat or areas where poaching is more prevalent, disrupting reproductive cycles, and increasing stress levels. These behavioral and physiological responses represent harassment that is reasonably likely to significantly disrupt normal behavior patterns including breeding, feeding or sheltering.

d. Because of the frequency and duration of training events at AAFB and Finegayan we expect that each of the 30 bats may be harassed multiple times over the duration of the proposed action.

Incidental take of the kingfisher, rail, and crow as a result of the proposed action cannot be anticipated at this time. Once these species are reintroduced on Guam, the Service will revise this Incidental Take Statement, as appropriate, to address such take.

Effect of the Take

In the accompanying Biological Opinion, the Service determined that this level of anticipated take is not likely result in jeopardy to the Mariana fruit bat or result in the destruction or adverse modification of Guam Micronesian kingfisher critical habitat, Mariana crow critical habitat, or Mariana fruit bat critical habitat.

K. REASONABLE AND PRUDENT MEASURES

Reasonable and prudent measures serve to minimize impacts on individuals or habitats affected by the action. The Service believes the following reasonable and prudent measures are necessary and appropriate to minimize the impacts of incidental take on the Mariana fruit bat:

1) The DON shall implement the Conservation Measures set forth in the Project Description in this Biological Opinion.

2) The DON shall minimize the level of incidental take of the Mariana fruit bat occurring as a result of construction and operation of the Proposed Action.

3) The DON shall monitor the level of incidental take of Mariana fruit bat.

4) The DON shall compensate for removal of the ungulate fence required by the Incidental Take Statement in the Service's Biological Opinion addressing the ISR Strike Action.

5) The DON shall report on the progress of project implementation related to take of the Mariana fruit bat.

L. TERMS AND CONDITIONS

In order to be exempt from the prohibitions of section 9 of the Act, DON must comply with the following terms and conditions, which implement the reasonable and prudent measures described above and specify reporting requirements. These terms and conditions are non-discretionary.

In order to implement the reasonable and prudent measure above, the following terms and conditions apply:

1) DON shall implement the Conservation Measures in the Project Description of this Biological Opinion. We reiterate this requirement here for convenience and clarity.

2) To minimize the level of incidental take of Mariana fruit bat the DON shall:

    a. Halt construction if a fruit bat is present within 492 ft (150 m) of a construction site, at any point during the construction cycle, until the fruit bat leaves the area of its own accord. Information regarding the presence of fruit bats at a construction site shall be provided to the Service on an annual basis.

    b. Use hooded lighting within 482 ft (150 m) of all potential fruit bat roost habitat.

    c. Provide educational materials regarding Mariana fruit bat appearance, behavior, and biology to all personnel using the LFTRC so that they can correctly identify any fruit bats near or within the LFTRC during operation. If a fruit bat is sighted down range during operation of the LFTRC, all use of the range will cease until the fruit bat has left the area of its own accord.

    d. Search for Mariana fruit bat maternity colonies, on a semi-annual basis, in all areas of AAFB that could be affected by the proposed action including 1) all fruit bat habitat within the 65 dB noise contour from the LFTRC shown on Figure 17 and 2) all fruit bat habitat that will be subject to increased noise levels from aircraft overflights. Searches will begin one year prior to the operation of the LFTRC and one year prior to the proposed overflight increases. Surveys will proceed on a semi-annual bases for the first five years, then conducted annually for the length of the project. If a fruit bat maternity colony is found the Service should be notified within one week of the finding.

3) To determine the level of take the DON shall:

    a. Monitor all known roost sites, at a minimum once a quarter, from one year prior to and one year after the proposed overflight increases are fully implemented and during all years in which operation of the LFTRC is active. The monitoring methodology should, at a minimum, include direct counts of Mariana fruit bats utilizing a spotting scope at an appropriate distance to avoid disturbance impacts to the bats.

b. Conduct a noise study at the GNWR and at Ritidian Point upon operation of the MPMG range at the LFTRC. The noise study will occur during the first year of operation of the LFTRC. Multiple stations should record noise levels during operation of the MPMG at the GNWR and at Ritidian Point. The monitoring stations will be approved by the Service in coordination with the DON. Noise monitoring should occur during day and night activities over multiple days (minimum of ten days) at least once a quarter to address seasonal and climatic changes. Weather conditions during monitoring should be closely recorded including temperature, humidity, and wind direction. The results of the surveys will be provided to the Service (Ecological Services and Refuges) on a quarterly basis, with a final report due within three months of the conclusion of the study.

c. Submit reports summarizing the methods and results of the above monitoring efforts shall be sent to the Service's Pacific Islands Fish and Wildlife Office (300 Ala Moana Blvd., Room 3-122, Honolulu, Hawaii 96850) every year until the monitoring is completed.

4) The DON shall

a. Finalize an agreement with the Service, prior to any construction of the LFTRC, regarding the future location of the ISR Strike-related ungulate fence. The DON is responsible for reconstructing the fence, removing ungulates within the fenced exclosure, and re-planting any native outplantings that occurred within the current ISR Strike fence at Ritidian Point. The DON will be responsible for maintaining the fence and continuing any forest enhancement as required under the Incidental Take Statement in the Service's Biological Opinion on the ISR Strike action. Construction of the new ungulate fence and ungulate removal within the fenced area shall be completed by December 2022. If an agreement is not reached, and work on the new fenced exclosure has not begun by January 2017, then the DON shall be out of compliance with both the DON and ISR Strike-related Biological Opinions.

5) The DON shall:

a. Submit annual reports detailing the implementation of the above Reasonable and Prudent Measures and Terms and Conditions. The first report shall be due at the end of October 2016. Annual reports due by the end of October shall be submitted as long as the proposed action is still operating.

Term and Condition for Reporting and Salvage Requirements

Where practical, an attempt should be made to salvage specimens of listed species incidentally taken by the proposed action as modified by the above RPA. The DON shall inform the Field Supervisor of the Service's Pacific Islands Fish and Wildlife Office in Honolulu, Hawaii, in writing of any salvaged specimens of any federally listed species within three (3) working days. The depository designated to receive specimens of any threatened or endangered species killed is the B.P. Bishop Museum, 1525 Bernice Street, Honolulu, Hawaii, 96817 (telephone: 808/547-

3511). If the B.P. Bishop Museum does not wish accession to the specimens, the permittee should contact the Service's Division Office of Law Enforcement in Honolulu, Hawaii (telephone: 808/861-8525; fax: 808/861-8515) for instructions on disposition. The Service's Pacific Islands Fish and Wildlife office (telephone: 808/792-9400) shall also be informed within three (3) working days of any injured threatened or endangered species found and the actions taken.

M. CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species, to help implement recovery plans, or to develop information. The recommendations provided relate only to the proposed action and do not necessarily represent complete fulfillment of the DON's section 7(a)(1) responsibilities for the species. In order for the Service to be kept informed of actions minimizing or avoiding adverse effects or benefiting listed species or their habitats, the Service requests notification of the implementation of any conservation recommendations.

The Conservation Recommendations below only include actions that the DON is not currently implemented or has not already committed to implement. They are meant to be recommendations and suggestions for future actions.

1) To further support species recovery efforts, the DON will actively participate in recovery committees for endangered or threatened species on Guam. The DON will work with the Service to develop a re-introduction plan and supporting programmatic biological opinion that ensures such re-introduction efforts are consistent with the species recovery plans.

2) To assist with Endangered Species Act (ESA) section 7 consultations and to further support species recovery on Guam and in the Commonwealth of the Northern Mariana Islands (CNMI), the Deputy Assistant Secretary of the Navy (Environment) and the U.S. Fish and Wildlife Service (Service), Pacific Regional Director established a team (Team) to explore establishment of potential conservation area(s) on Guam and in the CNMI as part of a broader consultation solution. As part of that broader solution, the Team is considering the establishment of conservation area(s) and/or the implementation of conservation actions throughout Micronesia to enhance endangered and endemic species protection and recovery in the Mariana archipelago.

3) The DON should replace the proposed project footprint for the LFTRC with an alternative that does not clear the primary limestone forest at Ritidian Point, does not demolish the ungulate fence at Ritidian Point, and does not put a SDZ over the GNWR.

4) The DON should manage Overlay Refuge land on Guam for recovery of listed species including protecting conservation lands in-perpetuity, conducting ungulate control and/or eradication, fencing for ungulates and non-native predators (including brown treesnake),

conducting invasive species control, and outplanting native species. Native forests should be restored to conditions more closely representative of the forest types described by Fosberg (1960).

5) The DON should work with the Government of Guam to identify, protect, and manage listed species habitat throughout Guam.

6) In addition to ensuring project-related fires do not effect habitat for listed species, the DON should incorporate the following measures into fire management operations: (1) establish and maintain cooperative agreements with Government of Guam and local jurisdictions to ensure DON fire suppression resources are able to assist with fire suppression efforts, as necessary, to protect remaining limestone forest and ravine forest from fire; (2) to facilitate fire management planning and implementation of daily fire suppression staffing, immediately establish remote automated weather stations on Guam and maintain weather and fire danger data in the interagency weather information management system; (3) complete landscape-level forest restoration to convert grasslands in the Naval Munitions Site back to limestone forest or ravine forest; (4) restore any areas of forest burned on DON lands, regardless of fire cause; (5) control public access at the Naval Munitions Site to minimize ignition of fires caused by the public.

7) The DON should extend the security fence around Ritidian Point and the LFTRC to connect with clifflines that serve as barriers to ungulates. The DON should remove all ungulates within this perimeter fence to help restore the land for native species.

8) The DON should continue to work with the Service to develop a Marianas-wide strategy for listed species conservation and develop a Programmatic BO to address all future DoD actions on Guam.

9) Once the SDZ from the LFTRC is established, the DON should provide consistent, reliable, and easy access to the GNWR for researchers, managers, and GNWR staff.

10) The DON should work with the Service to develop a re-introduction plan for listed species once threats to the species have been managed or controlled on Guam such that species re-introduction is feasible.

11) The DON should place barriers at strategic places around the LFTRC to reduce sound transmission into listed species habitats.

Brown treesnake/Invasive species:

12) The DON should fully fund and implement actions identified in the RBP to avoid the spread of invasive species to and from Guam, and within Micronesia.

Guam Micronesian kingfisher:

13) The DON should provide funding for establishing a wild back-up Guam Micronesian kingfisher population outside of Guam (recovery action 3.9 in the recovery plan). Such a population could hedge against the risk of the captive population being loss to disease or catastrophe. Furthermore, a successful wild population should minimize the progressive loss of behavior or genetic traits suited to survival in the wild as opposed to a captive environment, and could thus ultimately improve the likelihood of successful reintroduction to Guam.

Mariana crow:

14) The DON should provide funding for recovery actions for the Mariana crow on Rota in order to enhance the population on Rota to provide for future reintroduction to Guam. Recovery actions needing funding include

    a. Predator monitoring and control on Rota;
    b. Captive propagation of the Mariana crow on Rota; and
    c. Identification and management of sources of adult and juvenile mortality.

Mariana fruit bat:

15) Recovery of the fruit bat population on Guam will likely depend on immigration or translocation of fruit bats from Rota. Consistent protection and monitoring of the fruit bat population on Rota is required to ensure its persistence.

    a. The DON should provide financial and technical assistance to support actions of off-island Law Enforcement personnel (Federal or CNMI DFW from Saipan) conducting surveillance, investigations, and poaching deterrence on Rota. Although the fruit bat population on Rota has increased in recent years due to an increase in enforcement of wildlife protection laws, illegal hunting continues to be the primary threat to this population. Fruit bats continue to be a high-demand cultural delicacy on Rota, and social and familial obligations prevent local authorities from effectively enforcing wildlife protection laws because people feel accountable to each other, but not necessarily to outside agencies, laws, or institutions.

    b. The DON should provide financial and technical assistance for conservation and research projects that include training and employment for local CNMI and Guam residents. Direct involvement of local community in conservation and research efforts has been shown world-wide to be one of the most effective ways to change local attitudes about poaching; not only does direct engagement promote appreciation of the species' intrinsic value, but it also provides an alternative economic value to the species or system, and with this a greater probability of sustained success.

c. The DON should provide financial and technical assistance for research on captive Mariana fruit bats. Long-term research examining life history parameters and reproductive cycles of captive Mariana fruit bats is needed to model population growth, predict population trends in light of a species' response to human and environmental stressors (e.g., hunting and natural disasters), and to insure effective management and conservation of critical habitat. We do not have this information for the Mariana fruit bat and have, to date, been extrapolating from other species of flying fox. Without species-specific knowledge of life history and reproduction, effective population analyses, an accurate determination of species recovery and subsequent delisting will not be possible. To avoid negatively affecting the wild fruit bat population while acquiring knowledge needed for their conservation, recovery, and management, efforts examining life history and ecology using rehabilitated wild bats and an existing captive population should be utilized. There are currently over 75 adult and juvenile fruit bats at the Rota Zoo and the owner of the zoo is willing to cooperate with local and federal agencies, or private organizations on research projects using his captive fruit bat colony. The Rota Zoo has the only known captive breeding colony of Mariana fruit bats. With appropriate financial and technical support, and collaboration with the Rota Zoo, there is great potential to acquire valuable, and much needed information on the life history and reproductive potential of the Mariana fruit bat.

d. The DON should provide technical and financial assistance for monitoring the fruit bat population on Rota. The CNMI DFW receives federal assistance to support employment of a wildlife biologist to monitor and conduct research on the Rota fruit bat population. However, this position has not been consistently filled and has been vacant for the last several years. When the position is vacant, the fruit bat population is not monitored and there is no record of population fluctuations, disturbance events, colony movements, etc. Although a resident biologist on Rota is the optimal way to ensure effective monitoring of the fruit bat population, regular and consistent efforts from off-island biologists could provide an acceptable alternative if the CNMI DFW's bat biologist position remains vacant or inconsistently occupied.

Serianthes nelsonii

16) The DON should fund a study to identify any genetic differences between the Guam *Serianthes* tree and the Rota *Serianthes* trees / population.

Proposed species:

17) The DON should conduct full surveys of the proposed action area to identify all proposed species locations and suitable habitat.

N. REINITIATION – CLOSING STATEMENT

This consultation may need to be reinitated if the following situations arise:

- If cargo originating from Guam is implicated in the transport of a brown treesnake to the CNMI, Hawaii, or continental U.S., the Service shall assess the ongoing risk of brown treesnake transport and will determine if additional brown treesnake interdiction measures or other actions are necessary to ensure the effects of the action are minimized.

- If a maternal fruit bat roost colony is located at AAFB.

- If peak noise levels at the LFTRC are higher than the peak noise levels described in the Project Description.

- If listed species are reintroduced to Guam, the Service may need to reinitiate consultation to assess the effects of the proposed action on the listed species in the Action Area.

- If the June 11, 2015 MOA is not implemented.

This concludes formal consultation on this action. As required in 50 CFR §402.16, reinitiation of consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is met, any operation causing such take must cease pending reinitiation.

If you have questions regarding this Biological Opinion, please contact me at the letterhead address or by telephone at (808) 792-9400.

Sincerely,

Kristi Young
Acting Field Supervisor

cc:
Celestino Aguon, Guam Department of Agriculture, DAWR
Laura Beauregard, Guam National Wildlife Refuge
Mark Bonsavage, Joint Region Marianas, Guam

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P. APPENDIX A – INFORMAL CONSULTATION

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Pacific Islands Fish and Wildlife Office
300 Ala Moana Boulevard, Room 3-122
Honolulu, Hawaii 96850

In Reply Refer To:
01EPIF00-2015-I-0291

JUL 3 1 2015

Captain Joseph A. Campbell
Deputy Director, Joint Guam Program Office
Office of the Assistant Secretary of the Navy (EI&E)
Joint Guam Program Office, ASN (EI&E)
201 12th Street South, Suite 700
Arlington, Virginia 22202

Subject: Informal Consultation for the Joint Guam Program Office Relocation of the U.S. Marine Corps from Okinawa to Guam and Associated Activities on Guam

Dear Captain Campbell:

The U.S. Fish and Wildlife Service's (Service) received your letter on October 1, 2014, requesting our concurrence that the subject project may affect, but is not likely to adversely affect the federally endangered Mariana swiftlet (*Aerodramus bartschi*), the federally endangered hawksbill sea turtle (*Eretmochelys imbricata*) (hereafter referred to as the hawksbill turtle), and the federally threatened green sea turtle (*Chelonia mydas*) (hereafter referred to as the green turtle). Our analysis and finding in this consultation are based on your letter dated September 30, 2014, your Biological Assessment (BA) (DON 2014a), and other information available to us. This response is in accordance with section 7 of the Endangered Species Act of 1973 (ESA), as amended (16 U.S.C. 1531 *et seq.*). A complete administrative record is on file in our office.

Project Description

The Department of Navy (DON) proposes to relocate U.S. Marine Corps (USMC) personnel from Okinawa, Japan to Guam; construct and operate a main cantonment area, including family housing; and construct and operate a live-fire training range complex (LFTRC); and conduct training activities on Guam. Project activities will occur on land administered by the Department of Defense (DoD) and the Government of Guam (for road and bridge work). The proposed action includes the following components:

- Relocation of 5,000 USMC personnel and 1,300 dependents from Japan to Guam
- Construction of the main cantonment within 1,213 acres at Finegayan, Andersen Air Force Base (AAFB)
- Construction of housing within 510 acres at AAFB
- Utilities and site improvement activities within DON-administered lands
- Road and bridge development and/or improvement within DON-administered lands and Government of Guam lands
- Construction and operation the LFTRC at AAFB
- Establishment of a surface danger zone (SDZ) within Northwest Field (NWF), AAFB and the Guam National Wildlife Refuge (GNWR)
- Development and operation of a hand grenade range at Andersen South
- Air craft training activities within the Naval Base Guam's Naval Munitions Site (NMS) and adjacent areas

In addition, per an email correspondence from the DON (DON 2015b), the proposed project also includes surveying the water portion of the SDZ from three locations on the GNWR (Figure 1). The Range Safety Specialist (RSS) would access these locations using an ATV-type vehicle (*e.g*, 2 or 4 passenger Gator vehicle). The portion of the SDZ that cannot be observed by radar would be accessed by an existing dirt road and the RSS would park the vehicle along the road and walk into the locations depicted on Figure 1 to view the radar "blind spots". It is expected that the RSS would not need to walk the beach and would use a pair of binoculars to view the water portion of the SDZ from a static vantage point on the edge of the beach near the road. The RSS would drive out the same dirt road taken to access the locations. The above activity would take no more than 20 minutes.

A detailed project description is included in the BA (DON 2014a), the Draft SEIS (DON 2014b), addendum to the BA (DON 2015a), and the Biological Opinion for the subject project (USFWS 2015), and is hereby incorporated by reference into this informal consultation.

The conservation measures below are a subset of the conservation measures that are proposed in the BA (DON 2014a), addendum to the BA (DON 2015a), and via email correspondence between the DON and the Service. These conservation measures are intended to avoid and minimize effects to the Mariana swiftlet, green turtle, and hawksbill turtle. Any changes to, modifications of, or failure to implement these avoidance and minimization measures may result in a need to reinitiate this consultation.

Conservation Measures to Minimize the Effects of Construction

1. Contractor Education Program. The DON contractor education program ensures that construction contractor personnel are informed of the biological resources in the project area, including invasive species, special-status species, avoidance measures, and reporting requirements. This measure is intended to prevent inadvertent effects to terrestrial biological resources due to lack of awareness of resource presence, sensitivities, and protective measures. This measure will be implemented during pre-construction and construction.

2. Contractor Plans and Specifications. All construction will occur within the limits of construction shown in the plans and specifications. This measure is intended to prevent additional habitat loss. This measure will be implemented during pre-construction and construction.

3. Guam Landscaping Guidelines. Appropriate or non-invasive species will be planted in all new landscapes. This measure is intended to reduce potential effects associated with non-native vegetation, promote habitat for native species, reduce water consumption, and reduce the need for fertilizers. This measure will be implemented during construction.

4. LFTRC Range Berm Controls. LFTRC range berms will contain native or non-invasive herbaceous vegetation, and other engineering controls. This measure will help to manage stormwater runoff and control erosion, and the berm will minimize the number of bullets that may fall outside the range footprint. This measure will be implemented during construction.

5. Lighting Installation. Lighting will be designed to meet minimum safety, sustainability, antiterrorism, and force protection requirements. Hooded-lights will be used to the maximum extent practicable at all new roads and facilities within known sea turtle land habitat and fruit bat roost areas. Either hooded or "night-adapted" lights will be installed at the LFTRC. Illumination of forest, coastline, or beach will be consistent with range safety and security requirements and kept to an absolute minimum including the shielding of lights and directing lighting away from the forest or other wildlife habitat. This measure will be implemented during pre-construction, construction, and during operations.

6. Monitoring. The DON will be responsible for oversight of avoidance, minimization, and conservation measures implementation by the contractors for projects associated with the proposed action. The DON shall ensure that construction remains within the limits of construction and that sensitive resources are avoided, unless otherwise specified in the Project Description. This measure will be implemented during pre-construction, construction, and operations.

Conservation Measures to Minimize the Effects of Invasive Species

Regional Biosecurity Plan. To address invasive species pathways and encourage a more holistic approach to managing invasive species, the DON has funded the development of the Regional Biosecurity Plan (RBP) for Micronesia and Hawaii (formerly referred to as the Micronesia Biosecurity Plan). Individual activities for various species will continue, but the DON and others agree it is more efficient to manage pathways and prescribe corrective measures for a suite of species which will be monitored at discrete control points over time. The RBP will provide stakeholders in Micronesia and Hawaii with a platform for coordination and integration of inter-agency invasive species management efforts such as control, interdiction, eradication, and

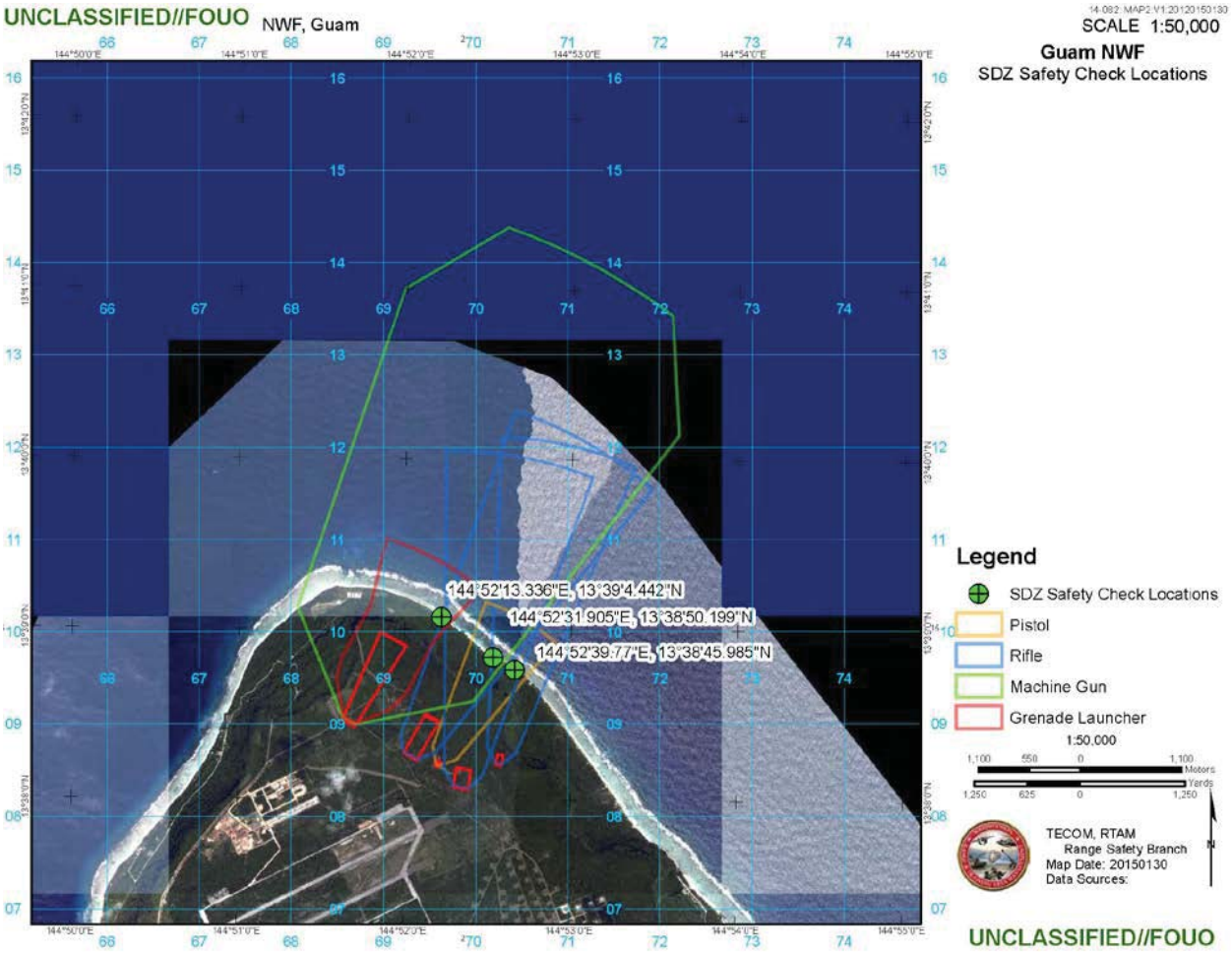

Figure 1. Safety check locations to view the radar "blind spots" of the SDZ, located on the Guam National Wildlife Refuge.

research. The final RBP was completed in 2015 (DON 2015b). Several of the recommendations are incorporated into the Project Description as BMPs:

1. Onsite vegetation waste management procedures. Green waste will be handled by the contractors at designated laydown areas within the limits of construction. Contractors will be required to divert all the green waste. The larger-sized green waste consisting of trees and stumps will be processed into mulch and the smaller sized green waste will be processed into compost. A proposed green waste processing facility at the NBG Landfill may also be used to process green waste generated during construction. The DoD will seek permit authorization from the Guam Environmental Protection Agency for the proposed green waste processing facility.

2. DON's Final Guam Landscaping Guidelines. The DON has developed a manual providing landscaping design guidelines specific to appropriate plant selection and

establishment for all the DON construction activities on Guam (DON 2011). This manual implements required DON policies including, but not limited to:

a. use of native regional plants for landscaping;
b. design, use, and promoting construction practices that minimize adverse effects on natural habitat;
c. pollution prevention by reducing fertilizer and pesticide use, integrated pest management practices, recycling green waste (composting), and minimizing runoff;
d. implementing efficient water practices; and
e. preventing the introduction of invasive species.

The above measure is intended to reduce potential effects associated with non-native vegetation, promote habitat for native species, reduce water consumption, and reduce the need for fertilizers.

3. Biosecurity outreach and education. The DON has initiated and will continue to implement a targeted, comprehensive outreach and education program for DoD and civilian populations for biosecurity focused on prevention. As a starting point, the DON contracted for the development of biosecurity outreach and education materials. The contractor has designed and produced an activity booklet, a two-sided, tri-fold, educational brochure with an associated poster that differentiates native from introduced species, defines invasive species, describes the known impacts of invasive species on native species and ecosystems, and what can be done to prevent and control invasive species. This effort also included the development of radio public service announcements (PSA) in three languages, and a television PSAs both of which aired for one month in September of 2013 during peak broadcasting times.

   The DON's biosecurity outreach and education program has already begun concurrent with the actions that were initiated under the 2010 Environmental Impact Statement's Record of Decision (DON 2010). The DON will develop additional informational videos, expand the radio PSAs broadcasts, and other print media as well as active public outreach concurrent with the arrival of the first major influx of USMC personnel in 2020 and continue for an additional 5 years.

4. Hazard Analysis Critical Control Point (HACCP) planning. HACCP planning is a pathway management tool that provides a comprehensive method to identify risks and focus procedures to prevent spread of species through pathways. Construction work could unintentionally spread non-target (potentially invasive) species. These non-targets could hitchhike on construction equipment or be included in shipments of materials and supplies from locations outside of Guam. The pathways used by invasive species to move into new locations are not always obvious. Many problematic species, diseases, and parasites have been transferred to new locations as undetected (and unplanned) hitchhikers. HACCP planning is a management tool that provides a structured method to identify risks and focus procedures. Understanding pathways and developing plans to reduce non-target species and prevent biological contamination is necessary to avoid unintended spread of species.

a. All construction contracts will contain a requirement to develop a HACCP Plan which will identify risks and potential pathways for non-native species and will outline procedures for controlling and removing risks identified. Construction contractors are required to provide documentation that supports prevention, worker awareness training, and control of non-native invasive and pest species in the project area and efforts to prevent the movement of non-native invasive species to areas outside the project area, whether in a purposeful or inadvertent manner. The contractor is responsible for ensuring that employees receive applicable environmental and occupational health and safety training and keep up to date on regulatory requirements for specific training for the type of work to be conducted onsite.

b. Construction contracts also will contain a requirement for inspections and proper re-use or disposal of vegetation to avoid contributing to the further spread of the coconut rhinoceros beetle (*Oryctes rhinoceros*). The construction contractors are to identify and implement control measures to prevent the inadvertent movement of non-native, invasive species to Guam and to and from the project site to other locations. The contractor is required to establish appropriate facilities that comply with all environmental laws and regulations, provide training for proper vehicle hygiene, and promptly take corrective and preventative actions for noncompliance. This includes vehicle washdown and inspection for soil and other materials and appropriate control measures are implemented to prevent the inadvertent movement of non-native invasive species from the project site to other locations.

c. All HACCP planning and implementation related to the proposed action will be the responsibility of the awarded project contractor(s) to ensure that proper control measures are used throughout the construction activities to prevent the inadvertent movement of invasive species from one location to the project site, and/or from the project site to other locations. It will be the responsibility of DON to review and concur with the development phase of the HACCP planning process to ensure proper compliance by these contractors.

d. HACCP plans will be approved and inspected by the DON.

5. Monitoring to evaluate effectiveness of HACCP

a. The DON shall provide training, review, and technical guidance on HACCP plan development, implementation, and revision during the construction phase of the buildup on Guam. The HACCP planning covers Guam-related rapid response actions. The DON contracted a baseline ecosystem monitoring study for projects on AAFB in 2011. Transects were focused on areas where newly introduced species were most likely to occur. The intent of the project was to establish a baseline of both native and non native plants present prior to the beginning of planned construction activities. This baseline will serve as a reference for

subsequent monitoring efforts conducted concurrently with construction in order to aid in evaluating the success of implemented HACCP plans. The baseline will also provide a basis of comparison for relative abundances of invasive species during construction, as well as whether any species detected during long-term monitoring are newly introduced or were present prior to the beginning of construction. The AAFB project was completed in December 2012.

b. The DON will develop an early detection and rapid response component for when an incipient invasive species is discovered in the proposed action area.

6. Brown treesnake interdiction

a. JRM has established a comprehensive brown treesnake (*Boiga irregularis*) interdiction program to ensure that military activities, including the transport of civilian and military personnel and equipment to and from Guam, do not contribute to the spread of brown treesnake to other islands or regions. Brown treesnake interdiction requirements are specified in DoD instructions (i.e., 36 Wing Instruction 32-7004, Brown Tree Snake Control Plan and COMNAVMAR Instruction 5090.10A, Brown Tree Snake Control and Interdiction Plan). The proposed project will continue to comply with these established procedures.

b. The DON will fund any increase of current federally-funded brown treesnake interdiction measures (in Guam, CNMI, and Hawaii) where the increase is related to direct, indirect and induced growth caused by the USMC relocation to Guam. The fiscal year 2010 level of funding for the Federal interagency brown treesnake interdiction effort on Guam, CNMI, and Hawaii and 2010 transportation levels associated with outbound cargo from Guam for the U.S. or U.S. territories will be used as the baseline. Any increase in funding will continue and become part of the DON's brown treesnake interdiction funding under authority of the Brown Tree Snake Control and Eradication Act (7 USC § 8501 note) (USFWS 2010a). The Department of Interior agrees that it is not DON’s responsibility to fund increased interdiction measures *that are identified* more than one year after the end of the fiscal year both USMC relocation construction has ended and the permanent non-transient USMC military units have relocated to Guam. For the purposes of this consultation, interdiction is defined as: “to hinder, prohibit, or prevent the brown treesnake from becoming established in new locations by conducting inspection and suppression processes.”

c. Rapid Response – Brown treesnake management, research, and coordination efforts have been refined and progressed to the point where U.S. Department of Agriculture-Animal and Plant Health Inspection Service, Wildlife Services inspection rates for cargo and flights departing Guam are almost 100 percent (BTS TWG 2015).

d. Coordination with the U.S Geological Survey (USGS) regarding the Brown Treesnake Research Closed Population Facility at NWF (located adjacent to the

LFTRC and SDZ) – The DON will ensure through briefings or information packages that the personnel using the LFTRC know the importance of the facility and maintaining the integrity of the fence. An SOP will be developed as part of the Range Management Plan for the LFTRC to ensure the above and that USGS will be immediately notified in the event that the fence is accidentally damaged so the fence can be quickly repaired.

Conservation Measures to Minimize the Effects of Training to Mariana Swiftlets

1. Aviation Training in NMS. All aviation training will be conducted so that flights will approach the southern portion of the NMS over the Talofofo River watershed and Fena Reservoir at heights of 1,000 ft (305 m) or greater above ground level. Flights may go up the Ugum River at altitudes of 1,000 ft (305 m) or greater above ground level until they reach 9,843 ft (3,000 m) from the mouth of the river at Highway 4 and then flights may conduct low level terrain flights. Low-level training flights will be restricted to the southernmost portion of the NMS where Mariana swiftlets are not commonly present. This measure is intended to avoid and minimize effects to swiftlets, and will be implemented during operations.

2. Ground Training in NMS. The DON will maintain 328-ft (100-m) no training buffers around the known Mariana swiftlet nesting caves (*e.g.*, Mahlac Cave, Fachi Cave, Maemong Cave) in NMS. This measure is intended to avoid and minimize effects to Mariana swiftlets, and will be implemented during operations.

Conservation Measures to Minimize the Effects of Increased Human Presence at Nesting Sea Turtle Beaches

1. Sea Turtle Public Outreach and Coordination. The DON, in cooperation with the Guam Department of Aquatic and Wildlife Resources (DAWR), has undertaken an educational program to inform military and civilian personnel about sea turtle nesting and the potential impacts to the species from nest disturbance, direct harassment of sea turtles, beach disturbance, and other threats. The DON has developed and distributed sea turtle conservation posters, tri-fold brochures and activity booklets for elementary school children. These educational materials have been distributed to local dive shops on Guam, and will continue to be used and refined throughout the construction period of the proposed USMC relocation. As part of the Range Safety Specialist (RSS) training package, personnel would be directed to not interact with sea turtles and report all sightings to the Service and coordinate with the GNWR on nesting surveys at the Refuge.

Action Area

The term "action area" is defined in the implementing regulations for section 7 at 50 CFR 402.02 as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action."

The action area for this consultation is the island of Guam (Figure 2). The specific areas likely to be affected, directly or indirectly, by the proposed action are discussed in detail in the BA. In addition to what is detailed in the BA, the following effects from the action may be Guam-wide: 1) effects from introduction of invasive species by the proposed action could spread throughout the whole island of Guam and 2) the population increase resulting from the proposed action will cause additional human disturbance throughout the island, including at recreation sites, hunting areas, traffic along roads, etc.

Status of the Species

Mariana swiftlet

Listing status - The Mariana swiftlet was federally listed as endangered on August 27, 1984 (USFWS 1984). A five-year status review was completed in 2010 (USFWS 2010b) and a recovery plan for the Mariana swiftlet was completed in 1991 (USFWS 1991). No critical habitat rules have been published for this species.

Species description - The Mariana swiftlet (*Aerodramus bartschi*) was formerly considered a subspecies of the widespread Vanikoro swiftlet (*A. vanikorensis*), but genetic studies support that it is a distinct species (Thomassen et al. 2005, p. 274). It is a small swift with dark, gray-brown plumage on the upper parts, a slightly paler rump, and paler underparts, and the plumage of both sexes is alike. Weights of 21 birds averaged 7.4 grams (range = 6.4 to 9.0 grams). Other measurements include: wing, average of 107.6 mm and 108 mm; tail, average of 52.3 mm; exposed culmen, average of 4.0 mm; tarsus, average of 10.4 mm, and wingspan, maximum of 233 mm (USFWS 1991, p. 1; https://ecos.fws.gov, *accessed* 9 April 2015). It is the only resident swift in the Mariana Islands, and could potentially be confused with migratory swallows, or the fork-tailed swift (*Apus pacificus*), a rare vagrant (USFWS 1991, p. 1).

Life history - Mariana swiftlets are aerial insectivores that nest in limestone caves and can echolocate (USFWS 1991, p. 2; Reichel et al. 2007, p. 686 and references therein; Valdez et al. 2011, p. 301). They forage over a wide variety of habitats, including cleared and forested areas, but favor ridge crests and open grassy savannas (USFWS 1991, p. 6). Large flocks have been reported to form in the evening, with birds feeding close to the ground until it is dark (Chantler and Driessens 1995, p. 130).

Mariana swiftlets produce a single egg which is incubated for approximately 23 days (range 17-30 days), and chicks fledge after approximately 47 days (range 40-55 days; Reichel et al. 2007, p. 686). Eggs are laid in cup-shaped nests made of moss and saliva attached to cave walls or ceilings. Assessment of guano on Saipan indicate Hymenoptera, especially flying ants (*Formicidae*), were the most common insect prey followed by Coleoptera (Kershner et al. n.d.).

Analysis of guano from swiftlets on Aguiguan showed that their diet consisted primarily of Hymenoptera, with a small percentage of Hemiptera (Valdez et al. 2011, p. 301).

Status and distribution - The Mariana swiftlet is endemic to Guam, Rota, Aguiguan, Tinian, and Saipan, but has declined on all islands and is extirpated from Rota and Tinian (Cruz et al. 2008, p. 233; Valdez et al. 2011, p. 301 and references therein; USFWS 1991, p. 7-14). Based on the most recent data available in our files, the current range-wide population estimate for Mariana swiftlets is approximately 1,493 swiftlets on Guam (DON 2014a, p. 8), over 6,100 swiftlets on Saipan (CNMI DFW 2011, p. 36), and approximately 400 swiftlets on Aguiguan (Cruz et al. 2008, p. 240) for a total of approximately 7,993 swiftlets. In addition, a small population was introduced and currently persists on Oahu, Hawaii (Wiles and Woodside 1999, p. 57, as noted in Valdez et al. 2011, p. 301).

Threats - The causes for the decline of Mariana swiftlets are mostly unknown, but human disturbance, predation, pesticides, and disease have been hypothesized as having a role (USFWS 1991, p. 18-22). Swiftlets have been documented to flush, or fail to enter their caves when humans are near or within their caves (Wiles and Woodside 1999, pp. 57, 61). Swiftlet sensitivity to human presence has resulted in injuries to chicks and adults, and could result in damage to eggs (Wiles and Woodside 1999, p. 61). Sources of human disturbance have included Japanese soldiers during World War II, guano mining, hunters, hikers, and vandalism.

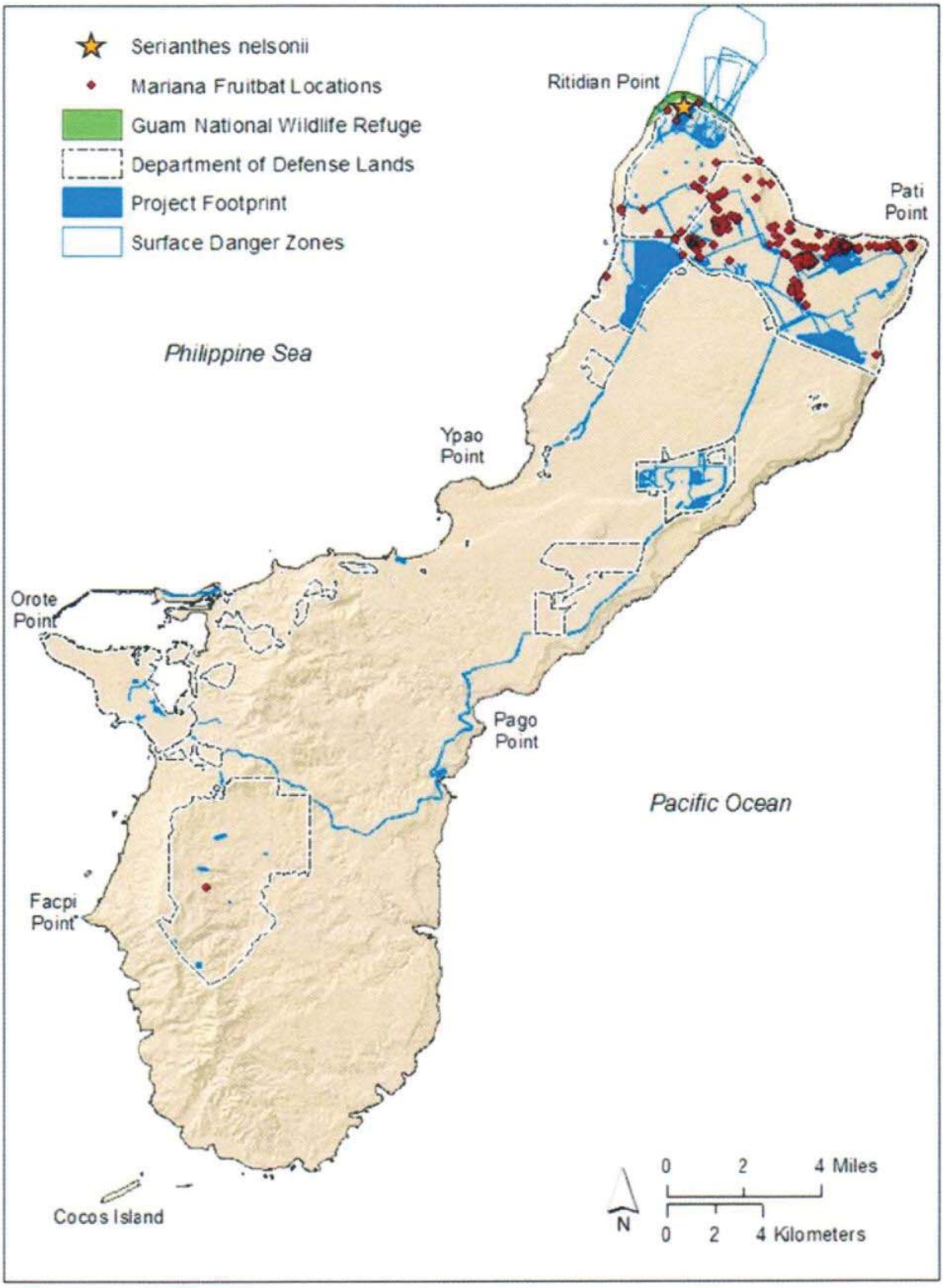

Figure 2. Action Area.

Brown treesnake predation on swiftlets is considered to be a regular event, and there are recent observations of brown treesnake predation on swiftlets in Mahlac cave on Guam (DON 2012). The use of pesticides such as DDT has been suspected of causing the decline of swiftlet populations on Guam (Diamond 1984, p. 452), but the concentrations of pesticide residues found in swiftlet guano have not supported this hypothesis (Grue 1985, p. 301). On Saipan, non-native cockroaches are known to destroy swiftlet nests by consuming the saliva that holds the nests to the walls or ceilings (Cruz et al. 2008, p. 242). Savidge et al. (1992, p. 206) investigated the role of disease in the decline of birds on Guam and determined that there is no evidence that it has played a significant role. The typhoons that frequently occur in the area may cause periodic declines in swiftlet populations, but are not expected to threaten the species as a whole since the species has survived numerous such events during its evolutionary history (USFWS 1991, p. 22).

Green sea turtle

Listing status - The green turtle is listed as endangered in Florida and on the Pacific coast of Mexico, and as threatened throughout the rest of its range (NMFS and USFWS 1978). The National Marines Fisheries Service (NMFS) and Service have recently proposed to relist the green turtle based on 11 different distinct population segments (DPS's). The new proposal, if finalized, will uplist their status, along with the rest of the Central West Pacific DPS, to endangered. This DPS includes the Mariana Islands, southern Japanese Islands, the Marshall Islands, the islands of Belau, and parts of Melanesia (NMFS and USFWS 2015, p. 15311). The entire DPS is estimated to have approximately 6,500 nesting females (NMFS and USFWS 2015, p. 15311). Persistent threats to this DPS include continued poaching and development of nesting beaches in addition to ongoing detrimental changes to marine habitats both from in-water and upland sources (NMFS and USFWS 2015, p. 15313). These threats continue to hinder their recovery when compared to other DPS's analyzed in the listing proposal, and therefore, is one of the three DPS's – of 11 proposed worldwide – that is proposed for uplisting to endangered. There is no critical habitat within coastal water or on nesting beaches in the Mariana Islands, although critical habitat for the green turtle occurs within coastal waters in portions of its range (NMFS 1998).

Species description - The green turtle grows to a maximum size of 4 ft (1.2 m) in carapace (upper shell) length and 440 lbs (200 kg) in body mass (https://ecos.fws.gov, *accessed* 5 June 2015). It has a heart-shaped shell, small head, and single-clawed flippers (NMFS and USFWS 1998a, p. 7). Hatchlings generally have a black carapace, white plastron, and white margins on the shell and limbs. The adult carapace is smooth, keelless, and light to dark brown with dark mottling; the plastron is whitish to light yellow. Adult heads are light brown with yellow markings. Identifying characteristics include four pairs of costal scutes, none of which borders the nuchal scute, and only one pair of prefrontal scales between the eyes (NMFS and USFWS 1998a, p. 8; https://ecos.fws.gov, *accessed* 5 June 2015).

Life history - Most green turtles spend the majority of their lives in coastal foraging grounds, and rely on marine algae and seagrass for their diet. Green turtles use nesting beaches that are characterized by intact dune structures, native vegetation, little to no artificial lighting, and beach temperatures between 26 and 35 degrees Celsius (NMFS and USFWS 2015, p. 15275, and references within). All species of sea turtles have high site fidelity to their hatching (natal)

beaches, returning close to their own hatching site to lay their nests, usually nesting multiple times over a nesting season.

The green turtle nesting season varies with locality. A female can lay multiple clutches within a nesting season at about 10 to 15-day intervals. Clutch size varies but can consist of about 100 eggs each. Hatchlings generally emerge at night and dig upward in a communal effort and take 2 to 3 days before reaching the surface. Newly emerged hatchlings are strongly photopositive and can be disoriented away from their path to the sea by artificial lighting (NMFS and USFWS 1998a, p. 18).

Status and distribution - Green turtles have a circumglobal distribution, occurring throughout tropical, subtropical, and to a lesser extent, temperate waters. Their movements within the marine habitat are not fully understood, but they are known to inhabit coastal waters of over 140 countries, and nest at 468 known sites worldwide (NMFS and USFWS 2015, p. 15275).

The NMFS and Service completed a five-year status review in 2007 (NMFS and USFWS 2007). An estimated 108,761 to 150,521 females nest each year among sampled nesting sites throughout its range. Among 23 sides for which data enables an assessment of the threatened population, 10 nesting populations are increasing, 9 are stable, and 4 are decreasing. Long-term continuous data sets (greater than 20 years) are available for 9 sites, all of which are either increasing or stable (NMFS and USFWS 2007, p. 14).

Threats - The causes for the decline of green turtle numbers are similar to the hawksbill turtles (refer to *Threats to Sea Turtles - Nesting Environment* below)

Hawksbill sea turtle

Listing status - The hawksbill turtle was federally listed as endangered throughout its range. Critical habitat was designated in nesting beach areas and marine areas in 1982 and 1998, respectively (USFWS 1992, NMFS 1998). Recovery plans for populations of the hawksbill turtle were completed in 1993 and 1998 (NMFS and USFWS 1993, 1998b).

Species description - The hawksbill turtle is one of seven species of sea turtles found throughout the world. One of the smaller sea turtles, it has overlapping scutes (plates) that are thicker than those of other sea turtles. This protects them from being battered against sharp coral and rocks during storm events. Adults range in size from 30 to 36 inches (0.8-1.0 m) carapace length, and weigh 100 to 200 lbs (45-90 kg). Its carapace (upper shell) is dark brown with faint yellow streaks and blotches and a yellow plastron (under shell). The name "hawksbill" refers to the turtle's prominent hooked beak (website https://ecos.fws.gov, *accessed* 15 June 2015).

Life history - Hawksbill turtle movement within the marine environment is not fully understood. Adult hawksbill turtles were once considered to be relatively non-migratory, but are now thought to use a mixed migration strategy. Studies have revealed that some turtles remain close to their rockery and others are highly mobile, traveling hundreds to thousands of kilometers between nesting and foraging areas (NMFS and USFWS 2013, p. 11 and references therein).

Hawksbill turtles typically feed in the vicinity of rock or reef habitat in shallow tropical waters with little turbidity (Witzell 1983). Throughout their range, hawksbill turtles feed on sponges but their primary diet differs depending on the region occupied. For example, in the northeastern Australia Great Barrier Reef, the primary food item was algae (72.2 percent) followed by sponges, soft corals, invertebrate species (total 23 percent), and inorganic material (5.4 percent) (Bell 2012).

Female hawksbill turtles exhibit strong fidelity of their choice of nesting sites and can lay multiple clutches at approximately two-week intervals within one nesting season (Witzell 1983). Female hawksbill turtles usually select a nest site within the cover of woody vegetation, although some will use grass or open sand if the preferred cover is not accessible (NMFS and USFWS 1998b, p. 17). There is much variation in clutch size from site to site (Witzell 1983). Maragos (1991) estimated 130 eggs per clutch for Palauan hawksbill turtles, and in eastern Caribean clutch size is closer to 150 eggs per clutch (Corliss et al. 1989).

Status and distribution - Hawksbill turtles are circumtropical in distribution, generally occurring from 30 degrees north to 30 degrees south latitude within the Atlantic, Pacific, and Indian Oceans and associated bodies of water (NMFS and USFWS 1998b). They prefer nearshore areas where they can forage on their preferred diet of marine sponges. Like green turtles, they rely on nesting beaches that have little to no artificial lighting. Hawksbill turtles usually select a nest site within the cover of woody vegetation, although they will nest occasionally in grass or open sand (NMFS and USFWS 1998b, p. 17).

The NMFS and Service completed a five-year status review in 2013 (NMFS and USFWS 2013). An estimated 22,004 to 29,035 hawksbill turtles nest each year among 88 sites within nesting beach in the Atlantic, Indian, and Pacific regions. Among the 63 sites for which historic trends could be assessed, all 63 (100 percent) showed a decline during the long-term period of greater than 20 to 100 years. Among the 41 sites for which recent trend data are available, NMFS and Service determined that 10 (24 percent) were increasing, 3 (7 percent) stable, and 28 (68 percent) were decreasing (NMFS and USFWS 2013, p. 24).

Threats to Sea Turtles – Nesting Environment

Green and hawksbill turtles, both historically common in tropical nearshore waters, have been significantly reduced over the past few centuries due to a variety of factors. The significant reduction in numbers of green turtles due to development of coastal areas for industry and tourism, meat and egg harvest in different parts of the world, and accidental catch in other fishery industries led to the listing of this species (NMFS and USFWS 1978, 32803-32807). While hawksbill turtles share many of the same threats, their numbers also declined because their shells were widely used for ornamental and practical uses (NMFS and Service 1998b, p. 4). Today, harvest continues to be a major threat in the Pacific islands, but development of historical nesting beaches also has drastically reduced populations of both sea turtles in the Pacific (NMFS and USFWS 2015, p. 15311). Threats to the green turtles on nesting grounds, as outlined in their recovery plan (NMFS and Service 1998a), are representative of those also faced by hawksbill turtles (NMFS and Service 1998b). Storm events, including typhoons, may destroy nests because of flooding or piling of eroded sand on the nest site. Beach erosion due to wave action

may decrease the availability of suitable nesting habitats and result in a decline in the nesting rate. A number of non-native and native predators dig into nests and prey upon incubating eggs, while some predators, including birds, may take hatchlings just prior to or during their emergence from nests.

Human crowding of nesting beaches can disturb nesting females and prevent laying of eggs. Flashlight use, beach fires, and artificial lighting on human structures may deter females from coming up onto a beach or may disorient hatchlings as they emerge from nests and try to find the sea (Witherington and Martin 1996, pp. 4-5). Emerging hatchlings may respond to the effects of artificial lighting by causing hatchlings to move in the wrong direction (*misorientation*) and/or interfere with their overall ability to orient (*disorientation*), which causes hatchlings to move in circles attempting to orient in the correct direction. Both behaviors can result in hatchling mortality through exhaustion, dehydration, predation, and other causes (Mann 1977, p. 54; Witherington and Martin 1996, pp. 4-5).

Human presence on nesting beaches also may lead to an increase in the presence of domestic pets (which can depredate nests) and litter (which may attract wild predators). Humans may inadvertently trample nests through recreational beach activities and increase sand compaction, which may damage nests or hatchlings. Bonfires also may damage strand vegetation and alter behavior by nesting females who are sensitive to smells such as smoke. Humans may introduce exotic vegetation in conjunction with beach development that can overrun nesting habitat or make the substrate unsuitable for digging nest cavities. Construction on or in the vicinity of sea turtle nesting beaches can result in sand compaction, beach erosion, and increase in direct and ambient light pollution. The rate of habitat loss because of erosion and escarpment may be increased when humans attempt to stabilize the shoreline, either through re-nourishment or through placement of hard structures, such as sea walls or pilings. Off-road vehicle traffic also contributes to habitat loss through erosion, especially during high tides or on narrow beaches where driving is often concentrated on the high beach and fore dune.

One of the most substantial threats to nesting sea turtles in the Pacific islands remains the illegal poaching of adults and eggs (NMFS and Service 1998a, NMFS and Service 2015, p. 15313). The direct harvest of adult nesting females can increase the rate of local extinction. Harvesting of eggs reduces the chance that recruitment will replace the reduced breeding population.

Environmental Baseline

Status of the species within the action area-Mariana swiftlet
A nest/roost cave on Ritidian Point was previously used by Mariana swiftlets, but this cave was abandoned by the late 1970s (USFWS 1991, p. 9). The reason for the abandonment is unknown, but is likely related to human disturbance or predation, since negative effects from pesticides and disease are not supported by available data (USFWS 1991, p. 18-22; Grue 1985, p. 301; Savidge 1986, p. 9). The Mariana swiftlet currently occurs in three known caves on Guam within the Naval Munitions Site (Mahlac, Maemong, and Fachi; DON 2012, p. 8) (Figure 3). Monthly counts at the three caves fluctuate, but approximately 90 percent of the swiftlet population on Guam is thought to nest/roost within the Mahlac cave (DON 2012, p. 8). In 2014, the average number of swiftlets was 1203 ± 120 at Mahlac, 226 ± 38 at Maemong, and 64 ± 61 at Fachi

(DON 2014, p. 1). The estimate of the Guam population was 1,150 birds in 2008 (Grimm 2008, p. 1), and by 2014 the estimate was 1493 ± 171 (DON 2014, p. 8).

In 2012 surveys for Mariana swiftlets were conducted in an area within the Naval Munitions Site (NMS) and a Private Lands Site (PLS) as part of the biological inventory for the Guam SEIS (DON 2013). The NMS study area is located in the northwestern portion of the NMS in the Santa Rita municipality of Guam. The PLS is located southeast of the NMS in the Talofofo municipality of Guam. No swiftlets were observed during surveys at the NMS, despite the survey stations being 1.3-2.8 mi (2.1- 4.5 km) from three known occupied swiftlet nesting caves (DON 2013, p. 17). Numerous detections of foraging swiftlets were documented during surveys within the PLS. Swiftlet observations within the PLS were 1.6- 3.1 mi (2.6- 5 km) from the three known occupied caves in the northeastern portion of the NMS (DON 2013, p. 12-15).

Status of the species within the action area-green sea turtle

Green turtles are regularly recorded in the waters around Guam (NMFS and USFWS 1998a, p. 12; Eldredge 2003, p. 653). No published estimates exist for the number of sea turtles that inhabit Guam. However, approximately 1,000 to 2,000 green turtles inhabit island reef areas in the southern island of the CNMI (Kolinski et al. 2004, pp. 98, 111). Aerial counts of all sea turtles are regularly performed twice monthly by DAWR by circumnavigating Guam's shoreline. The highest single-day count from the last two years of available data (2010-2011) was 92 turtles (DAWR, unpublished data), and DAWR staff estimate that the highest one-day counts are close to the total population of resident sea turtles (both green and hawksbill) in Guam's nearshore waters (B. Tibbatts, DAWR, pers. comm. 2015).

Although many historical nesting beaches in Guam are no longer suitable for sea turtle nesting due to onshore development and other persistent threats, green turtles continue to nest on multiple Guam beaches. A higher numbers of nests have been recorded in Guam between the months of February and July, but this correlates strongly to the number of surveys performed each month (Bonham 2014, p. 13). Therefore, green turtles can potentially nest during any month on Guam's beaches, and a peak nesting season is yet to be defined. Based on green turtle nesting data collected between 1975-2013 on Guam, about 92 total eggs were present in excavated nests that were analyzed (Bonham 2014, p. 16). Hatchling success was 87 percent and emergence success was 86 percent (Bonham 2014, p. 16). Since more frequent systematic monitoring began on the GNWR beaches in 2013, 17 green turtle nests were recorded during 2013, 4 in 2014, and 18 in 2015, as of May (GNWR 2014a, pp. 1-3; GNWR 2014b, p. 4; J. Cruce, USFWS, pers. comm. 2015). The approximately 5-km stretch of beaches at GNWR, most of which falls within the proposed SDZ, is one of the most active sea turtle nesting sites in Guam. Several crawls were recorded at Haputo Beach in 2008, and this beach has historical records of nesting (NBG 2012, p. 3).

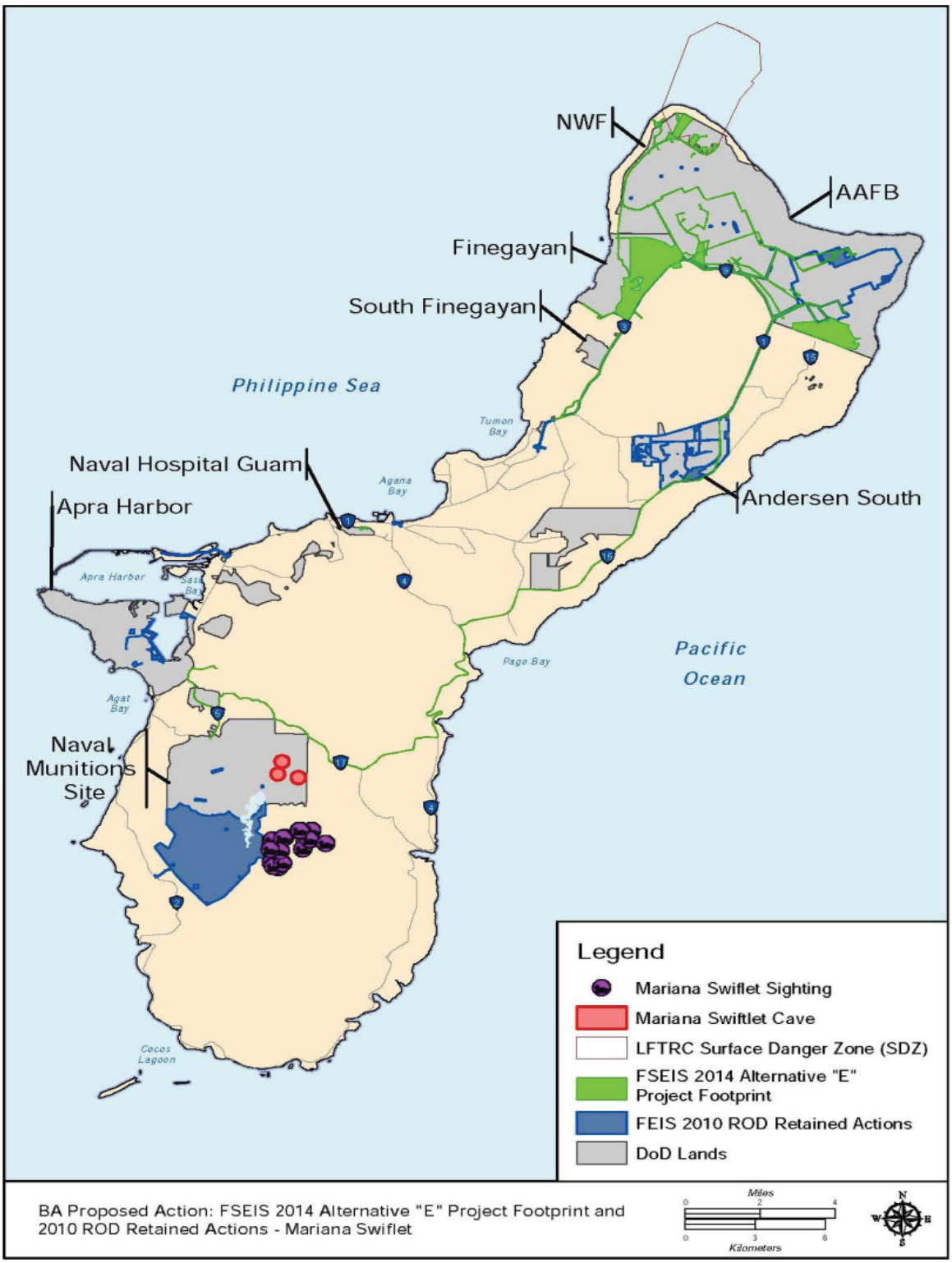

Figure 3. Mariana swiftlet locations and project footprint (DON 2014b).

Status of the species within the action area-hawksbill turtles

Hawksbill turtles are frequently sighted in the near-shore waters surrounding Guam (Grimm and Farley 2008, p. 1), although not as frequently as green turtles. Nesting data compiled by DAWR since 1975 included 15 recorded hawksbill nests in Guam. Between 1991 and 1994, hawksbill turtles nested in Sumay Marina, Guam, during varying months including October, December, February, and March (S. Wusstig, DAWR, pers. comm. 2009). The most recent documented hawksbill turtle nest was in 2009 (Bonham 2014, p. 15). Although not documented in recent years, it is possible that hawksbill sea turtles could nest at Ritidian or other historical nesting beaches on DoD property, Haputo, Double Reef, Tarague, Spanish Steps, or Dadi, if favorable nesting conditions are maintained there.

Effects of the Action

Mariana swiftlet

On Guam, all three of the caves currently occupied by Mariana swiftlets are located within the Naval Base Guam's NMS, and none of the project's ground activities will occur within or near the swiftlet caves located at the NMS. However, new aviation training flight paths are proposed over the Talofofo River watershed, the primary foraging area for swiftlets on Guam, and over the NMS area. Flights may also occur over the Ugum River watershed that supports swiftlet foraging near the mouth of the river. Foraging by most members of the swift family is likely limited to 328 ft (100 m) above the tree canopy because of the reduction in insect prey above that level (Chantler and Driessens 1995, p. 20). Tree canopy height plus 328 ft (100 m) is expected to be well below 1,000 ft (305 m) above ground level, thereby reducing risk of bird/wildlife aircraft strike hazard, but noise generated by the aircraft may still affect swiftlet foraging behavior, as has been documented in other species (refer to General Effects section of the Biological Opinion, USFWS 2015).

Mariana swiftlets on Guam are known to forage within 3.1 miles (5 km) of their nest/roost caves (DON 2013, p. 12), but it is not known if they will forage further away from nest/roost caves as this has not been examined for this species. The proposed LFTRC is over 20 miles (32 km) away from the known occupied swiftlet caves. However, there is a cave on Ritidian Point that was previously used by swiftlets and abandoned in the 1970's (USFWS 1991, p. 9). In addition, suitable foraging habitat is also present at Ritidian Point and seasonal insect blooms could attract swiftlets to Ritidian Point. Live fire within the LFTRC could preclude reoccupation of the Ritidian cave by swiftlets due to noise disturbance; however, we do not currently have enough information on swiftlet behavior to know if this would occur.

As stated above, conservation measures included in the project description that will avoid and minimize effects to Mariana swiftlets include:

1. The DoD will maintain 328-ft (100-m) no training buffers around the known Mariana swiftlet nesting caves (e.g., Mahlac Cave, Fachi Cave, Maemong Cave) in the Naval Munitions Site.
2. To avoid noise impacts and bird/wildlife aircraft strike hazard risks, all aviation training will be conducted such that flights approach the southern portion of the Naval Munitions

Site over the Talofofo River watershed and Fena Reservoir at heights of 1,000 ft (305 m) or greater above ground level. Flights may go up the Ugum River at altitudes of 1,000 ft (305 m) or greater above ground level until they reach 9,843 ft (3,000 m) from the mouth of the river at Highway 4 and then low-level terrain flights may begin. Otherwise, low-level training flights (DON 2010, p. 54) will be restricted to the southernmost portion of the Naval Munitions Site (DON 2010, p. 35) where swiftlets are not commonly present.

Adverse effects to Mariana swiftlets that nest and shelter in the caves are not expected. If construction noise, noise from aircraft overflights, or noise from the LFTRC disturbs foraging swiftlets, they would likely avoid the disturbance and forage elsewhere. There have been no reports of aircraft striking Mariana swiftlets on Guam. Conservation measures included in the project description, such as invasive species control and habitat restoration, may benefit the Mariana swiftlet. Overall, effects from the proposed action to the Mariana swiftlet are expected to be discountable.

Green and hawksbill sea turtles

The proposed action would result in the increase of recreational use at nesting beaches, increase in light pollution at nesting beaches, create noise disturbance from the operation of the LFTRC, and potentially hinder data collection by biologists on nesting beaches because of limited access to nesting beaches at the GNWR. To minimize impacts to sea turtles from recreational beach users, DON proposes to continue an education and outreach program about sea turtles and to use hooded lights to the maximum extent practicable. Educational outreach described in the proposed action is comprised of creating posters, brochures, and elementary school booklets that are distributed to local dive shops. Tarague Beach on AAFB and the Spanish Steps beach on NBG continue to have multiple sea turtle nests recorded annually, and nesting is possible at a number of other beaches on DOD property. These nesting beaches are open to personnel with access and are expected to experience an increase in recreational activities as a result of personnel moving to Guam through the proposed action. Educating beach users can minimize harmful activities associated with increased recreation like artificial lights or fires at night or bringing pets to nesting beaches. As mentioned above, darkness is important on nesting beaches as artificial lights can interfere with the ability of hatchlings to orient themselves. The use of hooded lights to the maximum extent practicable will help minimize artificial lighting and maintain conditions suitable for nesting on beaches. DON is also proposing to implement biosecurity measures and the development of a HACCP as best practice measures, which will minimize the likelihood of spreading invasive species that can harm nests and hatchlings such as biting ants and plants that are can root quickly and penetrate nests.

Although the SDZ will be monitored from observation towers, ground patrols would also be conducted on the nesting beach prior to the operations of the LFTRC, which will operate daily up to 39 weeks per year. As part of the RSS training package, personnel would be directed to not interact with sea turtles and report all sightings to the Service and coordinate with the GNWR on surveys at the Refuge (see Conservation Measures). The limited amount of time spent on beach edge closest to the road for the survey of the water portion of the SDZ, combined with implementing RSS training for sea turtles and coordination with the GNWR on presence of

nesting sea turtles at Refuge will minimize the likelihood of disturbance to nesting sea turtles and hatchlings by RSS personnel.

Currently, GNWR staff survey beaches at least weekly. Monitoring needs to be at least this frequent to facilitate nest excavations and to track important biological information on nesting sea turtles. Frequent monitoring is also important because evidence of crawls and nests weather away as time passes. Therefore, it is crucial that regular monitoring is coordinated between RSS and GNWR staff. As mentioned above, a "nesting season" is still largely speculative on Guam, and continued frequent monitoring can help researchers and managers determine these temporal patterns with more certainty. Further, this information will enable conservation and management by being able to accurately track the status of nesting females in the region, be able to detect declines, and respond with appropriate management actions. The operation of the LFTRC may limit regular access to beaches within the SDZ for up to 39 weeks a year. However, because GNWR will be coordinating scheduling of nesting surveys with the RSS, monitoring should be able to still occur with some regularity.

Nesting sea turtles may be exposed to noise disturbance from the operation of the LFTRC. The beach areas at GNWR may receive peak noise levels from the LFTRC of up to about 100 dB and average day-night level values between 65-74 dB (USFWS 2015). It is difficult to predict how this noise would affect nesting behavior. Sea turtles have ears that are well adapted to perceiving in-water noise, but they are poor receptors of aerial sounds (Hetherington 2008, p. 197). For aerial sounds, green turtles can only detect a limited frequency range (200-700 Hz), with best sensitivity at the low tone region of about 300-400 Hz (Ridgeway et al. 1969, p. 888). Large-caliber guns, like the ones proposed for use in the LFTRC tend to give off low-frequency sounds (16-100Hz) while small-caliber weapons can range between 150-2,500 Hz (Ylikoski et al. 1995, p. 3). Several studies have investigated behavioral responses of sea turtles when exposed to underwater noises such as airguns. In one study, green and loggerhead turtles (*Caretta caretta*) grew agitated when exposed to seismic airgun noise exceeding 166 dB at 1m (McCauley et al. 2000, p. 699), and sea turtles observed in the wild near airguns behaved in a startled way, usually by rapidly diving (DeRuiter and Doukara 2010, p. 1726). Based on the available literature, there are no data that indicates that proposed noise levels and frequency range of the weapons at LFTRC would have adverse effects on nesting sea turtles. Although turtles would be exposed to noise disturbance from the LFTRC, it is unlikely that sea turtles will be deterred from nesting on the beaches at the GNWR.

Because of the conservation measures detailed in the project description, including the use of hooded lights, an educational outreach program, and frequent monitoring, adverse effects to green and hawksbill sea turtles that nest on the beaches in the action area are not expected. Therefore, the effects from the proposed action to green and hawksbill turtles are expected to be discountable.

Conclusion

Based on the above information, including the proposed conservation measures, and our analysis, we concur with your determination that the proposed project may affect, but is not likely to adversely affect the Mariana swiftlet, green turtle, and hawksbill turtle. Unless the project description changes or new information reveals that the effects of the proposed action may affect listed species in a manner or to an extent not considered, or a new species or critical habitat is designated that may be affected by the proposed action, no further action pursuant to section 7 of the ESA is necessary.

Although conservation recommendations are not typically included in informal consultations, we ask that you consider the following measures to further prevent disturbance to nesting females, their nests, and emerging hatchlings on beaches.

Conservation Recommendations

- Avoid the use of artificial lighting at or near nesting turtle beaches. However, if lighting is used, use of hooded lights near or on nesting turtle beaches should be a requirement.
- Personnel should refrain from smoking while on nesting beaches to prevent deterring nesting females, as they can be sensitive to scent (J. Cruce, USFWS, pers. comm. 2015).
- If personnel encounter a nesting sea turtle or hatchlings, every possible measure will be taken to leave them alone. Personnel should keep at least a 5-meter distance from any individual turtle onshore, and any lights should be directed away and turned off.
- Personnel should keep beaches free from litter and debri, which can tangle nesting females and impede hatchlings.

We appreciate your efforts to protect listed species. If you have questions regarding this consultation or questions concerning the Mariana swiftlet, please contact Fish and Wildlife Biologist, Leilani Takano (phone: 671-989-6745). If you have questions regarding nesting sea turtles, please contact Ann Marie Gawel, Fish and Wildlife Biologist (phone: 671-989-6746).

Sincerely,

Kristi Young
Acting Field Supervisor

cc:
Celestino Aguon, Guam Department of Agriculture, DAWR
Laura Beauregard, Guam National Wildlife Refuge
Mark Bonsavage, Joint Region Marianas, Guam

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Q. APPENDIX B – MEMORANDUM OF AGREEMENT BETWEEN THE DEPARTMENT OF THE NAVY AND THE U.S. FISH AND WILDLIFE SERVICE REGARDING CONSERVATION OF GUAM MICRONESIAN KINGFISHER RECOVERY HABITAT IN NORTHERN GUAM

MEMORANDUM OF AGREEMENT

Between

THE DEPARTMENT OF THE NAVY
And
THE U.S. FISH AND WILDLIFE SERVICE

Regarding

CONSERVATION OF GUAM MICRONESIAN KINGFISHER RECOVERY HABITAT
In
NORTHERN GUAM

I. PARTIES

This Memorandum of Agreement (MOA) is entered into by and between the Department of the Navy (DON) and the U.S. Fish and Wildlife Service (USFWS), hereinafter referred to as "the Parties."

II. PURPOSE AND SCOPE

A. The purpose of this MOA is to ensure that:

1. A sufficient amount of suitable survival and recovery habitat (hereinafter "habitat") is conserved and managed in accordance with federal agency obligations under section 7(a) of the Endangered Species Act, 16 U.S.C. § 1536(a) in northern Guam to support the reintroduction and recovery of the Guam Micronesian kingfisher (hereinafter "kingfisher"); and

2. The DON can meet the purpose and need for the proposed action to relocate U.S. Marines to Guam (hereinafter "Guam Military Relocation") in accordance with its responsibilities under Title 10 of the U.S.C.

B. The provisions of this MOA will inform the Parties' respective present and future mitigation actions and decisions under section 7(a) of the Endangered Species Act (16 U.S.C. § 1531 et seq.), including those mitigation actions and decisions under subsection 7(a)(2) currently pending regarding the DON's proposed relocation of U.S. Marines to Guam as discussed in paragraph.IV.E below.

III. AUTHORITY

A. Section 7(a) of the Endangered Species Act (ESA), 16 U.S.C. § 1536(a)

B. Section 101 of the Sikes Act, 16 U.S.C. § 670a (as amended)

C. Title 10 U.S.C. § 5063

D. This MOA neither modifies existing agency authorities nor reduces, expands, or transfers any of the respective statutory or regulatory authorities and responsibilities of the Parties.

IV. BACKGROUND

A. Private and public development on Guam has reduced the amount of potentially available habitat for the kingfisher to a point where it has created uncertainty regarding whether there will be a sufficient amount habitat preserved for the future reintroduction and ultimate recovery of the kingfisher on Guam which supports the entire native range of the species.

B. The endangered kingfisher is currently extirpated on Guam. The USFWS has depicted "survival and recovery habitat" for the kingfisher on Guam in Figure 1 (hereinafter "kingfisher habitat"). The Parties agree that conservation of habitat of sufficient quality and quantity to support the reintroduction and ultimate recovery of the endangered kingfisher is needed on Guam.

C. The Parties have a responsibility under the ESA to conserve and protect endangered species.

D. The USFWS currently estimates that approximately 11,512 acres of habitat for the kingfisher is needed across all of northern Guam to support its survival and recovery in the wild. The USFWS has identified approximately 14,997 acres of potential kingfisher habitat in northern Guam, of which approximately 10,742 acres are located on lands currently under the custody and control of the Department of Defense (DoD) (Figure 1). The USFWS estimates that 8,178 acres of these 10,742 acres need to be conserved in northern Guam to provide reasonable certainty that sufficient habitat for the species will remain available for reintroduction and recovery of the kingfisher. The Parties further agree that lands in northern Guam not currently under the custody and control of DoD are also required to support the reintroduction and ultimate survival of the kingfisher in the wild.

E. The DON is proposing to relocate approximately 5,000 Marines as part of the Guam Military Relocation. This proposal is central to the U.S. Government's rebalancing of forces in the Pacific. The purpose and need for the proposed action is to ensure that the relocated Marines are organized, trained, and equipped as mandated in section 5063 of Title 10 of the U.S.C., to satisfy individual live-fire training requirements, and to establish an operational U.S. Marine Corps (USMC) presence in Guam in

accordance with April 2012 adjustments to the May 2006 United States-Japan Roadmap for Realignment Implementation.

F. The Guam Military Relocation would result in the clearing of approximately 1,015 acres of kingfisher habitat in northern Guam on lands currently under the custody and control of DoD. In addition, the USFWS estimates that an additional 319 acres will be indirectly impacted by the proposed action thereby resulting in a total impact to kingfisher habitat of approximately 1,334 acres in northern Guam.

V. GENERAL PROVISIONS

A. The USFWS has determined that approximately 8,178 total acres are required on lands currently under the custody and control of DoD in northern Guam to provide sufficient habitat for the reintroduction and eventual recovery of the kingfisher (Figure 2). To facilitate kingfisher conservation goals, the DON agrees to designate approximately 5,234 acres under the custody and control of the DoD in northern Guam as identified on Figure 3, to a status that will provide durable habitat protection needed to support native habitat restoration and land management for the survival and recovery of the kingfisher. These 5,234 acres have been identified by the USFWS as habitat for the kingfisher and needed to offset impacts of the Guam Military Relocation. The Parties recognize that the designation of the 5,234 acres under this paragraph may also provide a conservation benefit to other Federally-listed species with similar habitat requirements (e.g. Mariana crow, Mariana fruit bat).

B. Consistent with the Joint Region Marianas (JRM) Integrated Natural Resources Management Plan (INRMP) developed in accordance with section 101 of the Sikes Act, the DON agrees to actively restore native habitat and manage, in collaboration with the USFWS, the 5,234 acres identified in Figure 3 consistent with DoD's obligations under the 7(a) of the ESA and the Sikes Act to benefit the survival and recovery of the kingfisher. The DON will work cooperatively with the USFWS to identify, develop and implement specific management activities and projects on these 5,234 acres to support the following: 1) brown treesnake (BTS) control and suppression to facilitate the larger goal of suppressing snake population levels that will ultimately support kingfisher survival and recovery; 2) support for BTS control and eradication methods development, focusing on tools and techniques needed for landscape level survival and recovery of the kingfisher, 3) ungulate fencing and eradication; 4) control of small mammalian predators; 5) invasive plant control and eradication; 6) native plant restoration; and, 7) localized control of introduced invertebrates that may negatively impact kingfisher nesting/fledging. The DON has funded and initiated a number of projects to support the seven focal activities identified above. The DON agrees to continue these activities with items (2) and (3) prioritized for continued funding.

C. The JRM INRMP will be completed by DON within 365 days of signing of the MOA. This timeline is contingent upon the USFWS providing its specific concerns with the 2013 draft INRMP to the DON within 45 days of the signing of this MOA. Any delay by the USFWS in providing comments to the DON will result in a corresponding

extension of this 365-day time period. In accordance with the Sikes Act, the DON will coordinate with the USFWS on specific INRMP projects and goals. Such coordination will include, but is not limited to, the annual INRMP review.

D. Recognizing the importance of DoD's mission in northern Guam, within 120 days of the signing of the Record of Decision (ROD) for the Guam Military Relocation, the DON may, in collaboration with the USFWS, identify an alternative configuration for the 5,234 acres of habitat identified in Figure 3 as necessary to enable the DoD to meet its national defense requirements. While the DON anticipates that the 5,234 acres identified in Figure 3 will enable DoD to meet its requirements, DoD must conduct a thorough assessment to ensure current and future military requirements are appropriately considered. The revised map (acreage) must total at least 5,234 acres and be derived from areas identified in Figure 2 and provide contiguous landscape and connected forested habitat corridors. If an alternative configuration is not defined within 120 days of the signing of the ROD, the Parties agree to default to the acreage identified in Figure 3.

E. DON will provide durable habitat protection for the 5,234 acres identified in Figure 3 or as modified in subparagraph V.D. However, should an emerging national defense requirement dictate that some of the aforementioned 5,234 acres be cleared or otherwise made unsuitable for kingfisher survival and recovery, in coordination with the USFWS, the DON will identify and substitute habitat of equal or greater quality, as determined by the USFWS, to replace the impacted habitat. If habitat of equal or greater quality cannot be identified, then additional acreage suitable for kingfisher survival and recovery will be placed in durable protection to offset the loss of higher quality habitat. The amount of habitat will be determined based on the kingfisher mitigation framework developed using the best available information at that time. The Parties recognize that any substituted habitat must provide contiguous landscape and connected forest habitat corridors. The DON commits to rigorously exploring other alternatives to support an emerging national defense requirement and will only use lands within the 5,234 acres to meet the requirement if absolutely necessary.

F. For the land identified on Figure 3 (or as amended via the process described in subparagraph V.D of this MOA), the USFWS requires enhanced management activity to ensure this habitat supports reintroduction of the kingfisher. Accordingly, starting in Fiscal Year (FY) 2016, the DON commits to provide an additional $2 million per year of funding above execution year INRMP funding levels (as adjusted for inflation) for the next ten years, subject to Congressional authorization and appropriation. This additional funding will be used to support projects that fall within one of the seven focal activities identified under subparagraph V.B of this MOA, according to priorities established jointly by DON and the USFWS. Upon expiration of this ten-year period (FY 2026), the Parties mutually agree to reassess progress of recovery efforts. If, following this assessment, the USFWS determines that it remains possible to recover the kingfisher on Guam, the DON commits to extend the additional $2 million per year in funding for another five years. Subsequently, the Parties will reassess the progress of recovery efforts every five years. So long as the USFWS determines that it remains

possible to recover the kingfisher on Guam, and until the kingfisher is delisted, every five years the DON and USFWS will identify activities and a schedule of implementation that the USFWS determines are sufficient to conserve and enhance the habitat needed to support the survival and recovery of the kingfisher on these 5,234 acres. The DON will implement these activities, dedicating $2 million annually in accordance with the JRM INRMP. The Parties recognize that the level of funding may vary depending on the activities to be implemented in a given year, but will not exceed $2 million annually. The Parties may also subsequently modify, as necessary, the focal activities identified in subparagraph V.B of this MOA to be implemented on the 5,234 acres.

G. If the provisions of subparagraphs V.A to F of this MOA are not implemented as described herein, barring mutual agreement by the Parties, the Guam Military Relocation section 7 ESA consultation will require re-initiation. In addition, nothing in this MOA is intended to affect the responsibility of the USFWS and DON to re-initiate consultations pursuant to 50 CFR § 402.16, or the re-initiation regulation then applicable.

H. If new scientific information indicates the amount or extent of habitat needed for the survival and recovery of the kingfisher is different than identified herein, as determined by the USFWS, the Parties will revise this MOA in accordance with paragraph VI of this MOA.

I. The DON will maintain management authority on kingfisher habitat on Guam under the custody and control of DoD unless DoD transfers management authority to another military service, in which case the responsibilities under this MOA that apply to DON shall transfer to the military service that assumes land management authority.

J. In accordance with established security procedures to grant access to military facilities, USFWS staff shall be provided reasonable access to kingfisher habitat identified on lands under the custody and control of the DoD. DON commits to working with the USFWS to help streamline the security approval process.

VI. MODIFICATIONS, INTERPRETATIONS, ENFORCEABILITY AND TERMINATION

A. Changes and/or modifications to this MOA may be made at any time upon mutual written consent of the Parties. With regard to both Parties, no oral statement by any person and no written statement by anyone other than the undersigned, or an authorized representative as designated in writing, shall be interpreted as modifying or otherwise affecting the terms of this MOA.

B. This MOA shall be deemed null and void in its entirety if any one of the following events occurs: 1) Both Parties revoke the agreement in writing; 2) the DON does not sign a ROD with the currently identified preferred alternative in the Final Biological Assessment regarding the DON's proposed Guam Military Relocation as discussed in

paragraph IV.E of this MOA; or 3) the USFWS determines that the kingfisher is no longer viable for reintroduction on Guam.

C. The Parties understand and agree that performance by the DON of any of the terms of this MOA is subject to the availability of appropriated funds. Nothing herein shall constitute nor be considered to constitute an obligation or expenditure of funds in advance of or in excess of a proper appropriation by the Congress of the United States or otherwise be in violation of the Anti-Deficiency Act, 31 U.S.C. § 1341 et seq.

D. This MOA shall not be construed to create any private right, privilege, remedy, claim or cause of action against the Parties for or by any person or entity.

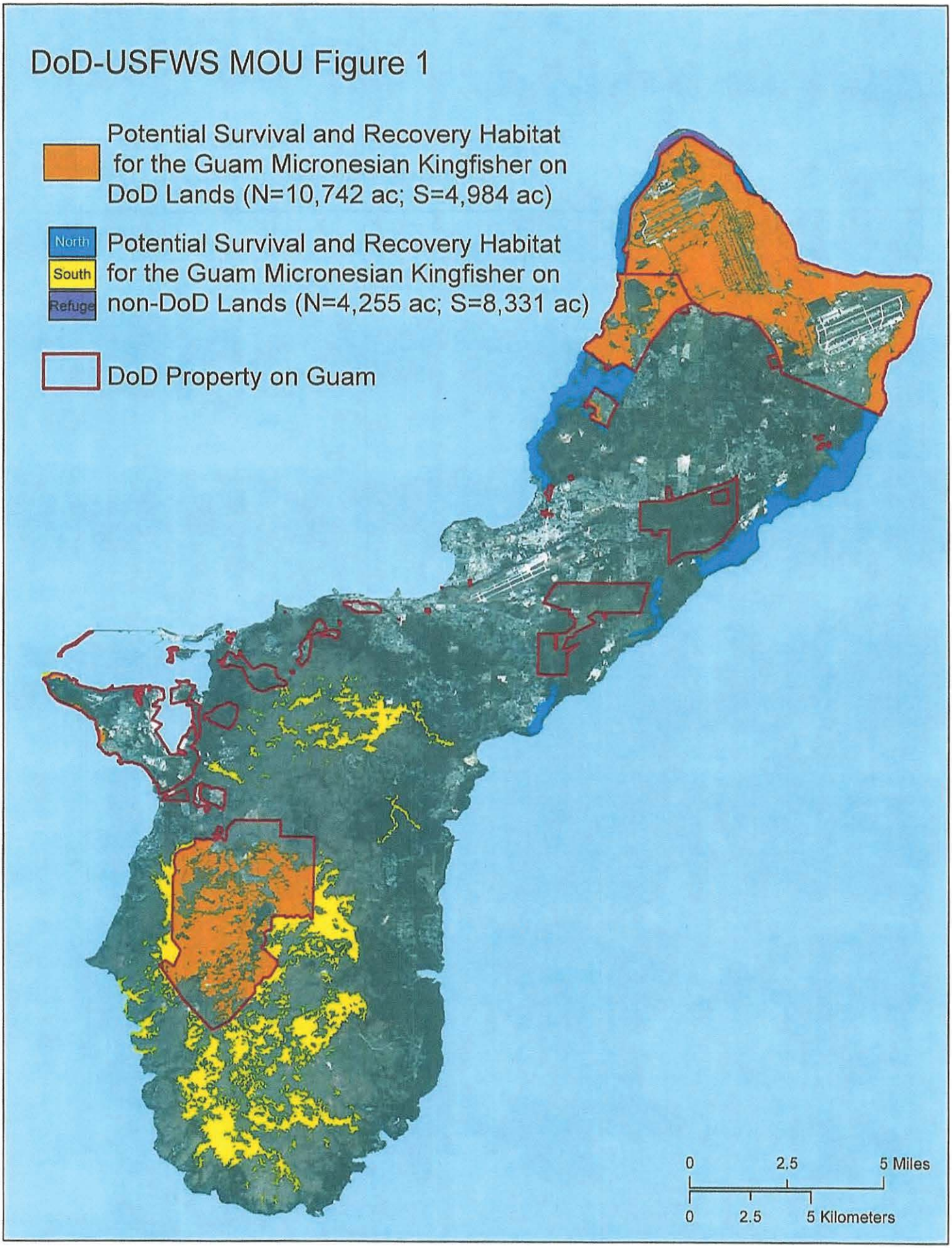
VII. RESOLUTION OF DISAGREEMENTS

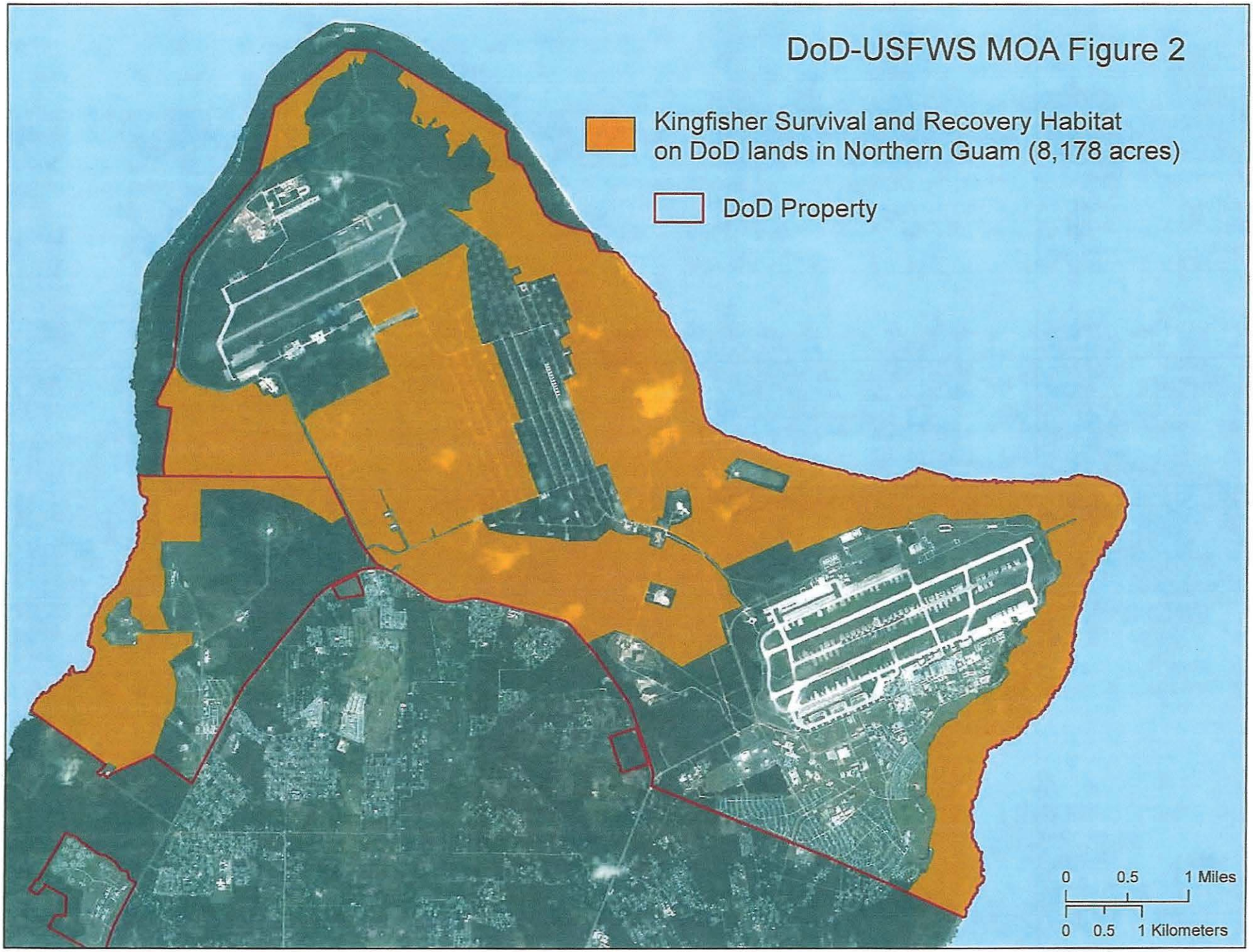
The Parties shall consult with one another to resolve issues at staff levels and elevate disputes through the respective organizational levels only if necessary. Notification of potential areas of disagreement by either agency should be in writing. If there is no resolution at the staff level, either agency may elevate the issue to the appropriate official within each agency or department.

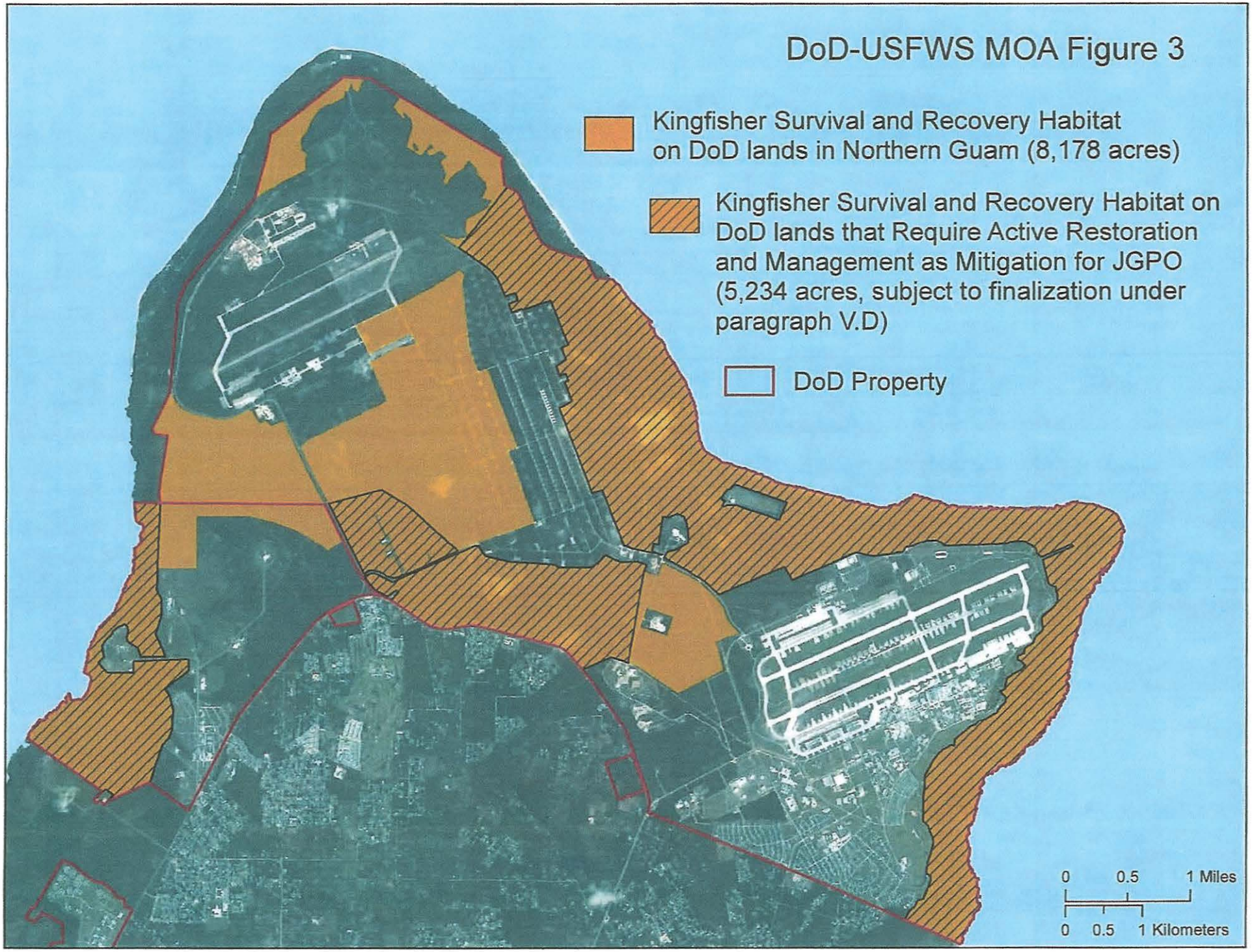
VIII. SIGNATURES

Donald R. Schregardus Date: June 11, 2015
Deputy Assistant Secretary of the Navy (Environment)

Date: June 11, 2015
Director, U.S. Fish and Wildlife Service


DoD-USFWS MOU Figure 1
Potential Survival and Recovery Habitat for the Guam Micronesian Kingfisher on DoD Lands (N=10,742 ac; S=4,984 ac)
North
South
Refuge
Potential Survival and Recovery Habitat for the Guam Micronesian Kingfisher on non-DoD Lands (N=4,255 ac; S=8,331 ac)
DoD Property on Guam
0
2.5
5 Miles
0
2.5
5 Kilometers


DoD-USFWS MOA Figure 2
Kingfisher Survival and Recovery Habitat on DoD lands in Northern Guam (8,178 acres)
DoD Property
0 0.5 1 Miles
0 0.5 1 Kilometers


DoD-USFWS MOA Figure 3
Kingfisher Survival and Recovery Habitat on DoD lands in Northern Guam (8,178 acres)
Kingfisher Survival and Recovery Habitat on DoD lands that Require Active Restoration and Management as Mitigation for JGPO (5,234 acres, subject to finalization under paragraph V.D)
DoD Property
0 0.5 1 Miles
0 0.5 1 Kilometers

R. APPENDIX C – FIGURES

FIGURES

Figure 1. Surface danger zone (SDZ) within the Northwest Field and Guam National Wildlife Refuge.

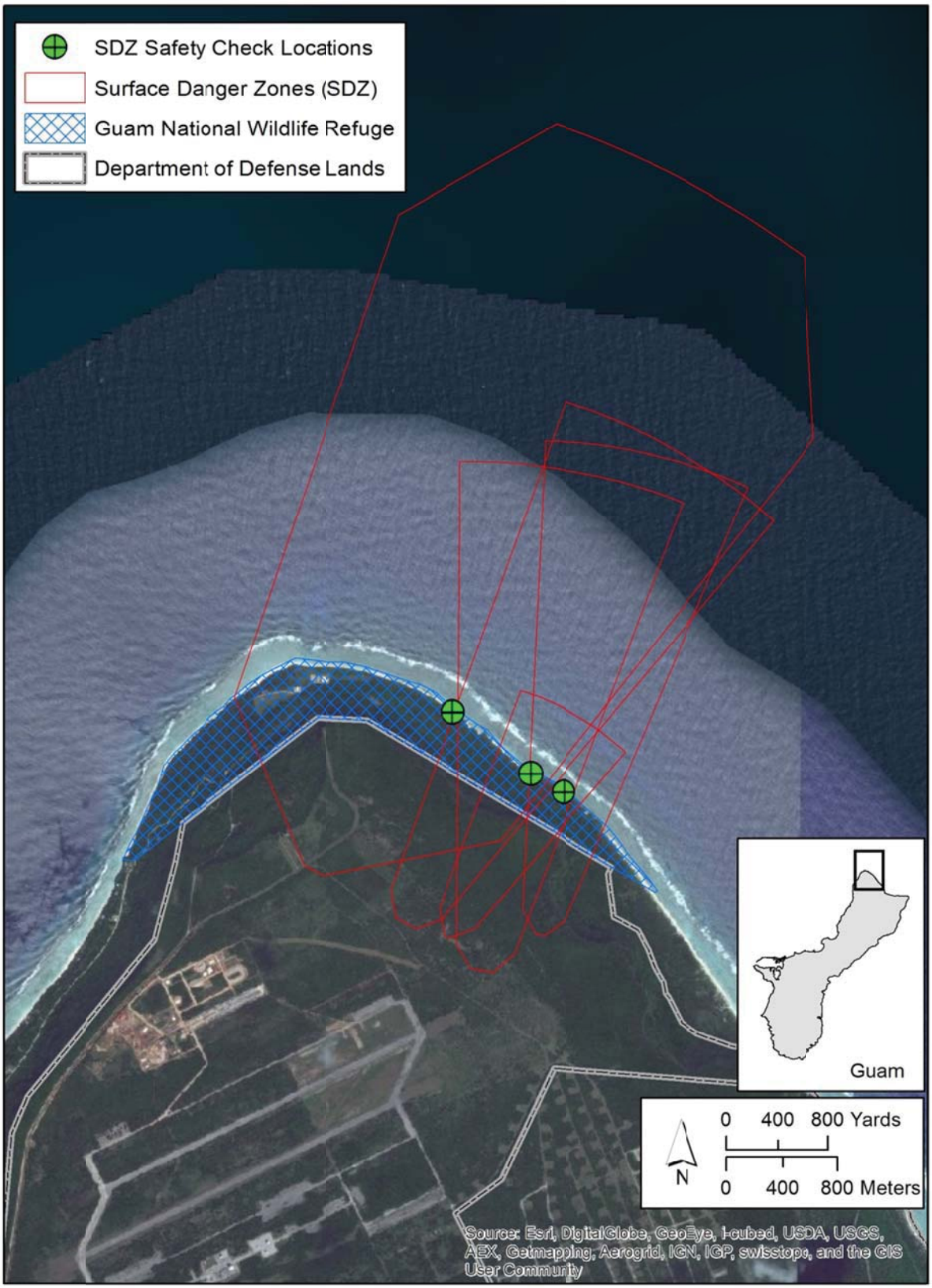


Figure 2. Well field construction sites.

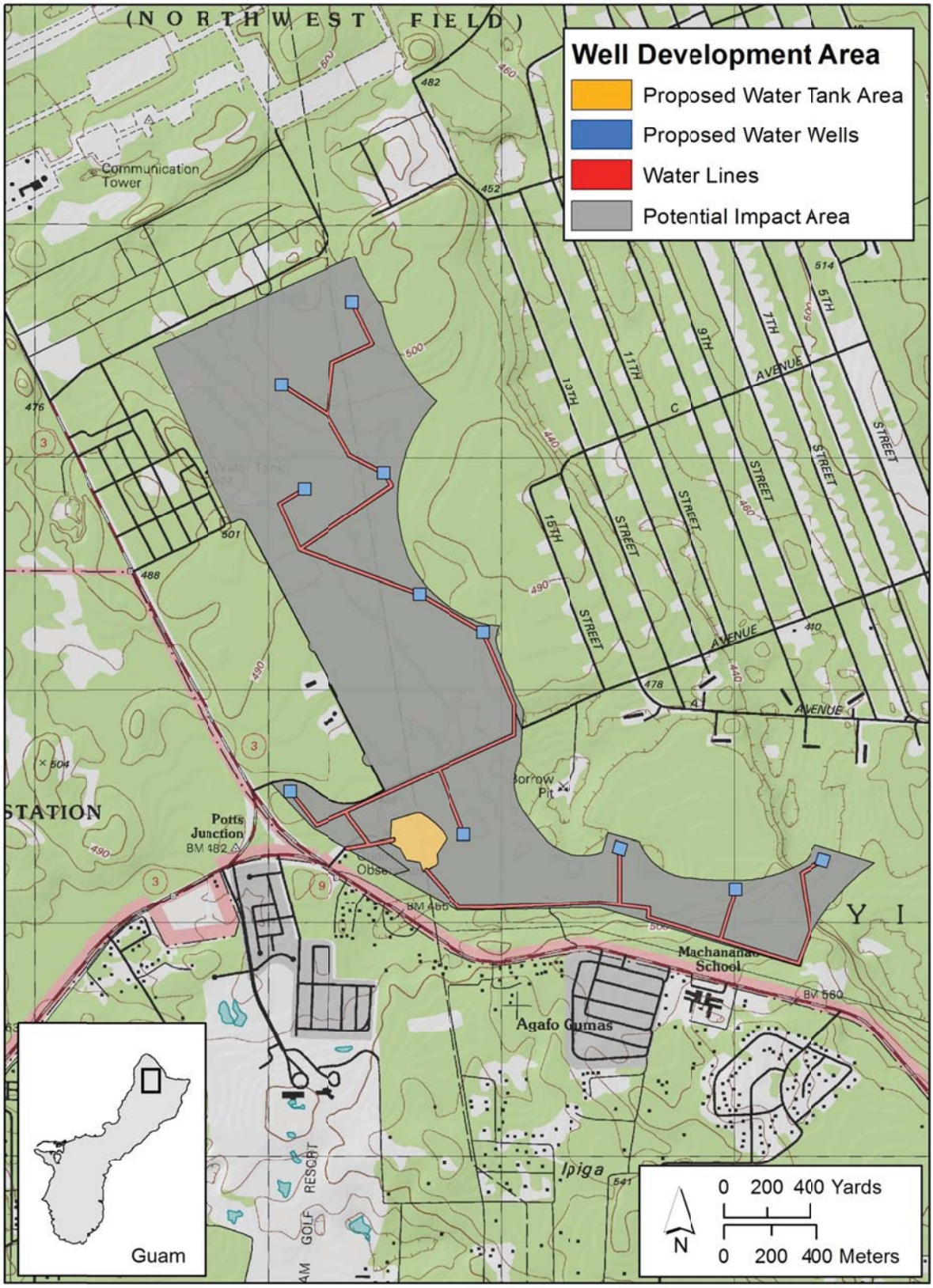


Figure 3. Forest enhancement project site and brown treesnake exclosure sites

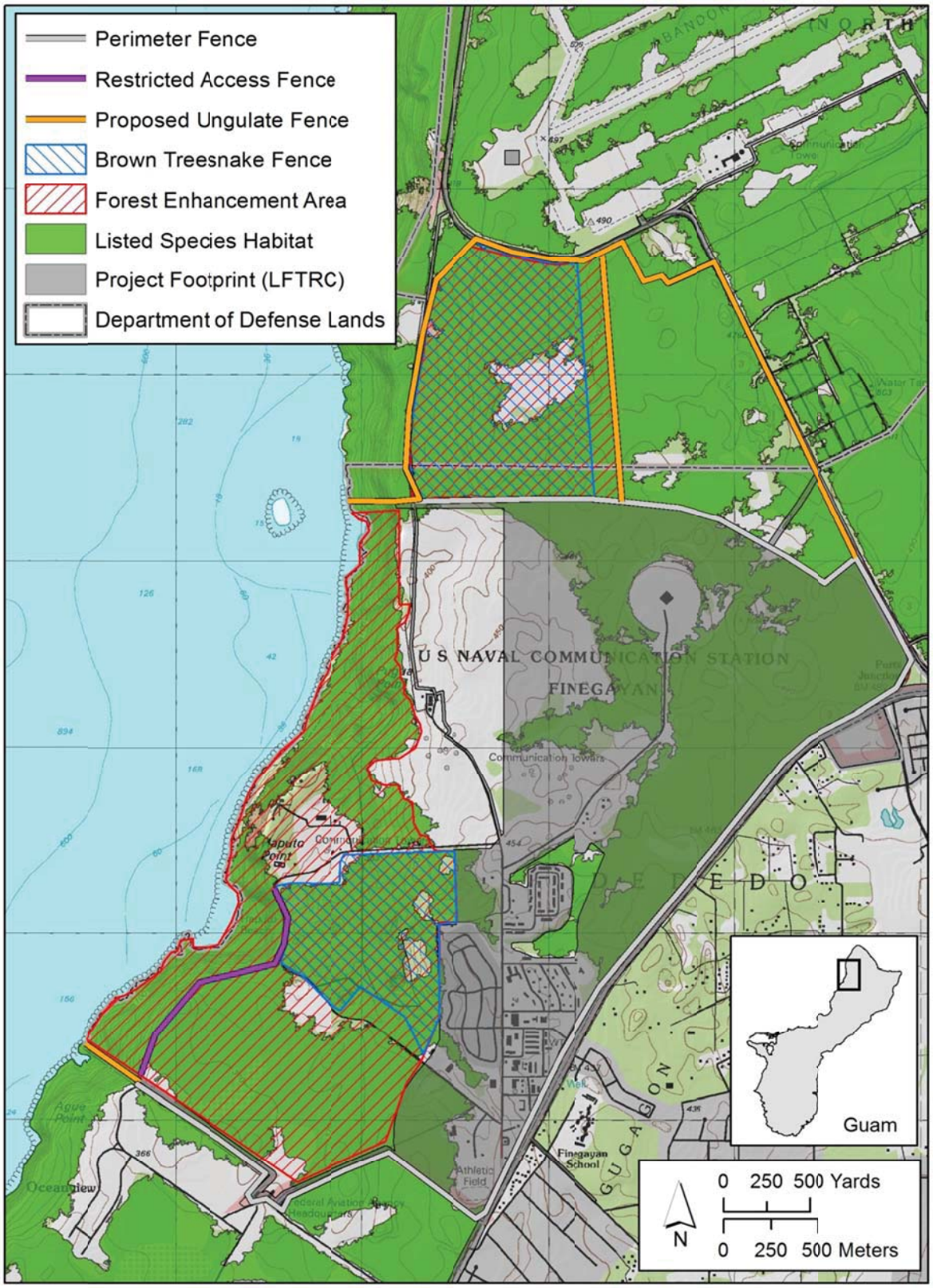


Figure 4. Action Area

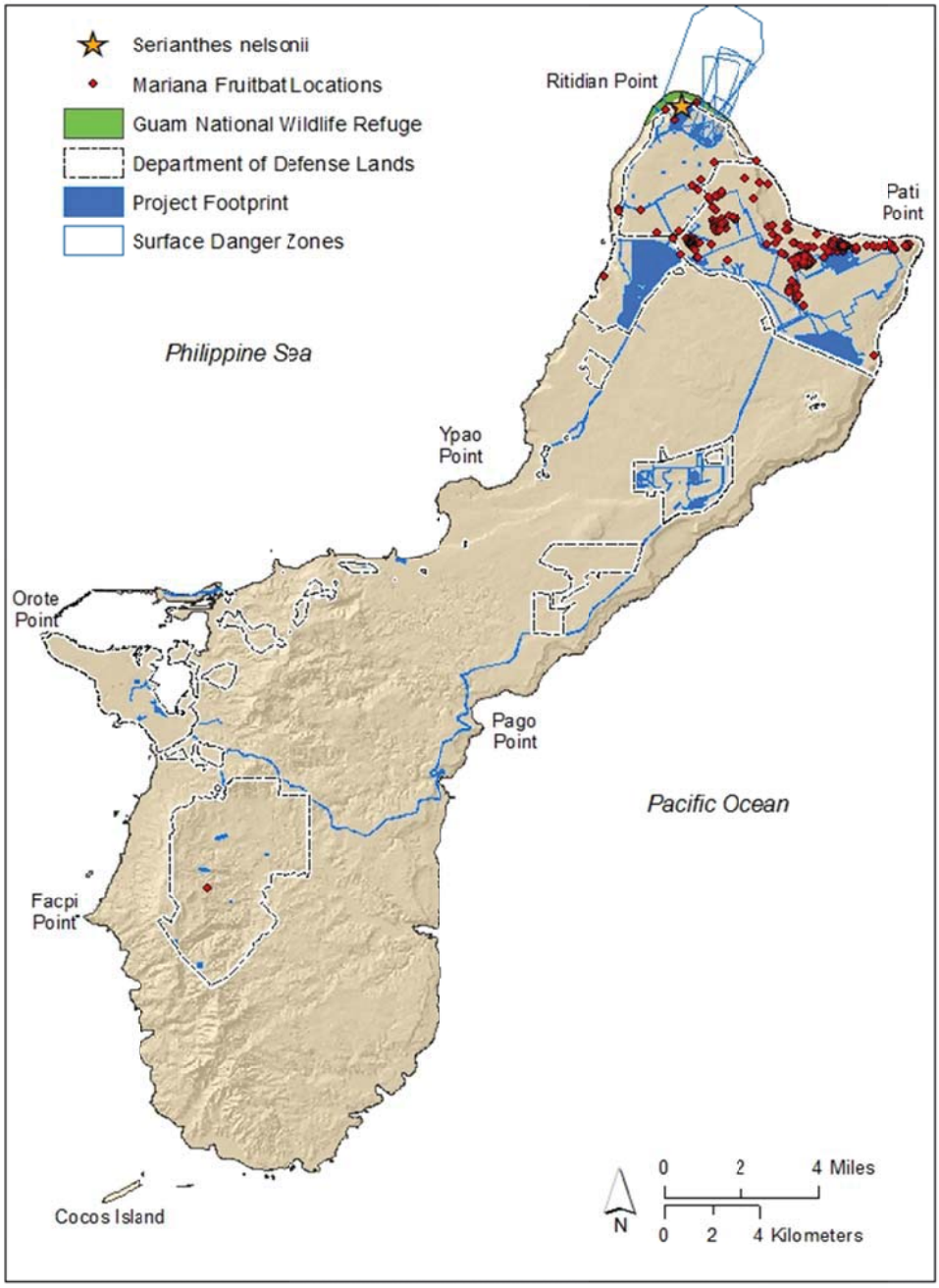


Figure 5. Direct counts of fruit bats at the historical fruit bat maternity colony at Pati Point on Andersen Air Force Base from 1984-2011 (A. Brooke, pers. comm. 2014, data compiled from survey efforts of the DON and Guam Department of Aquatic and Wildlife Resources).

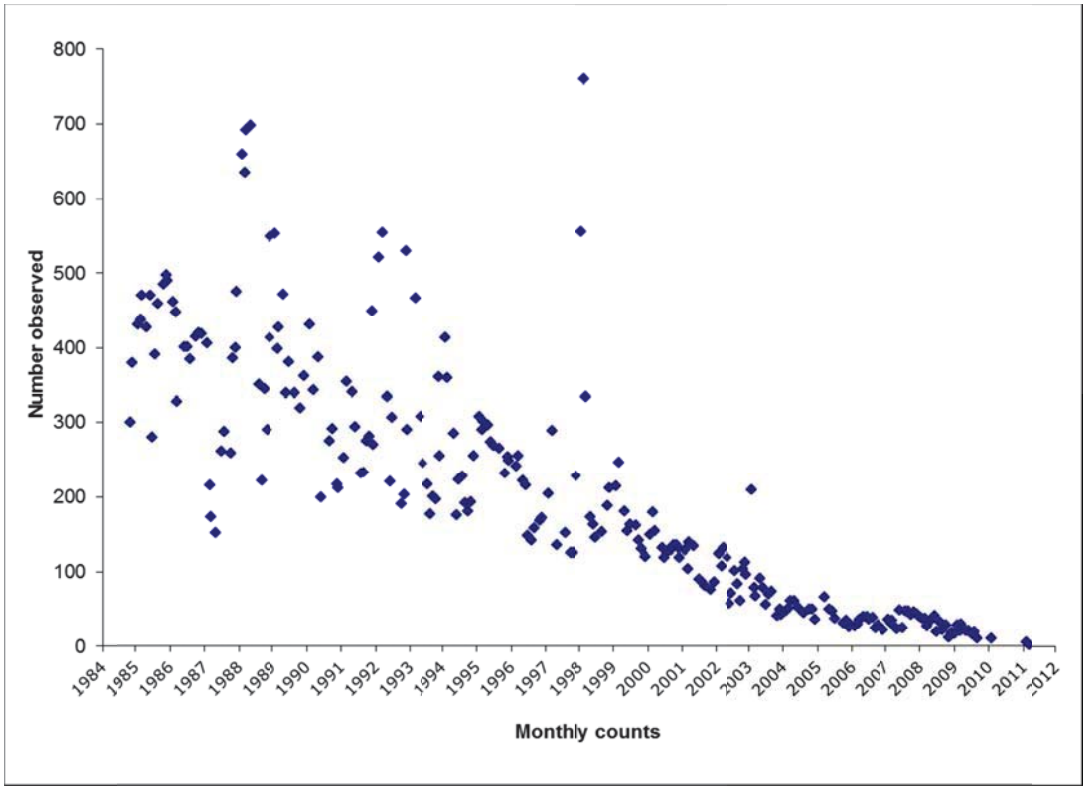


Figure 6. Guam Micronesian kingfisher habitat on Guam

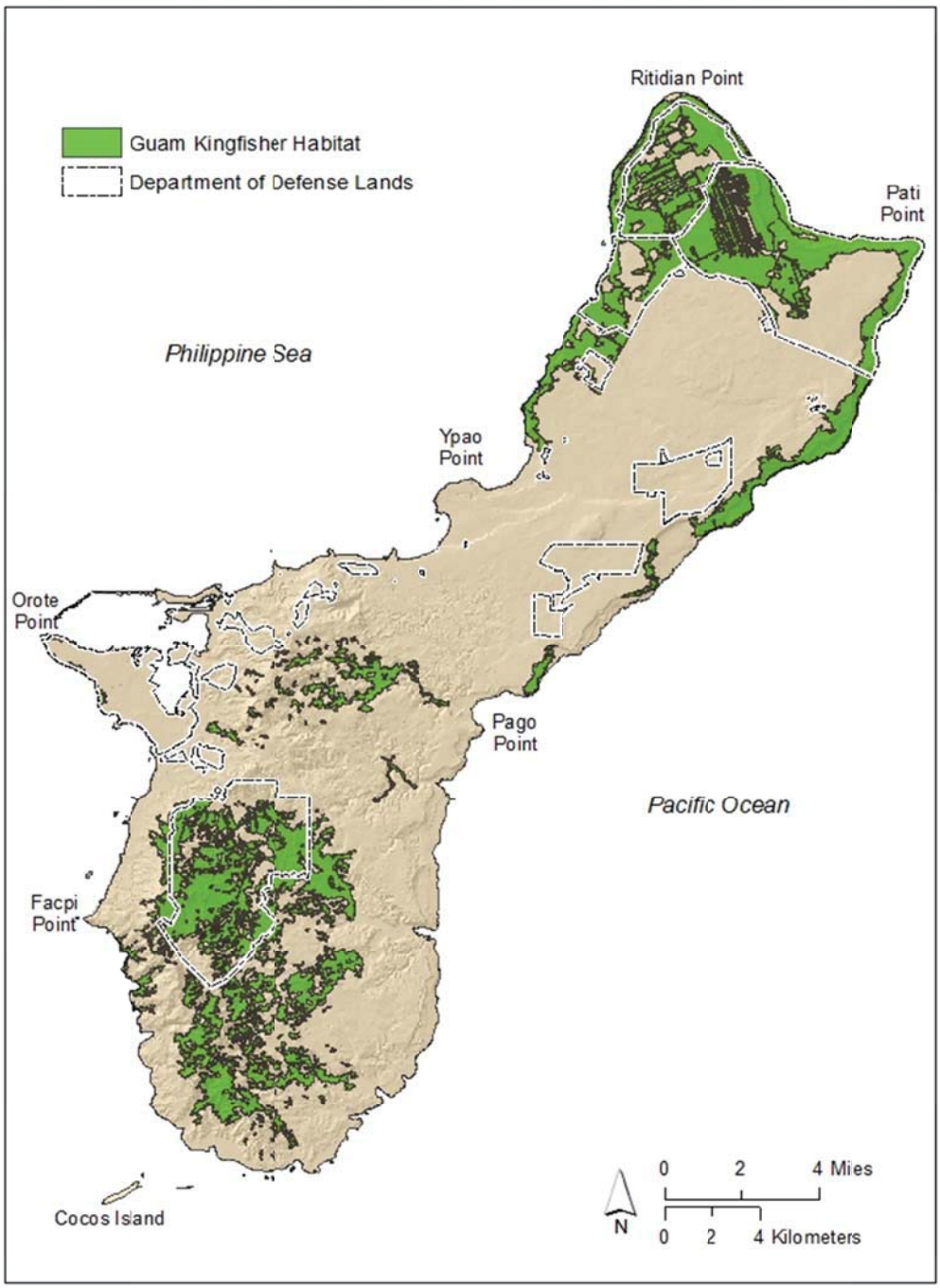


Figure 7. Mariana crow habitat on Guam.

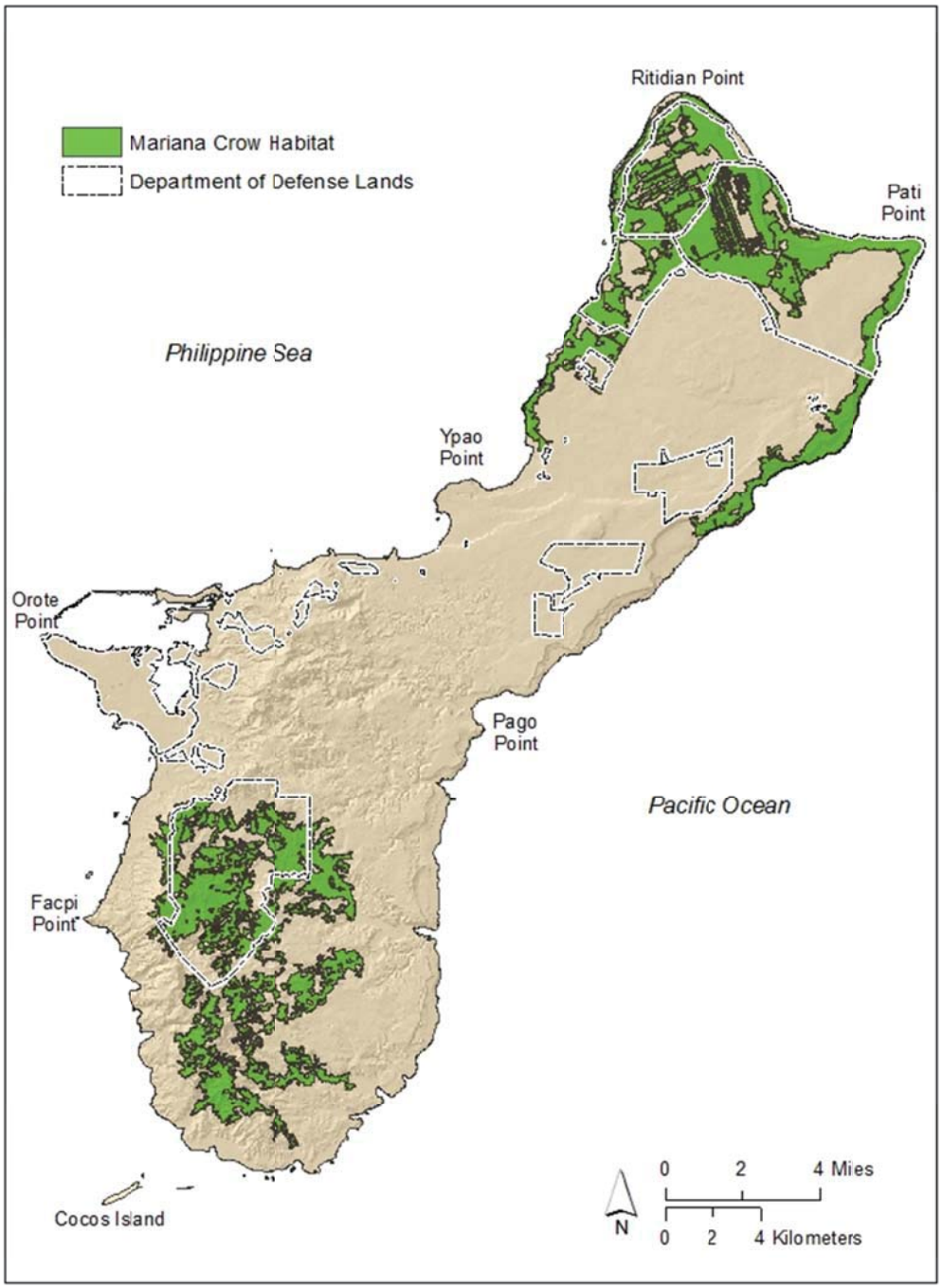


Figure 8. Guam rail habitat on Guam.

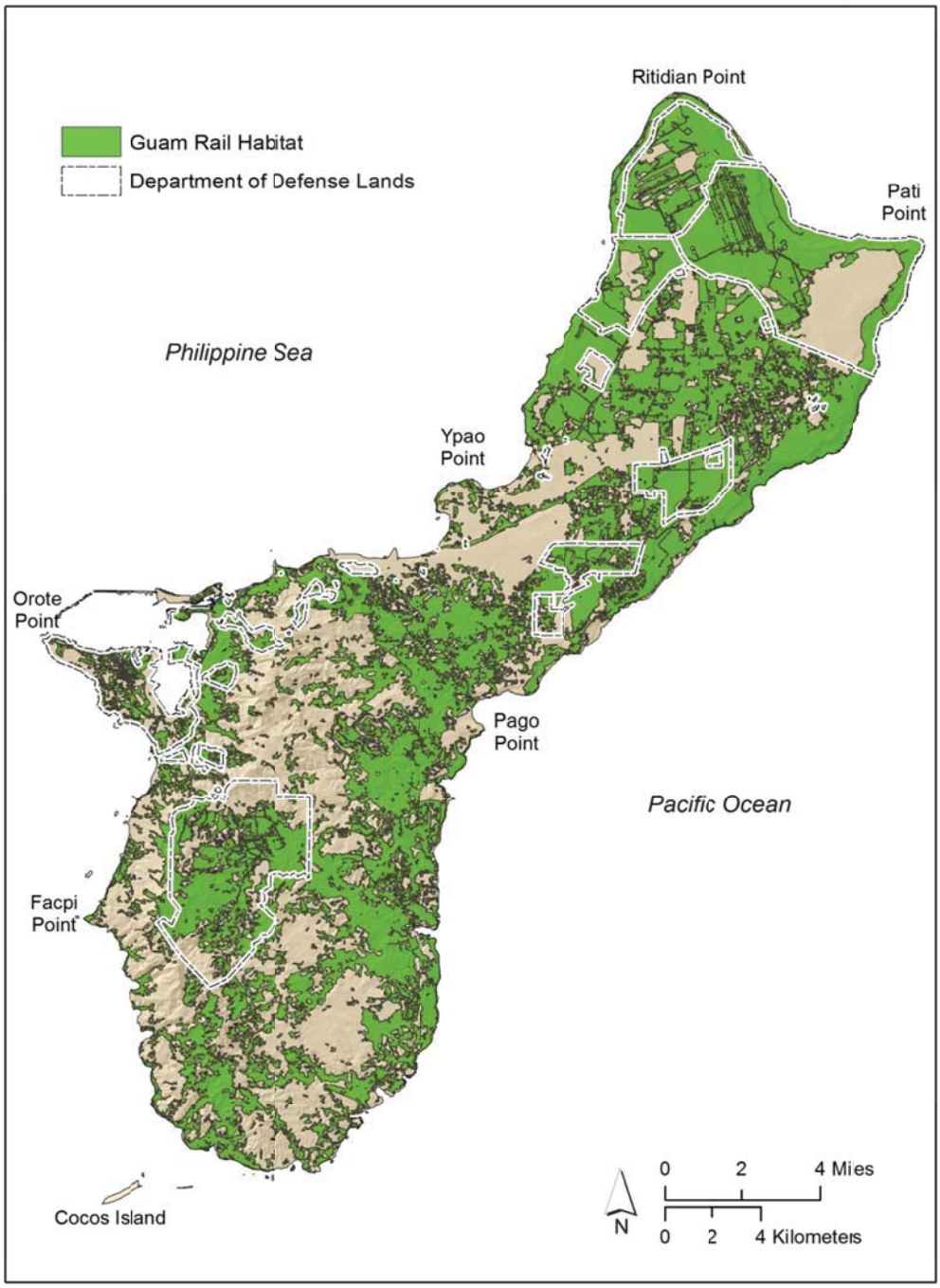


Figure 9. Mariana fruit bat detections and habitat on Guam.

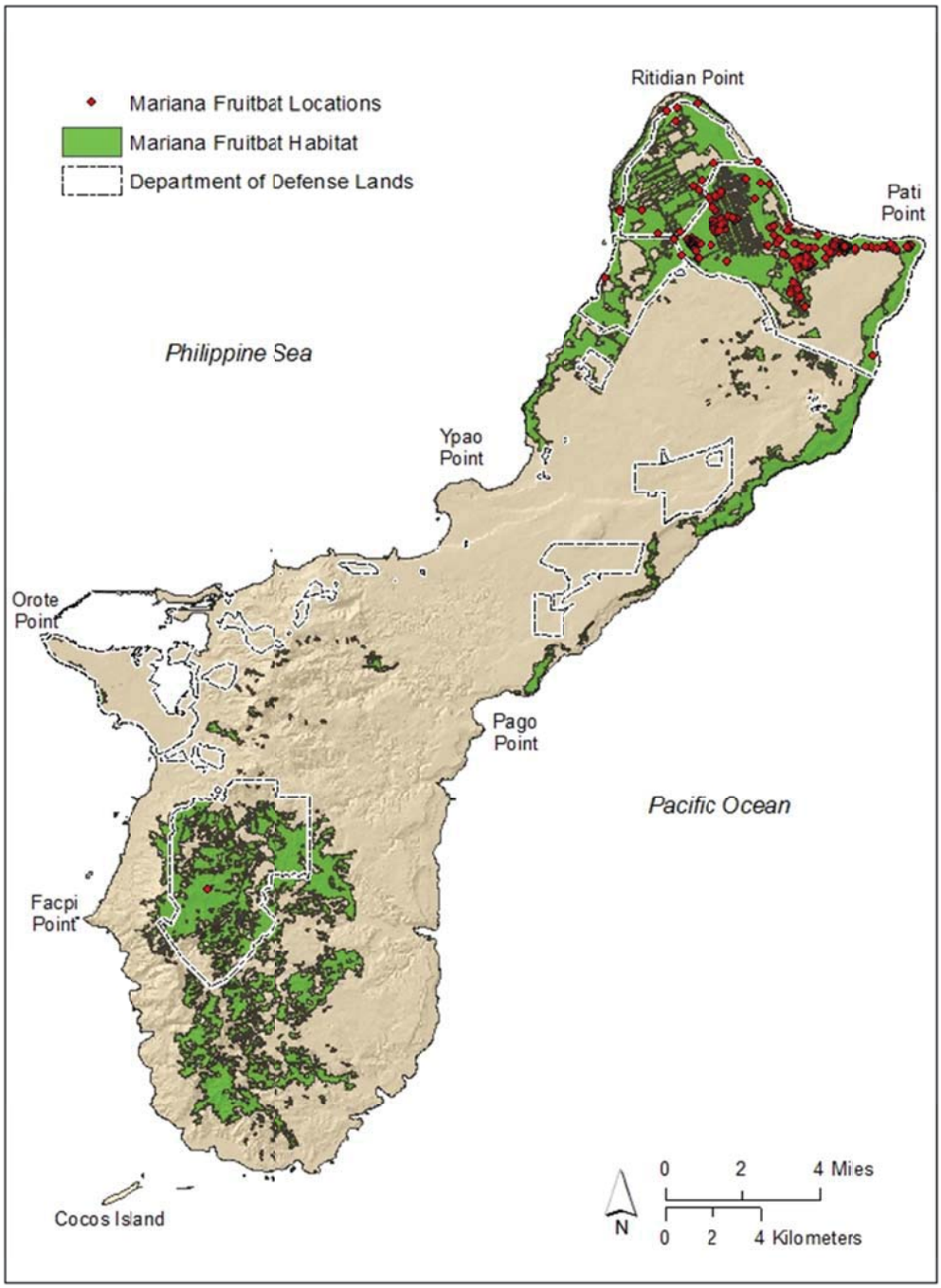


Figure 10. *Serianthes nelsonii* location and habitat on Guam.

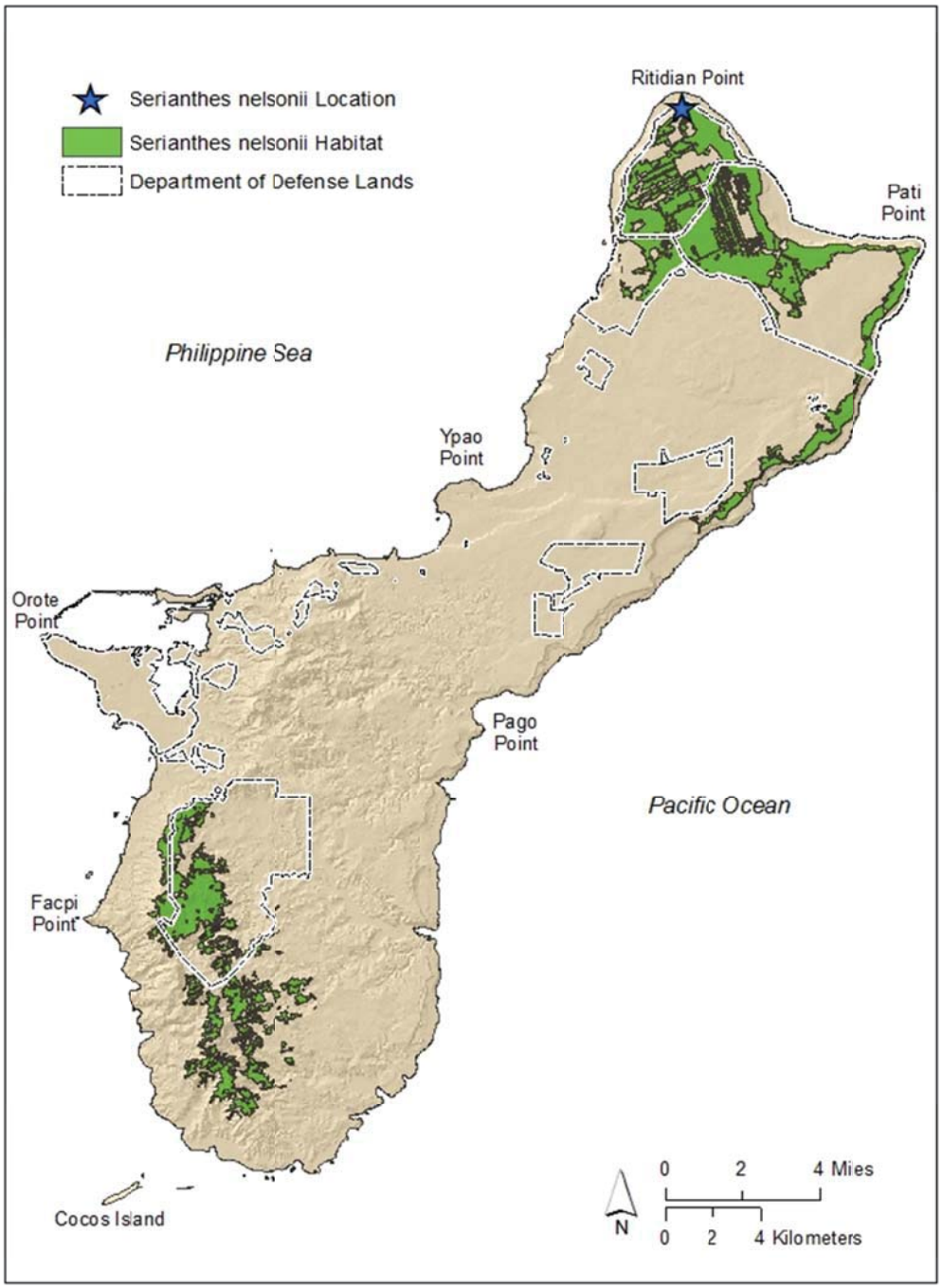


Figure 11. Primary and secondary limestone forests, Guam National Wildlife Refuge, and the project footprint at Ritidian Point, AAFB.

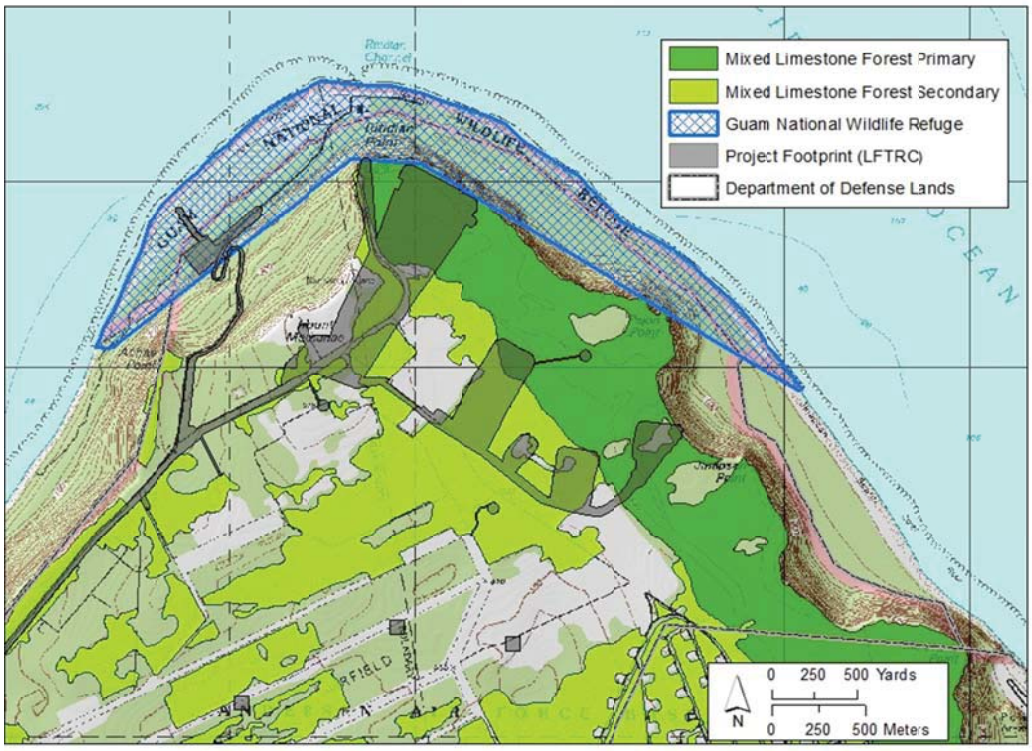


Figure 12. Listed species habitat, designated critical habitat, and the project footprint at Ritidian Point, AAFB.

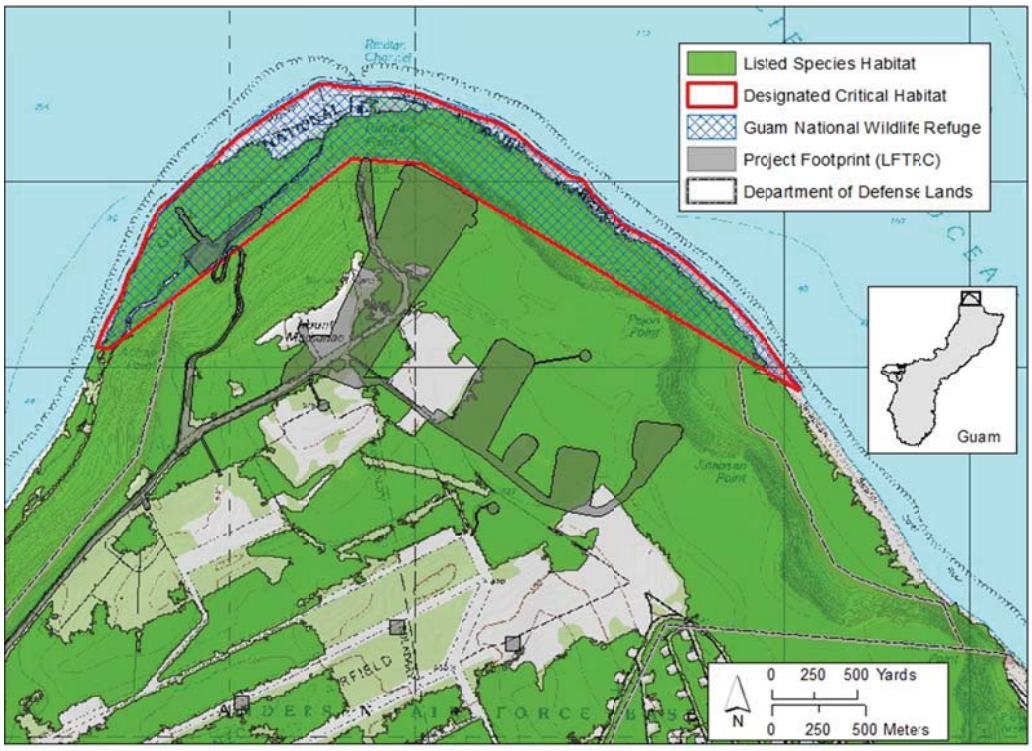


Figure 13. Results from noise modeling (80 dB contour) from operation of the LFTRC on Guam Micronesian kingfisher habitat

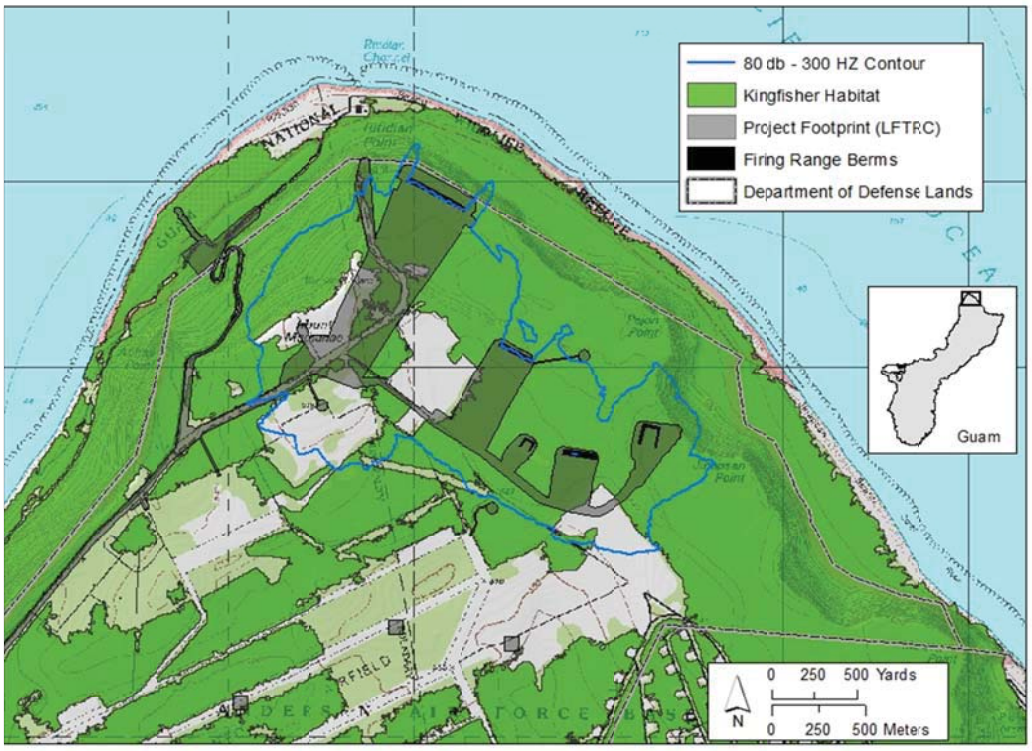


Figure 14. Results from noise modeling (80 dB contour) from operation of the LFTRC on Mariana crow habitat.

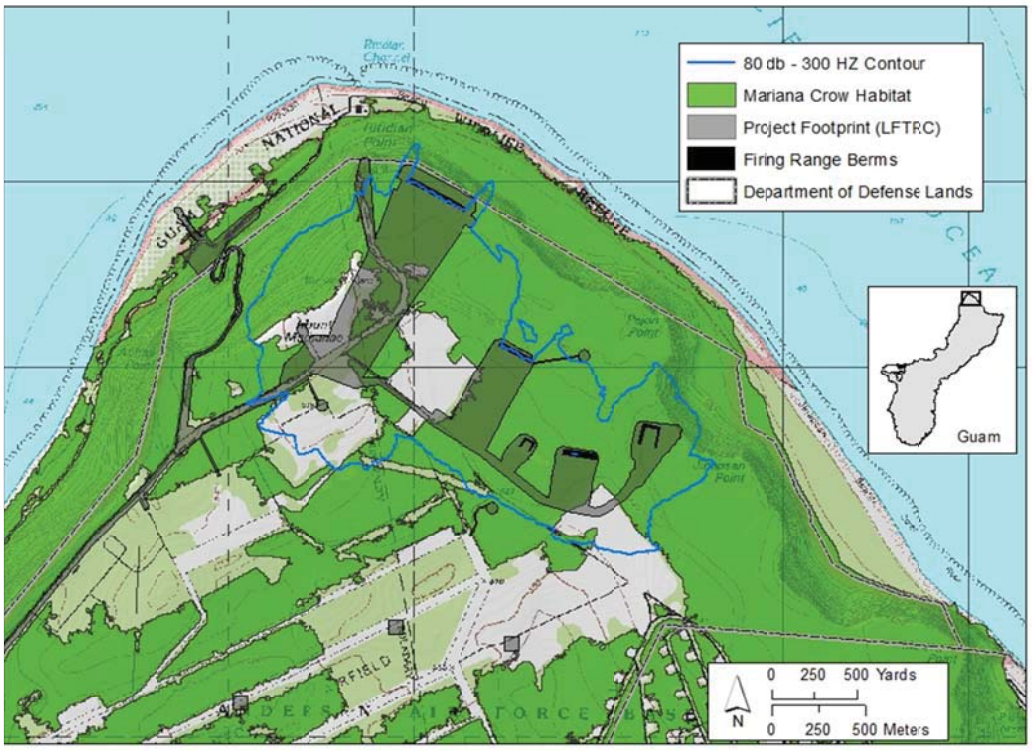


Figure 15. Haputo ERA, Mariana crow habitat, and the project footprint.

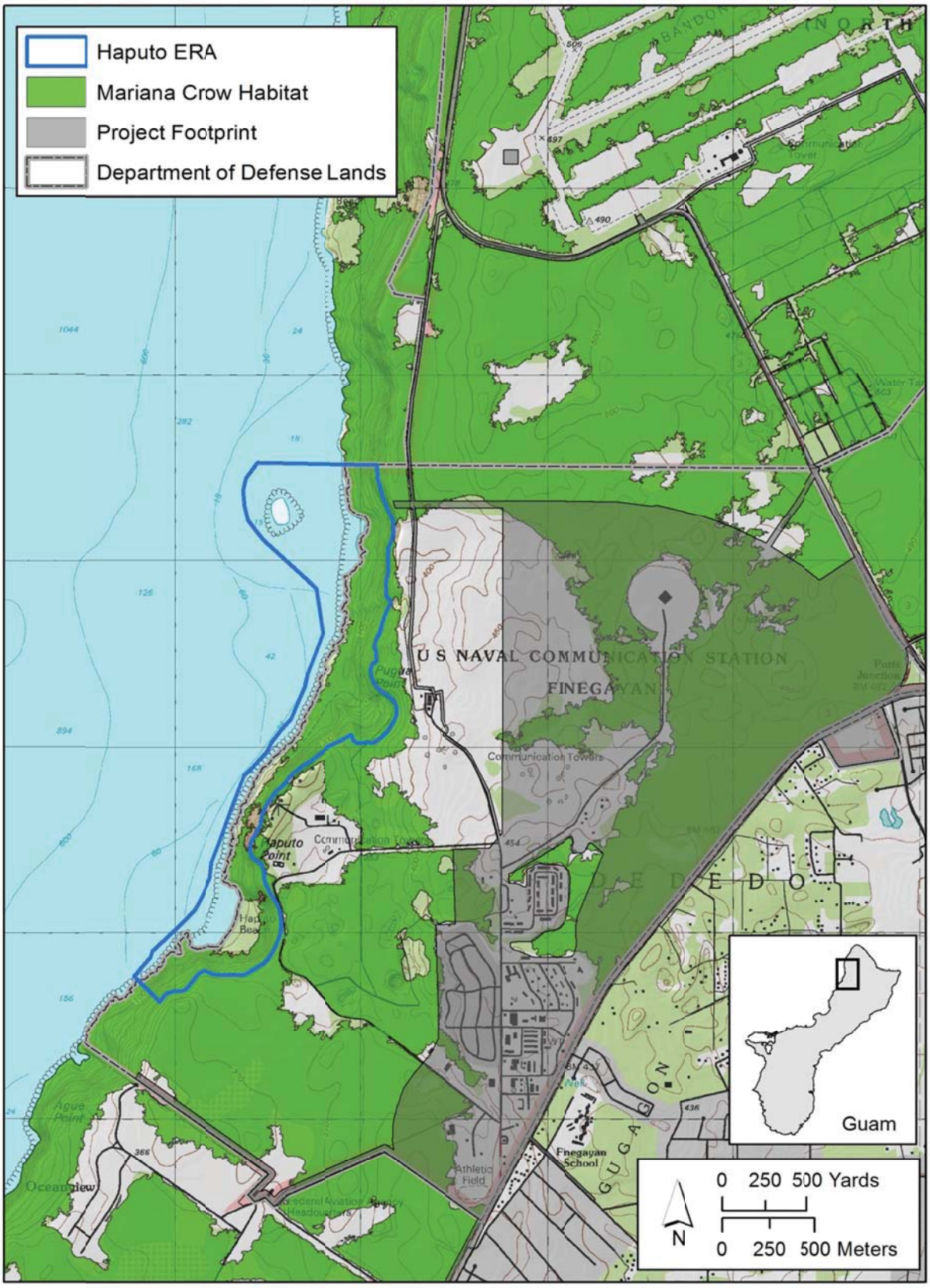


Figure 16. Guam rail habitat loss as part of the proposed action.

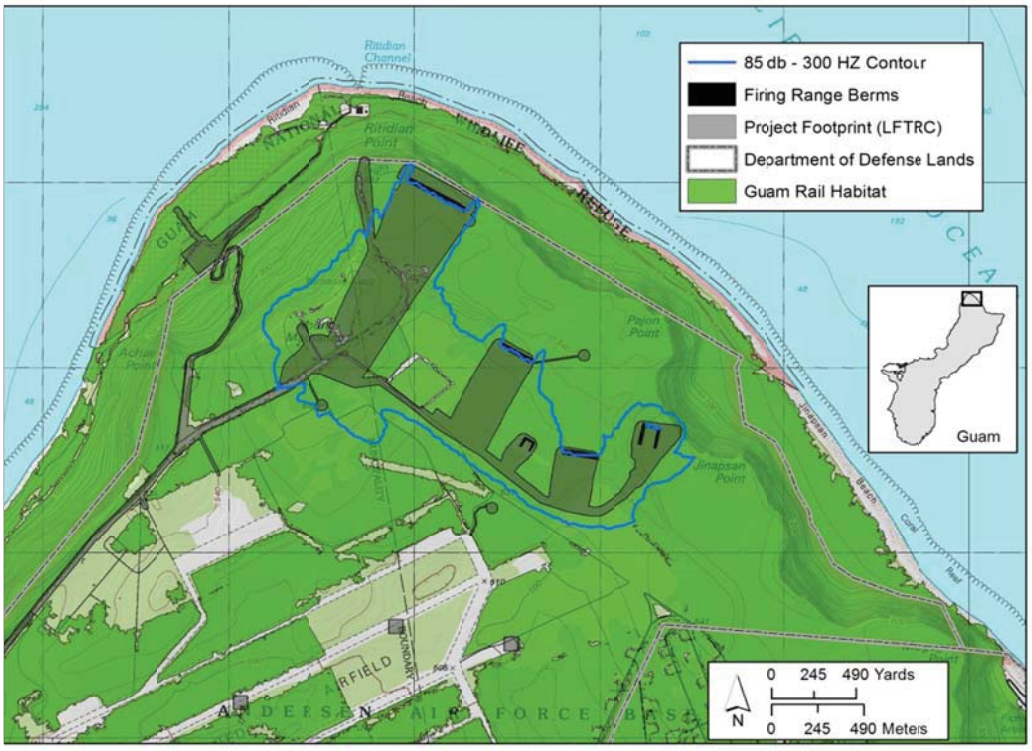
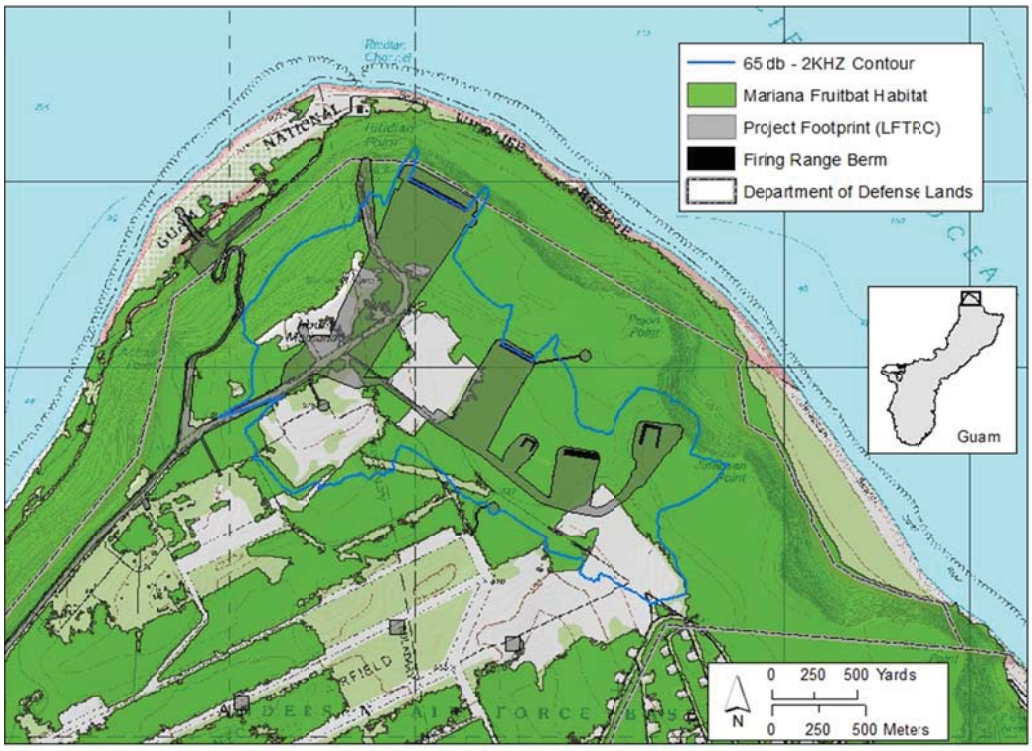


Figure 17. Results from noise modeling (65 dB contour) from operation of the LFTRC on Mariana fruit bats and habitat.



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F1H USFWS, Reinitiation of the 2015 BO on the DON's Relocation of U.S. Marine Corps from Okinawa to Guam and Associated Activities on Guam (July 2017)

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United States Department of the Interior

FISH AND WILDLIFE SERVICE
Pacific Islands Fish and Wildlife Office
300 Ala Moana Boulevard, Room 3-122
Honolulu, Hawaii 96850

In Reply Refer To:
01EPIF00-2015-F-0025
01EPIF00-2016-F-0185

Commander Jeffrey S. Powell
Director, Pacific Programs Office
Office of the Assistant Secretary of the Navy (OASN)
Energy, Installations and Environment (EI&E)
1000 Navy Pentagon
Washington, DC 20350-1000

Subject: Reinitiation of the 2015 Biological Opinion on the Department of the Navy's Relocation of U.S. Marine Corps from Okinawa to Guam and Associated Activities on Guam

Dear Commander Powell:

Enclosed is the US Fish and Wildlife Service's biological opinion for the proposed Marine Relocation from Okinawa to Guam. In accordance with section 7 of the Endangered Species Act of 1973, as amended, (16 U.S.C. 1531 et seq.) this concludes formal consultation for this project. Copies of the draft biological opinion were provided to your office for comments on June 2, 2017 with some errata corrections provided on June 6, 2017. We received your comments on June 19, 2017 and have incorporated corrections, additions and edits as appropriate. We appreciate your assistance and that of your team throughout this consultation. If you have any questions regarding this biological opinion, please contact Darren LeBlanc (Planning and Consultation Team manager) at 808-792-9403.

Sincerely,

MARY ABRAMS Digitally signed by MARY ABRAMS
Date: 2017.07.18 16:52:55 -10'00'

Mary Abrams
Field Supervisor
Pacific Islands Fish & Wildlife Office

TAKE PRIDE® IN AMERICA

United States Department of the Interior
FISH AND WILDLIFE SERVICE
Pacific Islands Fish and Wildlife Office
300 Ala Moana Boulevard, Room 3-122
Honolulu, Hawaii 96850

In Reply Refer To:
01EPIF00-2015-F-0025
01EPIF00-2016-F-0185

Commander Jeffrey S. Powell
Director, Pacific Programs Office
Office of the Assistant Secretary of the Navy (OASN)
Energy, Installations and Environment (EI&E)
1000 Navy Pentagon
Washington, DC 20350-1000

Subject: Reinitiation of the 2015 Biological Opinion on the Department of the Navy's Relocation of U.S. Marine Corps from Okinawa to Guam and Associated Activities on Guam

Dear Commander Powell:

This document transmits the U.S. Fish and Wildlife Service's (Service[1]) Biological Opinion (BO) regarding effects on the 11 endangered or threatened species listed in **Table 1**, from the proposed action of relocating U.S. Marine Corps (USMC) personnel from Okinawa to Guam and related infrastructure construction and military training activities. The U.S. Department of the Navy (DON) is the designated lead Federal agency for this consultation. This BO is a partial reinitiation of the *Biological Opinion for the DON's Relocation of the U.S. Marine Corps from Okinawa to Guam* (2015 BO) (USFWS 2015a), finalized on July 31, 2015. On October 1, 2015, the Service listed 23 species located in Micronesia as endangered or threatened (80 FR 59424). Of these 23 species, 13 were found to occur adjacent to or within the proposed project areas (**Table 1**).

The action to relocate USMC personnel to Guam was first consulted on in January 2010 and a BO was signed on September 8, 2010 (2010 BO) (USFWS 2010). In October 2014, the DON requested reinitiation of the 2010 BO due to significant changes to the proposed action. The conclusion of that reinitiation resulted in the 2015 BO, which completely superseded the 2010 BO.

[1] A complete list of acronyms can be found in **Appendix A**.

This BO is a reinitiation of the 2015 BO for the Mariana fruit bat only and superceeds all information and analysis related to the Mariana fruit bat in the 2015 BO. Information and analysis in the 2015 BO for the Mariana crow (*Corvus kubaryi*), Guam Micronesian kingfisher (*Todiramphus cinnamominus cinnamominus*), Guam rail (*Gallirallus owstoni*), and *Serianthes nelsonii* remains binding. This BO also evaluates anticipated effects of the proposed action on 10 newly listed species that are known to occur within the project area and their terrestrial habitat. This BO was prepared in accordance with the requirements of section 7 of the Endangered Species Act (Act) of 1973 as amended (16 U.S.C. § 1531 *et seq*.).

Table 1. Endangered and threatened species addressed in this BO, their listing status in accordance with section 4 of the Act, and the effect determination made by DON.

Common Name	**Scientific Name**	**Listing Status**
May Affect, Likely to Adversely Affect Determination		
Mariana fruit bat	*Pteropus mariannus mariannus*	Threatened
Mariana eight spot butterfly	*Hypolimnas octocula marianensis*	Endangered
Humped tree snail	*Partula gibba*	Endangered
Guam tree snail	*Partula radiolata*	Endangered
Fragile tree snail	*Samoana fragilis*	Endangered
No Common Name (NCN)	*Bulbophyllum guamense*	Endangered
NCN	*Cycas micronesica*	Threatened
NCN	*Dendrobium guamense*	Threatened
NCN	*Heritiera longipetiolata*	Endangered
NCN	*Tabernaemontana rotensis*	Threatened
NCN	*Tuberolabium guamense*	Threatened
May Affect, Not Likely to Adversely Affect Determination		
NCN	*Eugenia bryanii*	Endangered
NCN	*Maesa walkeri*	Threatened
NCN	*Nervilia jacksoniae*	Threatened

On March 3, 2017, the DON also requested our concurrence with a determination that the proposed action may affect, but is not likely to adversely affect (MA,NLAA) the endangered plant, *E. bryanii* (DON 2017a). Subsequent email correspondence and discussions, that began on May 3, 2017 and concluded on May 17, 2017, resulted in the inclusion of the endangered plants, *M. walkeri* and *N. jacksoniae* to the DON's MA,NLAA concurrence request. Our review of these determinations and a concurrence with the DON's effect determinations for *E. bryanii, M. walkeri,* and *N. jacksoniae* is located in **Appendix B**.

This BO is based on information provided in your March 10, 2015 letter and Conference Assessment (DON 2015a), the subsequent Revised BA, email correspondences, discussions between the Service and DON, and information contained in our files. A complete administrative record for this consultation is in the Service's Pacific Islands Fish and Wildlife Office (PIFWO) in Honolulu, Hawaii.

Consultation History

March 10, 2015. The DON submitted a request for initiation of a Conference consultation on

seven federally proposed species (*B. guamense*, *C. micronesica*, *T. rotensis*, Mariana eight spot butterfly (*H. octocula marianensis*), humped tree snail (*P. gibba*), Guam tree snail (*P. radiolata*), and fragile tree snail (*S. fragilis*)) that may occur in the project action area. The DON determined that the proposed project MA,NLAA these federally proposed species. The DON conference assessment did not include *D. Guamense*, *P. malaspinae* and *T. guamense* in their analysis due to their initial review of these species and *no effect* determinations.

March 24, 2015. The Service informed the DON via a conference call that we did not concur with their no effect and MA,NLAA determinations on the proposed project's potential effects to federally proposed species within the action area.

March 25, 2015. The DON submitted proposed Conservation Recommendations to the Service, including: (1) DON's active participation in recovery committees for endangered or threatened species on Guam and DON's commitment to work with the Service to develop a re-introduction plan and supporting programmatic BO that ensures such re-introduction efforts are consistent with species recovery plans and the military mission on Guam; (2) developing a team to explore the establishment of potential conservation area(s) in the Mariana Islands as part of a broader consultation solution; (3) working with the Service, other Federal agencies, as appropriate, and Government of Guam to use their authorities to carry out programs for the conservation of threatened and endangered species; and, (4) incorporating habitat conservation areas and actions into the Joint Region Marianas (JRM) Integrated Natural Resource Management Plan (INRMP), because (a) INRMPs ensure military operations and natural resources conservation are integrated and consistent with stewardship and legal requirements; and, (b) INRMPs are planning documents that allow Department of Defense (DoD) installations to implement landscape-level management of their natural resources while coordinating with various stakeholders.

June 11, 2015. The Service and DON entered into an MOA (DON & USFWS 2015) to ensure that sufficient amounts of suitable survival and recovery habitat for the Guam Micronesian kingfisher would be conserved and managed within DoD lands in northern Guam.

July 31, 2015. The Service issued a BO (TAILS # 2015-F-0025) (2015 DON BO) to the DON for their Relocation of the Marine Corps from Okinawa to Guam and Associated Activities on Guam (USFWS 2015a). The Service's Pacific Northwest Regional Office notified the DON that work on the Conference Assessment for the proposed species would start in August and should be completed by November 30, 2015.

August 21, 2015. During a DoD/Service meeting in Hawaii, DoD provided the status of the Marine Corps Relocation project and how the schedule of the consultation related to the timelines of the action as one subset of multiple other military projects. September 3, 2015. The Service acknowledged receipt of the DON's March 10, 2015 letter and Conference Assessment dated February 26, 2015, requesting a Conference on the effects of the proposed project on the seven federally proposed species noted in their letter. The

Service noted the review of incoming documents was delayed because of PIFWO's substantial section 7 consultation workload. The Service also requested clarification on the DON's use of the term "maximum extent practicable" related to their proposed conservation measures (The Service noted that the "maximum extent practicable" standard applies to Section 10 permit actions and does not apply to Section 7 consultations; however, it was discussed during this process to characterize conservation measures); a re-evaluation of their species effects determinations; and, the status of surveys for the proposed species conducted within the project footprint, including areas to be used for training within the Naval Base Guam's Naval Munitions Site (NMS) that was discussed August 21, 2015.

September 15, 2015. The DON responded to the Service's September 3, 2015 letter acknowledging completed survey data for newly listed species and requested confirmation of any additional surveys available. The DON also requested formal Conference on the species included within their March 10, 2015 Conference Assessment.

September 22, 2015. The Service provides DON with a revised DoD consultation "stacking" schedule based on the discussions with DoD on August 21, 2015.

October 1, 2015. The final listing rule for 23 species was published in the Federal Register (80 FR 59424).

October 1 & 2, 2015. The DON and the Service held in-person meetings on Guam. DON provided an update on the implementation of the conservation measures detailed in the 2015 DON BO. The DON requested to reinitiate the consultation because of potential project effects to five of the newly listed species (Mariana eight spot butterfly, *B. guamense*, *C. micronesica*, *T. rotensis*, and *H. longipetiolata*). The DON provided a map of *B. guamense*, *T. rotensis*, *T. guamense*, *H. longipetiolata*, and *D. guamense* locations within the ungulate exclusion fence at Northwest Field (NWF), Andersen Air Force Base (AAFB). The Service requested the survey results, including the methods, for the newly listed plants within the action area and was told the surveys would not be completed for eight months. The Service indicated this information was needed to complete the status of the species in the action area and confirm the project effect determinations for the newly listed species. The DON stated they would submit a progress report for surveys (including methods and results) in northern Guam. The DON and the Service also discussed the information needs, the timeline for the reinitiated consultation, and the re-evaluation of the effect determinations per the Service's September 3, 2015 letter. The Service and DON discussed the likelihood and challenges for successfully translocating recovered host plants for the Mariana eight spot butterfly due to habitat restrictions.

October 2, 2015. The DON provided information via email on the status of the JRM's fiscal year 2014 project on the *C. micronesica* in Tinian as requested by the Service.

October 13, 2015. The DON requested that project activities for geotechnical borings be allowed to proceed within areas of Northwest Field (DON project P-715 area) and Finegayan

(DON project J-016 area). The DON submitted maps of the newly listed species within both areas for the Service's review.

October 14, 2015. The Service emailed the DON a reminder of the request for the survey results for the newly listed plants within the action area. The Service also stated an updated BA would not be required contingent upon the DON providing the missing information and clarifications requested in the Service's September 3, 2015 request letter.

October 14, 2015. The DON emailed a map of listed species locations within the ungulate eradication fence to the Service. In addition, the DON stated the final report for the newly listed species would not be completed for another eight months because the DON modified the cooperative agreement to add additional survey areas. However, the DON would submit a progress report.

October 26, 2015. The DON submitted a letter in response to the Service's September 3, 2015 letter requesting clarification. The letter confirmed the request for a section 7 consultation for the five newly listed species discussed at the October 1 and 2, 2015 meeting; a statement that the survey maps of recently completed surveys for the NWF area were provided to the Service on October 13, 2015; a statement that the proposed action would directly impact the Mariana eight spot butterfly, *T. rotensis*, and *H. longipetiolata*; a statement that no project impacts are anticipated for *B. guamense*, *C. micronesica*, humped tree snail, Guam tree snail, and fragile tree snail; a statement that no Marine Corps relocation related ground training would occur in the Naval Munitions Storage (NMS); and a list of best management practices (BMPs).

October 29, 2015. The DON and the Service discussed the October 26, 2015, letter stating that no project impacts were anticipated for *B. guamense*, *C. micronesica*, humped tree snail, Guam tree snail, and the fragile tree snail. The DON stated that the consultation should be formal for *B. guamense* and *C. micronesica* and informal for the three listed snails.

November 10, 2015. The DON provided the Service with the monthly status reports of plant surveys (October 2014 to August 2015) that were submitted to JRM. These surveys did not include sufficient data and maps to address the Service's request for the complete surveys.

November 20, 2015. DON met with University of Guam butterfly researchers/experts to discuss the recovery value and the feasibility or logistics of the proposed conservation measures for the Mariana eight spot butterfly. The Service staff was unable to attend at the last minute due to extreme weather events.

November 24, 2015, The DON submitted maps for the Service's review that included plant species of cultural importance (including newly listed speices and high value trees) within geotechnical boring project activity sites in the Northwest Field and Finegayan

December 1, 2015. The Service approved the request to initiate work on geotechnical borings within the P-175 area.

December 3, 2015. The Service emailed the DON requesting the DON's proposed conservation measures for the Mariana eight spot butterfly. The DON and the Service discussed re-scheduling the November 20, 2015 meeting since the majority of partners were unable to attend.

December 15, 2015. In a letter and enclosed map, the DON included the locations of *T. guamense* and *D. guamense* within the northern Finegayan area. The DON requested these two species be included in the section 7 consultation and concluded that the proposed action may affect, but was not likely to adversely affect *T. guamense* and *D. guamense*.

December 16, 2015. The DON and Service held a teleconference focused on the December 15, 2015 letter and the conservation measures proposed for the *T. guamense*, *D. guamense*, and the Mariana eight spot butterfly. December 17, 2015. The DON sent an email to the Service requesting the due date of the final consultation.

December 22, 2015. The DON and the Service agreed to a revision of the Guam Micronesian Kingfisher (GMK) Recovery Habitat Memorandum Of Agreement (MOA), which was originally signed on June 11, 2015. The modification identified a mutually agreed upon revised configuration for 5,234 acres of habitat for the recovery and survival of GMK in northern Guam.

January 11, 2016. The Service requested an update on geotechnical boring activities proceeding within the NWF (DON project P-715 area) and Finegayan areas (DON project J-016 area).

January 12, 2016. The Service requested the DON review the description of the proposed training activity at the NMS to ensure the accuracy of the proposed action.

January 21, 2016. In response to the Service's January 11, 2016 request for an update, the DON reported that the Route 3A geotechnical work was completed, and the geotechnical work within the LFTRC was currently in progress with biomonitors accompanying the geotech crew on site.

January 21, 2016. The DON and Service discussed the timeline for the completion of the formal consultation. The Service inquired about the status of the report on species surveys within the ungulate exclusion fencing at NWF. The Service advised the DON that if a BO is completed based on the information to date, formal consultation may need to be reinitiated if new information revealed effects not considered in the resulting BO. As a follow up to the December 16, 2015 meeting, the DON stated they would not salvage *T. guamense* and *D. guamense*.

January 26, 2016. The DON and the Service discussed finalization of the BO to include the newly listed species and agreed that the target due date would be the end of March 2016.

January 28, 2016. The DON and the Service discussed the language to describe a qualified biologist per implementation of conservation measures in the draft BO, status of the ungulate eradication fence relocation at NWF, review of the Consultation History section of the draft BO, and status of the informal consultation for the subject action. The DON stated that any salvage or translocation of *T. guamense* and *D. guamense* should be included as a conservation recommendation (i.e., not as a conservation measure) in the final BO.

January 31, 2016. The DON asked for a timeline to complete the draft BO and review the DON's comments and finalize the BO.

February 3, 2016. The Service stated that they would provide a signed BO within five business days after receiving DON's comments on the draft BO.

February 4, 2016. The DON sent a letter to the Service to confirm the timeline changes for completing the draft BO. The DON asked the Service to provide a draft BO by mid-March, followed by a review period, with an anticipated final BO due in mid-April. The letter also included new information identifying over 5,000 *T. guamense* and over 300 *D. guamense* at Finegayan that had to be incorporated into the effects analysis.

February 4-12, 2016. Emails were exchanged between the DON and the Service clarifying the number of *B. guamense*, *T. guamense*, and *D. guamense* individuals within the action area, the number of individuals that would be removed as a result of the proposed project activities, additional project details, and a reference for the information on environmental baseline conditions for *S. nelsonii*.

February 5, 2016. The Service acknowledged that sufficient information to reinitiate the subject formal consultation was received from the DON for the following species; Mariana eight spot butterfly, *B.guamense*, *C. micronesica*, *D. guamense*, *H. longipetiolata*, *T. rotensis*, and *T. guamense*. The Service stated that a draft BO would be completed on March 25, 2016 and a final BO would be completed by April 15, 2016. The Service also acknowledged an ongoing dialog about the increase in the population of the Mariana fruit bat and whether that might warrant a revision to the effects analysis in the July 31, 2015 BO.

February 6, 2016. The Service and DON discussed U.S. Marine Corps (USMC) training at the NMS. The DON stated that the Project Description would not include USMC training at the NM) and that no Marine relocation ground training was planned in the NMS area over the next 5 years. DON would re-initiate if the species were listed and there would be a potential to affect the species in the NMS.

February 17, 2016. The Service sent the DON a draft Consultation History section for review.

February 19, 2016. The Service emailed the DON requesting the inclusion of a conservation measure to salvage and relocate the listed orchids, specifically *T. guamense* that could not be avoided in the course of construction.

February 23, 2016. The DON emailed a report to the Service on the monitoring of Mariana fruit bat within the Habitat Management Unit (HMU) at (AAFB). The report documents observations in one area of up to 112 fruit bats within the HMU.

February 24, 2016. The Service requested information on the number of *T. rotensis* individuals that would be removed as a result of the action.

February 24, 2016. The DON sent a letter to the Service requesting to reinitiate consultation on Mariana fruit bat as part of the on-going Marine Relocation to Guam consultation.

February 24, 2016. The DON emailed a report entitled *Memorandum for File, Subject: Pre-Construction High Value Tree (HVT) Surveys of J-001B Utilities and Site Improvements Phase I, Naval Base Guam*. The initial surveys focused on plant species of cultural importance and included the following HVTs: *C. micronesica (*cycad*), Intsia bijuga* (ifit), *Elaeocarpus joga* (joga), *Artocarpus mariannensis* (seed breadfruit), and *Artocarpus altilis* (seedless breadfruit). Additional tree species observed include *Ficus prolixa* and *F. tinctoria* (banyan) and *Maytenus thompsonii.* The supplemental surveys focused on re-surveying the HVTs post-storm events. Incidental sightings of plant species that were listed on November 1, 2015 and host plants for the Mariana eight spot butterfly were also recorded during the supplemental surveys.

March 1, 2016. The DON provided the Service comments on the draft BO Consultation History.

March 2, 2016. The DON determined and provided the number of *T. rotensis* individuals that would be removed as a result of the action.

March 3, 2016. The Service asked DON to provide the report on the surveys for the Mariana eight spot butterfly that indicated this species occurs at the Mangilao golf course and Fadian Cove, as stated in the DON's conference assessment.

March 10, 2016. The DON sent an email to the Service stating that *T. guamense* and *D. guamense* would be salvaged within the action area to the maximum extent practicable.

March 14, 2016. The Service and the DON discussed by teleconference project activities that would adversely affect the Mariana eight spot butterfly and *T. guamense*. Clarification on the impacted area for the butterfly within the proposed Live-Fire Training Range Complex (LFTRC) and proposed conservation measures for these two listed species were also discussed. The Service stated their preliminary analysis on the project impacts of the DON's action indicated very serious deleterious consequences for *T. guamense* and Mariana eight spot butterfly. The Service indicated the seriousness of the concern could likely push back finalization of the draft BO scheduled for March 25. The Service asked if the DON could possibly avoid taking approximately 5,000 *T. guamense* plants from the Finegayan area. The Service also indicated that one firing range, as currently planned, would take one of nine known populations of Mariana eight spot butterflies, and asked if

the range could be altered to avoid the take. The DON stated it would seek clarification and evaluate possible options.

March 21, 2016. The DON indicated that the construction plans for the Finegayan area were not finalized, and they could not be specifically altered at the current time because neither the construction bids nor the geological analyses of the site suitability were completed. The DON maintained that construction would avoid the orchids to the "maximum extent practicable" and that they would re-insert the conservation measure to relocate individuals that could not be avoided. The Service made clear that the success of transplantation was unknown and had to be considered as such in the analyses, and offered that the effects would likely still be severe unless more plants could be avoided. The DON suggested that the host plants of the Mariana eight spot butterfly might not be in the impact zone of the live-fire training range, and offered to provide some more detailed maps to better indicate the location of the butterflies relative to the range.

March 22, 2016. The DON sent additional information on the number of individuals of *T. guamense* that occur within DoD land on Guam.

March 24, 2016. The DON sent the rare plant survey report, titled "Plant Surveys, Joint Region Marianas Interim Report" to the Service.

March 31, 2016. The DON reviewed and updated the draft conservation measures for the proposed project to include the Newly Listed Species: Mariana eight spot butterfly, *B. guamense, C. micronesica, D. guamense, H. longipetiolata, T. rotensis,* and *T. guamense*.

April 4, 2016. Service staff conducted site visits of the AAFB portion of north Finegayan area to assess general habitat and growth characteristics of *T. guamense* in the wild. The purpose of the visit was to look at the existing habitat that the orchids inhabited and document observations to assist in the effects analysis and development of conservation measures.

April 5, 2016. The DON and the Service discussed by phone the DON's current understanding of the number of *T. guamense* and the construction impact on the Mariana eight spot butterfly. The DON indicated they would only be able to avoid 838 *T. guamense* of the just over 5,000 in the Finegayan action area (of the over 7,000 then identified on Guam) and that they could still not identify exactly which 838 *T. guamense* individuals would be avoided. In addition, while the DON was confident about avoiding 300 individuals, they were less certain about their ability to avoid the other approximately 500 of the 838. The Service indicated that this would have a substantial effect on the orchid population. The Service also stated the location of the avoided *T. guamense* individuals would be important, since not all habitat is created equal, and stated concerns with fragmentation of the *T. guamense* population. The DON indicated it was not possible to move the firing range that was going to impact the Mariana eight spot butterfly habitat due to safety issues on other adjacent firing ranges. The Service requested Geographic Information System (GIS) shape files for the locations of both the butterflies and the orchids.

April 11, 2016. Service staff conducted site visits of the Finegayan area to assess general habitat and growth characteristics of *T. guamense* in the wild.

April 13, 2016. The DON and the Service discussed the status of the draft BO. The Service indicated they had received all needed information except for that anticipated from a field visit planned to the Finegayan action area. The DON confirmed that impact area around the firing range was still as mapped (i.e., including the demolition of six of the nine known host plant locations of the Mariana eight spot butterfly). The Service indicated again that the proposed action effects on *T. guamense* and the Mariana eight spot butterfly were sufficiently significant to potentially delay finalizing the BO and would likely require Service review above the Field Office level.

April 18, 2016. DON escorted the Service in the field to look at the clusters of orchids near the NE corner of Finagayan.

April 26–May 5, 2016. Through a series of calls, the Service and the DON discussed possible alternative minimization and conservation measures for *T. guamense* and the Mariana eight spot butterfly.

April 29, 2016. The DON emailed the Service with an adjustment (including map and description of the change to the proposed action) to the firing range construction that would allow the DON to avoid all nine known locations of the Mariana eight spot butterfly. The DON included a map with this email as well as a description of the change to the proposed action.

May 4, 2016. The DON emailed the Service proposing further adjustments to the Finegayan construction area which would avoid 3,485 *T. guamense* individuals and a commitment to transplant an additional 2,000 individuals with an estimated success rate of 50 percent for the translocations (i.e. 1,000 successfully translocated and surviving)

May 5, 2016. The Service requested a consolidated proposal that would describe these proposed changes to facilitate review so that the draft BO could be sent to the DON by the end of May.

May 11, 2016. The DON emailed a letter and attachments of the consolidated proposals for best management practices and conservation measures on *T. guamense* and the Mariana eight spot butterfly for the Marine Corps Relocation to Guam to the Service.

July 8, 2016. In-person meetings between DON and the Service discussed the status of the consultation analysis and release of the draft BO.

July 17, 2016. The Service provided the DON a preliminary working draft BO for review. The draft BO contained analysis of impacts to only two of 11 species contained in the scope of the consultation.

July 24-28, 2016. Three-day meeting in Portland between DoD-Service representatives to discuss next steps in the development of Marianas Archipelago Conservation Strategy (MACS) that supports Service conservation initiatives and the DoD mission in the Region, and the Conservation Recommendations in the July 2015 BO while also providing overarching benefits to affected jurisdictions.

August 3, 2016. Conference call between DON and Service to determine a meeting date and to discuss DON's questions regarding the preliminary draft BO.

August 23-24, 2016. Meeting in Hawaii between the Service and DON to discuss the preliminary work on the draft BO. The discussion centered on new known occurrences of *T. guamense*, edge effect analysis, and potential impacts to butterflies and the conservation measures that would address these impacts. Review of the conservation measures offered by DON was conducted and a discussion of "certainty of effectiveness" led to Service requesting DON to provide additional information.

October 28, 2016. Conference call between the DON and the Service to discuss summary points and action items from the August 23-24, 2016, meeting in Hawaii. Discussion topics included ungulate eradication fence at NWF, butterfly rearing data from Dr. Moore's (University of Guam) research, and a BO amendment for Mariana fruit bat. The Service requested a revised reinitiation package that would include all previously submitted information.

November 4, 2016. The DON provided Phase 1 Data submission (including the draft write up on *T. guamense*, maps, metadata, survey line transects) and references to the Service.

November 5, 2016. In person meeting on Guam with DON and Service to discuss forest enhancement concepts at Finegayan, NWF, and Andersen South

December 1, 2016. Teleconference discussion of *T. guamense* Phase I data submission, clarification of the definitions of primary and secondary limestone forests, and discussion of schedule of future calls and in-person meetings.

December 14, 2016. Teleconference discussion of the Service's review of the Phase 1 data submission and how the edge effect analysis would consider the new empirical data provided by the DON. The Service notified the DON that we were developing a white paper on their edge effect analysis for *T. guamense,* which would be provided to DON prior to the upcoming in-person meeting. The group identified topics for discussion at the January 2017 in-person meeting in Portland.

January 12, 2017. The DON provided a white paper to the Service titled “Psychotria Criteria Review and Evaluation” supporting the argument that federally endangered *Psychotria malaspinae* is not the species that is present within the planned footprint of the Live Fire Training Range Complex (LFTRC). According to the research, the species present within the planned footprint of the LFTR is *P. hombroniana.* The DON provided their revised final comments on the Service’s draft BO.

January 17-18, 2017. The DON and Service consultation team members met in Portland, Oregon. Topics discussed included the Service's preliminary analysis on edge effects (edge effects white paper), the DON's Phase 1 information submission concerning *T. guamense*, general comments on the working draft BO, format and scope of anticipated BO (amendment vs. full BO), fire management plan, exclusion of *P. malaspinae* from the consultation, corrections to the Intelligence, Surveillance, and Strike Capability Project (ISR-Strike) history and compliance as portrayed in the working draft BO, potential inclusion of a perimeter fence/ ungulate eradication around the LFTRC, the consultation schedule, and new species occurrence data for butterfly and host plants at Northwest Field.

January 24, 2017. The Service presented by teleconference the white paper on edge effect analysis based on occurrence data provided by DON. The DON expressed concern with the assumptions and purpose of the statistical analysis of the edge effect paper, pointing out that the data collected was not intended to be used as statistical analysis, and that only a very small subset of the data provided was used to support the Service analysis. In addition, conclusions on edge effect were being made solely on the manipulated distribution data, without taking into account any other factors of the environment and habitat. The DON recommended that the statistical analysis by DON represents only a view of occurrence distribution from existing edges and not a determination of edge effect. The Service took the DON's comments under advisement.

January 25, 2017. Conference call between the Service and DON to discuss edge effects; the Service stated that revisions to the edge effects papers are being considered, including adding more data and changing the title to a study on the distribution of species with regard to existing edge. The revised white paper would be provided to the DON when complete.

January 31, 2017. DON requested a waiver regarding implementation of Term & Condition #4 in the Relocation of the USMC from Okinawa to Guam and Associated Activities on Guam BO (2015-F-0025) since the subject fence would be addressed in the current consultation.

February 1, 2017. The DON and Service discussed butterfly related topics on a conference call. Topics included DON providing additional new host plant and butterfly occurrence data from Dr. Fiedler, University of Guam, to update butterfly and host plant occurrences since the Final Listing Rule was published. A review of conservation measures specifically related to the butterfly was discussed. The DON opened the discussion on potential Terms and Conditions for the butterfly. FWS suggested that all measures be included as Conservation Measures.

February 8, 2017. Conference call between the Service and DON during which the Service committed to providing a response by February 15, 2017 to the DON's letter requesting a waiver from the 2015 BO term and condition (2015-F-0025). Also discussed were the edge effect paper, the Mariana fruit bat amendment, the Makua BO for reference

regarding the fire management plan, and conclusion of the previously discussed ISR-Strike BO language.

February 21, 2017. The Service acknowledged (2017-TA- 0150) the DON's efforts to comply with Term and Condition #4 from the 2015 BO (2015-F-0025), and agreed to discuss DON's alternatives to the ISR-Strike fence location as part of the current consultation.

February 22, 2017. Conference call between the Service and DON to discuss any outstanding tasks and issues. The Service provided DON with the revised draft Edge Effect white paper, which focused only on *T. guamense*.

February 23, 2017. The DON and Service subject matter experts discussed the Mariana fruit bat amendment and clarified that the military relocation and the Habitat Management Unit (HMU) management are separate actions and require separate amendments, and clarified Fire Management Plan specifics.

March 3, 2017. The DON emailed a letter and enclosed BA requesting a re-initiation of formal section 7 consultation on the effects of the proposed project on the eleven federally listed species noted in their letter. The DON determined that the action may affect, but was not likely to adversely affect three species (*E. bryanii*, the fragile tree snail and the humped tree snail) and may affect, likely to adversely affect the remaining eight species (the Mariana eight spot butterfly, the Guam tree snail, *T. guamense*, *B. guamense*, *D. guamense*, *C. micronesica*, *T. rotensis*, and *H. longipetiolata*).

March 13-14, 2017. In person meeting between DON and the Service in Hawaii to review information presented in the March 3, 2017 BA. The Service informally identified some additional information needs from the BA.

March 24, 2017. The Services provided the DON a list of information and comments from the 2017 BA necessary to complete a BO.

April 5, 2017. DON and Service consultation call to discuss status updates.

April 11-13, 2017. DON and Service teleconferences to clarify questions in the BA especially related to the information needs identified in March 24, 2017 letter.

April 12, 2017. DON submitted responses to the information request and comments provided by the Service regarding the Marine Corps Relocation to Guam BA. DON also emailed GIS data, EndNote library, sample HACCP plan, Wildland Fire Plan for MCB Hawaii and COMNAVMAR INST 3500.4.

April 12, 2017. The Service acknowledged receipt of a complete consultation package with a consultation start date of March 3, 2017. The Service also acknowledged that the consultation will also include the Mariana fruit bat to address new information on the species status and DON's request for an amendment to the amount of take of Mariana fruit bat specified in the 2015 BO (2015-F-0025).

April 20, 2017. Service requested information on the draft Forest Enhancement Plan.

April 21, 2017. DON and Service teleconference to discuss monitoring plans and specific details for all out-planting vegetation restoration activities mentioned in the Revised BA.

April 25, 2017. In person meeting on Guam with DON, Service and species experts to discuss monitoring concepts for the Mariana eight spot butterfly and the three listed snail species, especially those recently observed at Andersen South.

April 27-28, 2017. DON and Service conducted in-person site-visits on Guam to examine the project footprint areas and listed species habitat, including: LFTRC; Andersen South; Haputo ERA; Finegayan; and, other listed species locations. The Service identified and made DON aware of a discrepancy with the GPS location of the mature *S. nelsonii* and proposed Multipurpose Machine Gun Range (MPMG) range. The Service also indicated to DON that the 5 year review on *S. nelsonii* was recently completed and that the status for the species in the wild on Rota declined by 73% from the 1992 baseline. The Service recommended that DON should re-consult due to the significant wild population decline. May 4, 2017. DON confirmed that any project activities would not be within 100 feet of the *S. nelsonii* tree since prior maps misidentified the exact location of the tree and identified construction within this 100ft boundary.

May 11, 2017. The DON provided information clarifying Table 6 in the BA, relating to the population of *B. guamense*.The Service requested information on Forest Enhancement site establishment, monitoring, and proposed success criteria.

May 12, 2017. The Service recommended to the DON that *M. walkeri* and *N. jacksoniae* be included in the consultation with an effect determination of MA,NLAA due to DON proposing actions that will avoid or minimize effects to these two listed species within the NMS.

May 16, 2017. DON provided the Service with their identified measures related to out-planting the listed plant species. A draft vegetation map of the forest enhancement areas used to develop more site specific enhancement plans/targets was also provided.

May 17, 2017. DON verbally agreed to include *M. walkeri* and *N. jacksoniae* as MANLAA in the current consultation since DON intends to identify the area with these two species as a "No Training Area" to restrict access to the areas with these two plants in order to avoid the potential for effect. DON also stated that they were not interested in adding *S. nelsonii* to the current BO. The Service also received information on Forest Enhancement site establishment, monitoring, and proposed success criteria.

June 2, 2017. The Service provided a draft BO to DON.

June 19, 2017. The DON provided written comments to the Service on the draft BO.

June 22, 2017. The DON and Service consultation team members met in Hawaii to discuss DON comments on the draft BO

July 14 and 17, 2017. Conference calls between the DON and the Service to discuss the revised draft Incidental Take Statement.

BIOLOGICAL OPINION

Description of the Proposed Action

The DON proposes to relocate USMC personnel from Okinawa, Japan to Guam; construct and operate a Main Cantonment area and separate Family Housing; construct and operate a LFTRC; and conduct military training activities on Guam. Project activities will occur on land administered by the (DoD). The proposed action includes activities described in the 2015 BO addressing effects to the species in **Table 1** (above).

Minor non-substantive clarifications and organizational changes have been made to the description of the proposed action included in this BO and therefore this section differs from the 2015 BO. The only component actions not included in this BO are five roadway and bridge work projects (USFWS 2015a, p. 35), as majority of these projects have been completed, or occur within previously developed areas of Guam such as residential and commercial areas (**Table 2**). Where appropriate, effects from completed roadway projects are included in the Environmental Baseline section. In addition, 50 individual road projects have been proposed but would occur in urban areas and would be the responsibility of the Government of Guam or the Federal Highway Administration (FHWA). Where appropriate, these projects are included in the Cumulative Effects section. Finally, new details from DON have been included to describe proposed conservation measures within the two Forest Enhancement Sites (North Finegayan and Finegayan) and ungulate fencing and eradication activities surrounding the LFTRC in the Northwest Field (NWF). The conservation measures specific to these areas amend the measures described in the 2015 BO (USFWS 2015a, p. 37-38).

Table 2. Five roadway and bridge work projects included in the 2015 BO that have since been completed or initiated.

#	Description	Status
1	Route 1 and Route 8 intersection and improvement (Hagåtña) ("Guam Road Network" GRN1) – (Part of Hagåtña Bridge Replacement Project Scope)	Completed
2	Route 1 and Route 3 intersection and roadway improvements (Dededo) (GRN2)	Under Construction
3	Replacement of Hagåtña (Agaña) Bridge #1 with reinforced concrete (GRN3)	Completed
4	Route 11 roadway improvements from the port to Route 1, including pavement strengthening (GRN4)	Completed
5	Widening of the Route 1 and Route 11 intersection, adding a second left turn lane and pavement strengthening (GRN5)	Completed

The proposed action is divided into ten components listed below and described in detail in subsequent sections. The locations for these project components are shown in **Figure 1 (**all Figures are located in **Appendix C)**.

1. Relocation of approximately 5,000 USMC personnel and 1,300 dependents from Japan to Guam;
2. Utilities and Site Improvement Activities within DON-administered lands;
3. Construction of the Main Cantonment at the Naval Base Guam Telecommunications Site (NBGTS), Finegayan;
4. Construction of Family Housing at AAFB;
5. Construction and Operation of the LFTRC at the NWF and the establishment of an associated Surface Danger Zone (SDZ);
6. Construction and Operation of a hand grenade range at Andersen South as part of the LFTRC;
7. Training Activities and Aircraft Operations within AAFB;
8. Training Activities and Aircraft Operations within Naval Base Guam;
9. Training Activities and Aircraft Operations within the Naval Munitions Site (NMS) Southern Land Navigation Area; and
10. Conservation Measures to avoid or minimize project impacts.

Relocation of U.S. Marine Corps Personnel and Dependents

In furtherance of an agreement with the Government of Japan, the DON plans to relocate 5,000 USMC personnel and 1,300 dependents from Okinawa to Guam. The most recent population estimate for Guam is approximately 174,000 residents (UN 2015). The proposed action would temporarily increase Guam's population by approximately 10,000 (DON 2015b, p. ES-4) or 7.1 percent by 2021 (UN 2015). This number will decrease to about 7,400 additional residents after construction is completed by 2032 (DON 2015b, p. ES-4) or a 4.6 percent overall increase (DON 2017a, p. 14). All construction projects and training activities listed under project components would be conducted in support of or as a result of USMC relocation to Guam.

An estimated maximum number of 1,227 workers from Guam and up to 3,227 workers from off-island would work on construction projects related to the proposed action (DON 2015b, p. 4-136). It is anticipated that the majority of off-island construction workers would be H-2B visa holders or temporary non-agricultural workers from the Philippines and other Pacific Islands. In 2011, construction of the Ukudu Workforce Village (Village) in urban Dos Amantes, Guam was completed. The Village is designed to be scalable in support of the proposed action. The Village's first phase includes accommodations for 2,000 tenants. At full capacity, the 252-acre complex would include a fire station, medical clinic, recreational spaces and other residential amenities necessary to house up to 14,000 temporary residents (Montvel-Cohen 2011). During the later years of construction (2025-2026), it is anticipated that more workers from Guam than from off-island would work on construction projects related to the proposed project (DON 2015b, p. 4-136).

Utilities and Site Improvements

The proposed action includes approximately 100 separate construction projects identified as Utilities and Site Improvements (U&SI) that would occur prior to large-scale vertical construction (**Figure 2**). These projects include clearing, grubbing, grading, earthwork (such as digging, trenching, drilling, boring and/or cut and fill), processing and stockpiling of green waste, erosion and sediment control, temporary construction fencing, perimeter or security fencing, landscaping and other activities to prepare the area for vertical construction. Additionally, the effort will likely require removal of unexploded ordnance (UXO) and munitions and explosives of concern (MEC), seismic fault, and geotechnical/geophysical and/or topographic surveys in preparation for vertical construction. Conservation measures including contractor education, inspection of construction equipment and supplies to ensure they are free of invasive species, and biological monitoring to ensure project impacts to listed species are minimized and impacts to their habitats do not occur outside of the designated project footprint, are described in more detail in the Conservation Measures section of this project description. U&SI activities include installation of electrical, water, and sanitary sewer systems. The following sections describe in detail all U&SI projects included in the proposed action.

Clearing, Grading, and Earthwork

Clearing and grubbing U&SI projects, conducted at specific project sites, include removal of vegetation, stripping limestone rock, and removal and stockpiling of reusable topsoil. U&SI projects would permanently convert 1,219 ac (493 ha) from limestone forest habitat, and 613 ac (248 ha) from herbaceous scrub forest to developed land (**Table 3**). Clearing and grubbing site work preparation would occur prior to mass grading of the site.

Table 3. Amount of vegetation type or substrate that would be permanently modified to support the construction of the cantonment, family housing, and LFTRC facilities, as well as utility system preparatory work to connect the facilities to existing or new electrical, water, and sanitary sewer systems.

Project Site	**Existing Vegetation or Substrate**		
	Limestone Forest[1]	Herbaceous Scrub	Developed/Barren Land
Finegayan, Main Cantonment	683 ac (276 ha)	115 ac (46 ha)	394 ac (159 ha)
AAFB, Family Housing	12 ac (5 ha)	0.13 ac (0.05 ha)	488 ac (197 ha)
LFTRC	187 ac (76 ha)	49 ac (20 ha)	70 ac (28 ha)
AAFB, South	212 ac (86 ha)	80 ac (32 ha)	115 ac (47 ha)
Naval Base Guam	86 ac (35 ha)	358 ac (145 ha)	2, 106 ac (852 ha)
Water Wells and Sanitary Sewer Systems[2]	39 ac (16 ha)	11 ac (4 ha)	48 ac (19 ha)
TOTAL	1,219 ac (493 ha)	613 ac (248 ha)	3,221 ac (1,303 ha)

[1]Includes both primary and secondary limestone forest habitat, characterized by limestone karst and native vegetation.

[2]Majoriity of electrical system infrastructure would be installed along existing roadways or occur within the Main Cantonment footprint (DON 2017a, p. 17).

Grading and earthwork U&SI projects include major earth moving of large contiguous areas (mass grading) and limited fine grading along the roadway corridors and drainage systems. The cut and fill quantities associated with this mass grading effort would provide for a building pad for future vertical construction, which anticipates further import of structural fill material. Grading for construction of the cantonment and family housing areas and associated infrastructure, comprising the Finegayan and AAFB components would include 3,732,871 yd^3 (2,853,984 m^3) of cut (excavation) and 2,958,469 yd^3 (2,261,911 m^3) of fill, resulting in a net of 774,402 yd^3 (92,072 m^3) of cut material available for use as needed (DON 2015b, p. 2-50). The cut and fill quantities also assume a two foot deep road pavement section, including compacted base and pavement surfacing.

Grading to provide a clear zone for perimeter security fencing is included. In accordance with USMC Order 5530.1A, a 15 ft. (4.6 m) wide gravel perimeter road would be constructed on the inside of all perimeter fence lines, and a 20 ft. clear zone would be provided on the outside of the perimeter fence line.

If soil testing and/or geotechnical recommendations indicate native material excavated on site is not suitable for reuse as fill material, then importation of fill material may be required. Contractors are required to obtain aggregate/soil from contractors/vendors who have local permits. Imported sand and other quarried products from abroad are subject to inspection by the Guam Department of Agriculture which issues an importation permit. All sand and aggregate material imported will be accompanied by official records indicating chemical composition, pest-free certification, treatment certificate, and certificate of origin. Treatment (disinfection) would be conducted at the point of origin.

Processing of Green Waste and Construction Debris

Green waste processing and demolition debris generated during construction will be handled by contractors at designated laydown areas, in accordance with the *Comprehensive Construction and Demolition and Solid Waste Management Plan* (DON 2010). Contractors will be required to process the generated green waste as part of their assigned contract requiring 100 percent diversion of the green waste into mulch (trees and stumps) and compost (leaves and grass), and 60 percent minimum diversion of construction and demolition debris waste into reusable material, including but not limited to, concrete crushing and reuse as base material. Green waste would be processed in accordance with Marine Corps Activity Guam (MCAG) management procedures to prevent and reduce the spread of the invasive coconut rhinoceros beetle (*Oryctes rhinoceros*) and little fire ant (*Wasmannia auropunctata*) (DON 2016). The DON subject matter experts will review the contractor's green waste processing and composting facility operations plan to ensure that it meets industry and regulatory standards. The contractor would be responsible for obtaining the solid waste facility permit issued by Guam Environmental Protection Agency (GEPA) prior to commencing activities. Construction and demolition debris and green waste that cannot be recycled or reused, as well as waste that is prohibited at Layon Landfill in Southern Guam, would be disposed of at the Naval Base Guam Landfill and other permitted private hard fill facilities (DON 2015b).

Removal of Unexploded Ordnance, Munitions and Explosives of Concern

Any earthwork or excavation for building foundations, roads, underground utilities, and other infrastructure could encounter unexploded military munitions in the form of UXO, discarded military munitions (DMM), and/or material potentially presenting an explosive hazard (MPPEH). To reduce the potential hazards related to the exposure to MEC, in accordance with DoD Directive 6055.9, Ammunition and Explosive Safety Standard (ESS) and Naval Ordnance Safety and Security Activity Instruction 8020.15D, ESS documentation would be prepared that outlines specific measures that would be implemented to ensure the safety of workers, the public and avoid adverse effects to natural/cultural resources. UXO that is identified during construction of facilities that requires open detonation in-place may require an emergency permit from GEPA. UXO that is safe to transport would be taken to the AAFB Hazardous Waste Management Facility – Explosive Ordnance Disposal (EOD) Permitted Facility to be safely detonated. Depending on the location and the nature of the UXO, it may be taken to either the AAFB permitted facility or to the NBG Magazine for detonation as part of an emergency response under the Military Munitions Rule.

Electrical and Communication Systems

The proposed action is estimated to require a minimum of 5.7 megawatts of electrical power annually, in addition to DON's existing power needs, with increases primarily occurring as a result of the Main Cantonment and family housing projects (DON 2015b, p. 3-19). Because no refurbishing/reconditioning of any combustion turbines would be required, a supplemental major stationary source impact concentration analysis was not performed. Various upgrades to existing substations would not exceed the existing facility footprint. In addition, a new substation equipped with two 15 megavolt ampere, 34.5 kV – 13.8 kV transformers would be constructed in the Main Cantonment area, south of the main gate. A new 34.5 kV transmission line from the Harmon Substation, connecting Finegayan to AAFB would be placed underground (**Figure 2**).

Proposed Information Technology/Communications (IT/COMM) systems would require inter-base connections between the proposed Main Cantonment, the proposed LFTRC, AAFB, Andersen South, and other existing bases. These hardwired connections would consist of up to eight 6-inch conduits buried approximately 3 ft (0.9 m) deep. Off-site conduits would be encased in concrete and would have lockable manholes for security. Because redundant off-island communication paths are needed, an additional connection to the Tata Communications Cable Termination Facility (in Piti, Guam) from AAFB may be required. Off-site conduits would follow existing roads and rights-of-way between the facilities.

AAFB Well Field and Associated Water System

In order to support the proposed action, approximately 11 new water supply wells are proposed to be installed at AAFB, as well as several well-refurbishment projects and upgrades to DON's existing water system. When complete, the proposed water well area would total an estimated 45.2 ac (18.3 ha), including up to 7.6 ac (3.1 ha) for the test wells and approximately 11 production wells (each 200 ft [61 m] in diameter), approximately 28 ac (11.3 ha) for the water

lines and access roads that would connect the wells, and approximately 9.6 ac (3.9 ha) for a well field water storage tank, pumps, and treatment system (**Figure 2**). The new potable water distribution pipes would be installed underground at least three feet (0.9 m) deep. The width of the trench to install the pipes would be about 1.5 ft (0.5 m) to 4 ft (1.2 m), for 6-inch (15.2 cm) to 24-inch (61 cm) pipelines. The specific number and locations of wells would be determined during well development and would consider updated water system information. The estimated long-term increase in potable water demand to the Guam Waterworks Authority (GWA) potable water system would peak during construction around year 2021 at 0.84 million gallons per day (Mgal/d) (3.18 million liters per day [ML/d]) as a result of the proposed action (DON 2015b, p. 4-111). This estimate does not include forecasted organic civilian growth.

Based on conservative estimates, it is anticipated that to locate one well of sufficient yield to support production, approximately three test wells would be required. The well field area can accommodate approximately 22 test wells, 11 production wells and associated equipment. However, the actual footprint of the wells and the access roads to each is not known at this time, but is anticipated not to exceed 90 ac (36.4 ha) of cleared vegetation (DON 2017a, p. 24).

Prior to the start of drilling, efforts would be made by the design contractor to minimize disturbance to the limestone forest by inspecting the area with a DON biologist and identifying previously disturbed areas to the extent possible, for use as water well sites (DON 2017a, p. 23). In addition, the following actions would be implemented:

- Where disturbed areas cannot be identified, for each well location, a 14-ft (4.3 m) path will be created for the drill rig, trucks/vehicles and other equipment to get to the test well locations.
- An approximately 100 ft by 100 ft (or 0.23 ac [0.1 ha]) work area will be required to set up the equipment at each test well location.
- For each test well, an 8-inch to 12-inch (21 cm to 30.5 cm) borehole will be drilled to a depth of approximately 500 ft to 600 ft (152 m to 183 m) below ground surface. A submersible pump will be placed at the bottom of the well, and pump test and water sampling conducted. Based on the results of the pump test and water sampling, the well will either be abandoned or identified as a potential production well. For test wells identified as a potential production well, GIS survey coordinates will be taken and a stake placed at the test well site.
- A production well consists of well casing (approximately 10-inch to 12-inch [25 cm to 30.5 cm] in diameter), screen, gravel pack, submersible well pump, pump motor housing, and surface/borehole seal. At each well station the following will be provided: well housing, discharge piping, and flow meter. Each well head will have electrical lines, water transmission pipes, and feeders to each well.
- Locations of the water transmission and feeder lines will follow already disturbed areas made during test well drilling (path made by the drill rig/vehicles/equipment). A 20 ft to 30 ft (6 m to 9.1 m) wide strip will be required for construction of the pipelines, and manholes, valves, bends, anchor blocks, etc. as well as backfill material. The main transmission lines, ranging from 8 inches to 16 inches (20.3 cm to 40.6 cm) in width, will connect the well field storage tank facility to feeder lines. The individual well feeder lines, approximately 6 inches (15.2 cm) in width, will connect the wells to the main transmission lines.

- In the well field storage tank facility area, there will be a booster pump, water treatment storage tank, electrical room, and central emergency backup generator and fuel storage tank. In addition to the 14 ft (4.3 m) wide path for cranes/vehicles/equipment, an approximately 550 ft x 650 ft area (8.2 ac) will be disturbed during construction of the water storage tank and associated facilities.
- Unless cuttings or excavation materials are deemed contaminated or unacceptable as fill material, cuttings will be placed back into a borehole or trench. Unacceptable fill material or excess cuttings/excavation material will be removed from the site.
- The DON will be responsible for tracking and ensuring that 90 ac (36.4 ha) of cleared area is not exceeded during water well pre-construction, construction, and operation. When 68 ac (27.5 ha) or 75 percent of the allowed disturbance area is reached, the construction contractor will stop work and re-evaluate to determine if 90 ac (36.4 ha) could be exceeded, upon which time the DON will notify USFWS (DON 2017a, p. 24).

During well testing, only those wells with good water quality and capacity will be identified as production well sites. Test wells deemed unsuitable will be filled and capped and left in place, restored or converted to monitoring wells for management of the Northern Guam Lens Aquifer (NGLA).

Total average daily water extraction from the NGLA from all sources (the DoD water system, the GWA water system, and a few private wells) is estimated to be 47.0 Mgal/d (177.9 ML/d) by year 2028 (USGS 2013). USGS developed a numerical groundwater model to estimate the regional effects to groundwater availability from various withdrawal and recharge scenarios that include the increased withdrawal due to the proposed action and all other known future DoD actions, as well as organic growth of the Guam civilian population. The results from the model assist water resource managers in planning, designing, and managing water systems that will produce a sustainable and reliable freshwater supply (USGS 2013). The results of the USGS study confirm the recharge rate of the NGLA used in a 1992 Government of Guam study, but indicate that increased withdrawal from the NGLA may result in higher levels of chloride concentrations as compared to the 2010 base year scenario (DON 2015b, p. 4-112). The model indicates that these chloride concentration spikes would be a localized phenomenon, in which simulated salinity levels (i.e., measured by chloride concentration) in three wells (two GWA and one DoD) in the Finegayan basin moved into the cautionary classification. However, by redistributing withdrawal rates among the extraction wells, it would be possible to meet the water demands and maintain acceptable salinities over all existing and proposed GWA and DoD wells (DON 2015b, p. 4-112).

Sanitary Sewer System

The proposed wastewater collection system for the Main Cantonment and Family Housing would connect to the existing GWA collection system along Route 3 and Route 9 (**Figure 2**). The proposed wastewater collection system would include a network of gravity mains, manholes; two wastewater pump stations, force mains, and refurbishment of existing wastewater pump stations. Upgrades to existing GWA pump stations would connect to GWA's Supervisory Control and Data Acquisition (SCADA) system at the central monitoring station in Mangilao, Guam.

Wastewater would be conveyed to the Northern District Wastewater Treatment Plant (WWTP) in Dededo for treatment and disposal.

DON anticipates a monthly maximum wastewater flow of up to 4.77 Mgal/d (17.8 ML/d) from Cantonment/Family Housing, USMC personnel and other DoD, or project-related contractors. These levels would represent a 36 percent increase from the baseline (DON 2015b, p. 4-114).

The Northern District WWTP currently requires upgrades to meet the National Pollutant Discharge Elimination System (NPDES) permit standards of secondary treatment and the Guam Water Quality Standards, including those for nutrients (DON 2015b, p. 4-115). Until the required upgrades are operational, additional projected wastewater flows from the proposed action and all other sources would be treated to only primary treatment standards before discharge into coastal waters that are located south of Tanguisson Point on the northern shoreline of Guam (EPA 2013). In order to bring the Northern District WWTP into compliance, in August 2016 DoD awarded GWA $55.3M for: 1) the GWA Interceptor Sewer Refurbishment; 2) the Northern District Wastewater Treatment Plant Upgrade; and 3) the Northern Guam Lens Aquifer Monitoring System Expansion and Rehabilitation (GWA 2017). Timelines for completion of these projects are unknown and would depend on a variety of factors.

Construction and Operation of the Main Cantonment at Finegayan

The proposed Main Cantonment development includes base operations and support facilities constructed within 1,213 ac (491 ha) at Finegayan (DON 2017a, p. 18). A security fence approximately 27,900 ft (8,504 m) in length will be constructed around the Main Cantonment perimeter. The components of the Main Cantonment and support facilities are listed below, followed by examples of buildings for each category.

- Command Core: Marine expeditionary brigade headquarters and command buildings.
- Unit Operations: 3rd Marine Expeditionary Brigade Command Element, 4th Marines; 9th Engineer Support Battalion; ground combat element infantry battalions; artillery battalion; combat logistics battalion; and combat engineer battalion, including explosive ordnance disposal.
- Base Operations: Base administration, fire station, public works, vehicle fueling, base auto shop, kennel, corrosion prevention and control, and security.
- Housing: Bachelor enlisted quarters (BEQ) and bachelor officer quarters (BOQ).
- Community Support: Dining facility, fitness center, recreation areas, education center, auditorium/theater, branch exchange, bank/credit union, food court/amusement center, medical/dental clinic, and post office.
- Training: Battle training center, individual combat skills course.

Unit Operations and Base Operations will have the most intensive land use equivalent or similar to activities found in light industrial zoned areas. Activities in the Command Core, BEQ/BOQ, Community Support, and Training areas will have activities that are equivalent to residential or commercial zoned areas. Individual projects for follow-on vertical work will be implemented in accordance with function-specific criteria pertaining to civil, architectural, structural, mechanical, electrical and other engineered features of work.

Construction and Operation of Family Housing at AAFB

The Family Housing facilities will be located on 510 ac (206.4 ha) of developed or disturbed land on AAFB. Family housing includes residences for accompanied permanent USMC personnel and their dependents, and support and recreational facilities. Unaccompanied USMC personnel would stay at the Main Cantonment during their shorter-term (approximately six month) assignment to Guam. The new housing density at AAFB would be 5.5 units per acre. The family housing area would be accessed by the existing family housing gate (the Santa Rosa Gate) at the northern end of Route 15, or from the AAFB Main Gate off Route 9. The existing family housing would be demolished and 912 family housing units would be constructed as replacements for the existing AAFB housing, in addition to the 535 family housing units required for USMC families. All of the 1,447 family housing units would be integrated into one large housing pool where all eligible personnel and families would reside.

Expansion of existing community support facilities, such as the child development center, youth center, and temporary lodging facility may be required. New facility construction may include a temporary lodging facility, a community center, and a family support center.

The existing capacity of utilities at AAFB is adequate for the Family Housing project. The increase in the number of housing units and facilities would be minimal compared to the current number of housing units and facilities. Additionally, the new facilities would implement energy and water efficient features meeting Leadership in Energy and Environmental Design (LEED) silver or greater standards, which would reduce utility requirements.

Construction and Operation of the LFTRC and Associated Surface Danger Zone

The proposed LFTRC at AAFB NWF would consist of five individual ranges, range support buildings, range towers, range access roads, and a perimeter fence, removal of portions of the Ritidian Ungulate Fence (USFWS 2006) and the establishment of a Surface Danger Zone (SDZ) over NWF and the existing Guam National Wildlife Refuge (GNWR) (**Figure 3**). Repairs to Route 3A would also be part of the project. The LFTRC would require construction of electrical, telecommunication, wastewater, and water lines or facilities configured to operate with the existing utility infrastructure of AAFB NWF (DON 2017a, p. 19). The individual ranges are described below:

- *Known Distance (KD) Rifle Range*. The KD Rifle Range would have 50 firing points for 5.56-millimeter (mm) weapons. The range would be 534 ft (163 m) wide and 1,500 ft (457 m) from the farthest firing line to the target line. The target line would be flush with the ground, and there would be level ground from the 600 ft (183 m) firing line to the target line. The range would include a 25 ft (8 m) tall impact berm behind the target line. The range footprint would encompass approximately 18.5 ac (7.5 ha). The berm will be vegetated in accordance with the DON's landscape guidelines.
- *KD Pistol Range*. The KD Pistol Range would provide 25 firing points for training with 9-mm and 0.45-caliber (cal) weapons. The range would be 123 ft (37.5 m) wide by 150 ft (46 m) long with level ground from the firing line to the target line. The range would

include a 12 ft (4 m) tall impact berm behind the target line and 12 ft (4 m) lateral berms. The range footprint would encompass approximately 0.4 ac (0.2 ha).

- *Non-Standard Small Arms (NSSA) Range*. The NSSA Range would provide 25 firing points, and be used for training with 5.56-mm weapons. The range would be 204 ft (62.3 m) wide by 328 ft (100 m) long with level ground from the 300 ft (91 m) firing line to the target line. There would be a 16 ft (5 m) tall impact berm behind the target line and 16 ft (5 m) lateral berms on each side. The NSSA range footprint would encompass approximately 1.5 ac (0.6 ha).
- *Modified Record of Fire (MRF) Range*. The MRF Range would have 16 firing points for use by 5.56-mm weapons. This live-fire range area would be 525 ft (160 m) wide by 657 ft (200 m) in length with a 25 ft (8 m) tall impact berm at the far end of the range. The range footprint would encompass approximately 7.9 ac (3.2 ha).
- *Multipurpose Machine Gun (MPMG) Range*. The MPMG Range would have eight stationary firing lanes to support training with 5.56-mm, 7.62-mm, and 0.50-cal weapons, as well as 40-mm inert training rounds (i.e., nonexplosive). The range would be 525 ft (160 m) wide at the firing line, expanding to 1,050 ft (320 m) wide at the far end of the range. The range would be 3,281 ft (1,000 m) long and would include a 25 ft (8 m) tall impact berm at the far end of the range. The MPMG range footprint would encompass approximately 59 ac (24 ha).

Specific support buildings in the LFTRC NWF would include three range observation towers, target-storage and maintenance shed, ammunition issue points, covered bleachers, portable toilets, safety signage and lighting, and parking.

The range footprints would be entirely cleared of vegetation and the ranges would be designed with perimeter berms to contain expended rounds of ammunition within the range footprint. The MPMG range would include more uneven terrain with some vegetation. The purpose of the MPMG range is to simulate a more natural environment. Vegetation on the ranges would be designed using the Guam Landscaping Guidelines (DON 2011) and use appropriate or non-invasive species in order to reduce potential impacts associated with non-native vegetation.

Lighting will be designed to meet minimum safety, sustainable, antiterrorism, and force protection requirements. “Night-adapted lights” will be installed in the briefing and bleacher areas at NWF. Night-adapted lighting includes bulbs in red or other spectrums that allow a person’s eyes to remain adapted to low light or night conditions while still providing enough light for work and safety. Illumination of the coastline or beach will be kept to an absolute minimum including the shielding of lights and directing lighting away from the forest or other wildlife habitat (see Conservation Measures section).

LFTRC Construction Phase

Development of the LFTRC is anticipated to occur in two phases: Phase-1 would include the construction of the smaller ranges and repair/improve Route 3A; and, Phase-2 would include the construction of the larger MPMG Range. Due to the uneven limestone rock substrate prevalent throughout the NWF, construction of the LFTRC would involve the use of heavy machinery including, but not limited to the following: tractors, cranes, scrapers, jackhammers, pile drivers,

excavators, dozers, backhoes, and crane clam shovels (DON 2015b, p. 3-26). Blasting or the use of dynamite material will not be authorized. Approximately 212 ac (86 ha) would be cleared as a result of the construction of the LFTRC (DON 2014). Construction timelines are subject to availability of funding (DON 2017a, p. 21). Grading requirements for construction of the ranges and associated infrastructure would include 2,047,295 cubic yards (yd^3) (1,565,270 cubic meters [m^3]) of cut and 1,932,392 yd^3 (1,477,420 m^3) of fill, resulting in a net of 114,903 yd^3 (87,850 m^3) of cut (DON 2017a, p. 21). However, any grading and other earthwork required during facility construction at any of the ranges would be implemented to balance cut and fill on-site to the extent possible. If off-site fill material were needed, it would be obtained from a permitted source.

LFTRC Operational Phase

Range use would depend on the number of personnel required to complete annual individual training events, the duration of each event, and the training capacity of each range. The live-fire operations at the LFTRC would occur between 7:00 a.m. and 7:00 p.m. for up to 39 weeks (273 days) per year, and night operations (estimated to occur two nights per week over 39 weeks per year) would occur between 7:00 p.m. and 10:00 p.m. or 6:00 a.m. to 7:00 a.m. Training at the LFTRC would typically occur during weekdays but periodic weekend use could also occur as needed. Night training is estimated to occur twice per week during the associated qualification periods and would require consecutive firing days.

When operational, an estimated 6,719,190 rounds of various ammunition types are expected to be expended at the LFTRC NWF annually, by USMC and non-USMC personnel (**Table 4**) (DON 2017a, p. 22). Each range would also be required to have an emergency response vehicle. The actual number of emergency response vehicles would vary depending on the proximity of individual active ranges to each other. Transportation to and from the range is generally not expected to occur during peak travel hours.

Noise levels from training at the LFTRC would be impulse noise with very intense sounds of short duration (e.g., the discharge of a weapon). Firing noise from single shots merged in bursts, machine gun burst, and concurrent firing of multiple weapons would result in short periods of intense firing followed by periods of silence. Live-fire operations may occur for hours at a time, for five days a week, or not occur for multiple weeks in a row. The most widely used metric for noise is the day-night average sound level (DNL). The DNL represents energy-averaged sound levels measured by summation and averaging of sound exposure level (SEL) values during a 24-hour period. Noise levels at the LFTRC are estimated using the A-weighted DNL (ADNL), which is used to describe noise from transportation sources (e.g., vehicles, aircraft) and from other continuous sources (e.g., generators). The noise levels at LFTRC are estimated within the immediate and adjacent areas and would range from 55 ADNL to greater than 85 ADNL, depending on the zone or area (DON 2014, p. 68).

All operations of the LFTRC would adhere to the Marine Corps Ground Range Certification and Recertification Program (Marine Corps Order 3550.9, June 2004), Range Safety (Marine Corps Order 3570.1C, February 2012) and policies and procedures for range and training area management (Marine Corps Order P3550.10, July 2005). The Marine Corps Range and Training

Area Management Program is used to track ordnance expenditures and training area usage in order to remain in compliance with mandated government reporting requirements and environmental and safety policies.

Table 4. Annual amount of ammunition estimated to be expended at the LFTRC, NWF.

Range	Weapon	Ammunition Type	Estimated Annual Ammunition Usage		
			Day	Night	Total
USMC Usage					
KD Rifle Range	M16/M4	5.56 mm	1,533,300	322,800	1,856,100
	M249 SAW	5.56 mm	59,200	39,664	98,864
KD Pistol Range	M9	9 mm	324,956	19,328	344,464
Non-standard Small Arms Range	M16/M4	5.56 mm	569,356	403,500	972,856
	M249 SAW	5.56 mm	152,736	34,900	187,636
MRF Range	M16/M4	5.56 mm	304,920	62,820	367,740
	M249 SAW	5.56 mm	59,200	17,760	76,960
MPMG Range	M249 SAW	5.56 mm	377,104	0	377,104
	M40/M110	7.62 mm	13,824	4,104	17,928
	M240	7.62 mm	576,716	141,336	718,052
	M107	0.50 cal	3,520	0	3,520
	M2	0.50 cal	190,756	6,180	196,936
	MK19	40 mm inert	84,480	8,448	92,928
	M-203/M-32 Grenade Launcher	40 mm inert	24,940	2,580	27,520
Total Estimated USMC Use =			**4,275,008**	**1,063,420**	**5,338,608**
Joint Use (non-USMC)					
Total Estimated Joint Use =			**1,104,466**	**276,116**	**1,380,582**
Grand Total					
USMC + Joint Use			***5,379,474***	***1,399,536***	***6,719,190***

*SAW = Squad Automatic Weapon.

LFTRC Surface Danger Zone

The proposed action includes the establishment of a SDZ within the NWF and the GNWR. The SDZ would delineate areas that fired ammunition fragments or ricochets may land, forming the outermost limit of the LFTRC. The DoD standard for risk acceptance on ranges is a 99.9999 percent level of containment, which means the probability of munitions (for inert ordnance) or a hazardous fragment (for live ordnance) escaping the SDZ is one in a million. The SDZ projects north and outward over the GNWR-administered fee simple land and submerged lands. The DON would demarcate the SDZ beyond the shoreline through navigation map updates to alert maritime traffic of the potential hazard. For the land-based perimeter of the SDZ, perimeter access roads (KD and MPMG), perimeter fencing, or signage would indicate its boundaries for personnel and public safety. Approximately 3,701 ac (1,498 ha) of lands and submerged lands are required to support the SDZ. This includes approximately 142 ac (57.5 ha) of the Ritidian

Point Unit (fee simple land) of the GNWR and 3,059 ac (1,238 ha) of the submerged lands of the Philippine Sea.

Although most of the SDZ area can be seen with binoculars from the observation towers at Ritidian Point at NWF, ground patrols within the GNWR would ensure that the area under the SDZ is cleared of people prior to the operations of the LFTRC. Patrols would be conducted on the beach prior to the operations of the LFTRC, which will operate daily up to 39 weeks per year. The purpose of the access is to ensure the water portion of the SDZ is clear of people. The Range Safety Specialist (RSS) would conduct a ground survey of three locations (**Figure 4**); however they may only access one or two of these locations to clear the water portion of the SDZ. The RSS will access the location by using an all-terrain vehicle (ATV) (2 or 4 passenger Gator-type vehicle). The RSS will get out of the ATV and move to an area where the water portion of the SDZ can be seen (not on the beach). The RSS will use a pair of binoculars to clear the water portion of the SDZ. The RSS will walk back to the ATV and drive out the same trail taken to get to the access locations. Once the SDZ has been cleared, the RSS would notify Range Control and depart the area. The ground survey would last approximately 20 minutes.

Training Activities and Aircraft Operations within Andersen South

The proposed action at Andersen South would include the following: construction and operation of a Hand Grenade (HG) Range as part of the LFTRC; construction and operation of military training in an Urban Terrain Training Area (a portion of which will be a modular unit and another will be reconstructed from the existing unit); a logistics and administration area; a convoy course; an advanced motor vehicles operators course; an aviation training landing zone; an aviation and maneuver area landing zone; Pioneer Road; other range roads; a perimeter fence; main, secondary, and range road gates at Andersen South (**Figure 1**).

Construction and Operation of a Hand Grenade Range

The HG Range would include an approximately 0.9 ac (0.4 ha) area developed as a hand grenade training complex for the M67 fragmentation grenade that will be connected to existing utility infrastructure where available. The following features would be developed within the hazard zone: a holding shelter for four persons, four throwing positions with grenade sumps, a range observation tower with ballistic glass, and a grenade "dudded" impact area. A grenade house would be collocated with the grenade throwing pits. A concrete munitions storage (i.e., magazine) surrounded on three sides by earthen berms would be used for the temporary storage of hand grenades during training events.

In addition to the live-fire area, there would be a 1.0 ac. (0.4 ha) non-live-fire training area developed adjacent to the range and outside of the HG Range SDZ. The training area would consist of a demonstration area with bleachers, an open practice throwing field with various targets and throwing positions, portable toilets, and a parking area. Inert practice grenades would be used at this training area to provide familiarization training prior to proceeding onto the live-fire area of the range (DON 2017a, p. 24-25).

Other Activities at Andersen South

Convoy operations, maneuver training for military operations in urban terrain, and general maneuver and air-ground operations would vary, but may occur up to five days per week, 45 weeks per year, day and night. Up to 250 to 300 USMC personnel would participate in maneuver training at Andersen South each week, for a total annual throughput of approximately 11,250 to 13,500 personnel. Convoy operations would typically consist of 7 to 10 vehicles (e.g., high mobility multipurpose wheeled vehicles) traveling in tandem along an established course. Military operations in urban terrain includes transporting units to Andersen South by helicopter or vehicle, maneuvering toward the military operations in the urban terrain complex on foot or by vehicle, and engaging in integrated training at the urban terrain complex. Military operations in urban terrain at the reconstructed training area (also referred to as the Urban Embassy Component) will consist of 24 or more, multi-story concrete structures to simulate at least four city blocks.

The modular military operations in urban terrain (also referred to as the Rural Military Operations in Urban Terrain) would consist of movable components that can be stacked and grouped into a number of configurations to present tactical situations to be overcome by training units. This modular military operations in urban terrain will consist of shipping containers that will be assembled on site to simulate a more rural village or set of suburban buildings located outside the core urban area. Forklifts or cranes would be used to reconfigure the modules of the military operations in urban terrain to add variety and diversity to training. The military operations in urban terrain complex would include live-fire ranges, including a breacher and shooting house that will be used for forced-entry training, and the HG Range and storage shed. These training areas would be suitable for units or organizations of up to 800 USMC personnel at a time, and will be used daily by 40 to 750 personnel. The military operations in urban terrain will operate day and night; night operations will comprise an estimated 15 percent of all operations. The military operations in urban terrain will be used by organizations based on Guam, transients, and visiting regional allied forces. Units using the military operations in urban terrain may bivouac in the vicinity, or arrive and depart daily.

Typically, dry runs and individual skills training would occur prior to the military operations in urban terrain exercises, which will involve fire teams (smallest unit of infantry, typically four or fewer individuals), and squad drills (a group of 8 to 12 individuals). Types of weapons that will be authorized for use at the military operations in urban terrain will include M16, M4, M249, and M240. Blanks, simulators, smoke grenades, diversionary devices (improvised explosive devices and booby traps that release smoke when activated), special effects small arms marking system (similar to paintball), and a multiple integrated laser engagement system (small laser receivers scattered over the uniform of an individual soldier, which detect when the soldier has been shined by another soldier's firearm laser) are used in place of ammunition and explosives that would be used in a real combat situation.

Tactical motor vehicle operator training is a continuous requirement for USMC units. The advanced motor vehicle operations course would consist of a route along which a series of obstacles would be placed for driver trainees to negotiate. This would include obstacles simulating terrain features such as narrow bridges, serpentine courses, brake modulation blocks,

river crossing, side slope, pot holes, curb and ditch crossing, humps (similar to moguls on a ski slope), and narrow urban driving. The obstacles are connected with unpaved roads. The capacity of the advanced motor vehicle operations course facility will range from 25 to 60 personnel and will be used for individual, section, squad, or platoon training. An estimated 20 drivers per week would train at the advanced motor vehicle operations course, primarily with high mobility multipurpose wheeled vehicles. At two drivers per vehicle, an estimated 10 high mobility multipurpose wheeled vehicles would use the course during training events.

Convoy training consists of simulated threats and tactical scenarios to train in various defensive techniques. This area of Andersen South is currently used by the Air Force for expeditionary airfield and military operations in urban terrain training, which has similarities to the maneuver area training. The convoy training course is 2.5 mi (4 km) and would use existing and new roadways (see Andersen South construction area, **Figure 1**) within areas identified for the maneuver training space. All existing roads would be open to motor vehicle use associated with maneuver area training; this will primarily be wheeled vehicles, but occasionally a tracked vehicle may be used in maneuver area training at Andersen South. The area will continue to support Air Force training, while also accommodating Marine Corps training requirements. Access to the site would be by vehicle or air lift. Air lifts would typically involve two to four CH-53 helicopters dropping off and picking up personnel twice a week.

Andersen South would support landing zones for aviation training and include helicopter support team training for ground units. Personnel will be trained in rappelling from the helicopter and procedures that will be used in inserting and extracting troops via helicopter at combat locations. The air operation events associated with this air-ground training will typically consist of a pass for orientation, followed by a downwind approach, hovering at 30 ft (9 m) above ground level for approximately one minute at a designated landing zone and a departure. Since the maneuver area aviation training operations will be a component of training to meet the aviation training requirements, they are also described as aviation training. Helicopter-insertion extraction activities include fast rope, rappelling, helocasting, and parachute operations. Helicopter insertion-extraction training operations would involve one pass for landing zone orientation, followed by an approach of the landing zone, hovering at approximately 30 ft (9 m) above ground level for approximately one minute, and then departing the landing zone. During each training event, approximately three helicopter insertion-extraction operations would be conducted at one or more closely located landing zones. Approximately 114 helicopter insertion-extraction events would occur at Andersen South per year. Confined area landing, external loads, and maneuver lift (see descriptions above) training would also occur on Andersen South at a frequency of 125, 63, and 720 events per year, respectively.

Shooting house operations, which are to be located in Andersen South, are conducted in an enclosed structure and provide training in close-quarter skills, like room clearing and hallway navigation. Live-fire training operations with the 5.56-mm rifle will be authorized within the facility.

<u>Training Activities and Aircraft Operations within AAFB</u>

The main base at AAFB comprises about 11,500 ac (4,654 ha). Mass grading for construction of the Air Combat Element facilities addressed under the 2010 BO, has been completed as of May 2017. There are two airfields on AAFB, the north ramp and the south ramp runways. The facilities constructed at AAFB north and south ramps will be used by 12 permanently stationed MV-22 Ospreys and will accommodate the loading of additional transient aircraft. These aircraft will be used to conduct training and operational flights, including the following components: field carrier landing practice, familiarization-instrument, Marine air-ground task force, tactical air operations center, and routine operations to occur in association with the Air Mobility Command and the Air Combat Element (ACE). A training event consists of one aircraft performing a take-off, a training evolution, and a landing. These aircraft training operations (**Table 5**) would occur at existing airfields.

Table 5. Anticipated total flight operations at AAFB resulting from previous projects with the addition of the proposed action (Czech and Kester 2008).

Aircraft Type	**Anticipated Total Aircraft Operations per Year at Andersen Air Force Base**			
	Previously Addressed	Proposed Project	Total	% Increase
Helicopter	19,029	19,489	38,518	102%
Jet/Propeller	25,697	6,424	32,121	25%

The ACE facilities would be used for aircraft operations, maintenance of MV-22 tilt rotor aircraft, and training and support functions. The ACE facilities would also be used for USMC air control group training. The USMC air control group training involves coordination of air command, control, and defense units and the tactical air operations center. Training entails the set-up and operation of air traffic control radar and radio frequency emitters and facilities consisting of shelters, a portable tower, and electrical power sources. Tactical air operations center training involves the establishment and dismantling of these facilities within a 96-hour period. Training includes use of various emitters and sensors which need to be de-conflicted with other electronic equipment operating in the area. The ACE bed-down facilities will operate 24 hours per day and seven days per week. Staffing levels will be contingent on surge and operational requirements of the ACE facilities. Traffic would include government-owned vehicles, personal-owned vehicles, and shuttle buses from the proposed Main Cantonment area.

Approximately 1,000 annual field carrier landing practice and 79 annual familiarization-instrument flight events are proposed for AAFB. Field carrier landing practice operations entail one or more aircraft flying at a low altitude in almost circular patterns and involves landing on a simulated aircraft carrier during the day and, using night-vision goggles, at night. Familiarization-instrument training, including autorotation and simulated engine-out approaches will occur on the improved airfields with the support of aircraft rescue and firefighting facilities. Rotary-wing aircraft operations will occur at the AAFB airfields and in various proposed training areas on Guam. Fixed-wing aircraft operations will occur only in the immediate airfield environment of AAFB. Aircraft would then leave this area to conduct activities within established training areas of the Mariana Islands Training and Testing (MITT) program or other locations as described under MITT (USFWS 2015b). Air traffic at the ACE bed-down and the

north ramp will include helicopter, vertical lift aircraft, fixed-wing, and unmanned aircraft arrivals and departures.

In addition, the new Air Embarkation Facility was completed in June 2015 to serve as the passenger terminal for AAFB and temporary cargo storage. Air embarkation and disembarkation refers to the loading and unloading of passengers or cargo to and from aircraft. The passenger facilities are comparable to those of a small airport: luggage handling, waiting area, and ticket and documentation area. Cargo is staged for loading to aircraft or disbursement to warehouses or individual commands. The Air Embarkation Facility will operate 24 hours per day and seven days per week.

Training Activities and Aircraft Operations within Naval Base Guam

Naval Base Guam (NBG) is located along the southern side of Apra Harbor on the western coast of Guam. Relocation of the USMC to Guam would result in frequent embarkation operations supporting amphibious transportation of Guam-based Marines and other transiting amphibious forces for potential contingency, humanitarian, and exercise operations in the Pacific theater. In-water ship berthing and embarkation areas, staging areas, an amphibious craft laydown area, a military working dog kennel, a medical and dental clinic, wash down facilities, brown tree snake (BTS) barriers, and quarantine areas will be developed and operated at NBG. In addition, a U.S. Coast Guard (USCG) berthing and crew support building will be relocated to an area that is not currently forested. The military working dog kennel relocated from its existing site to a new site on NBG, within an existing laydown area for base maintenance with existing access roads and utility tie-ins.

The Apra Branch Medical and Dental Clinic will be built on a previously disturbed area that is currently vacant. The Morale, Welfare, and Recreation area will be developed to provide food and beverage booths, seating for 500 people, 40 phone bank seats, 100 stalls for visitor and rental car parking, portable restrooms, laundry facilities, temporary lighting, and trash dumpsters.

All facilities will have security lights mounted on buildings or steel poles. Lighting along the wharves will consist of 1,000-watt high pressure sodium floodlights mounted on new or existing poles. Lighting will be shielded and aimed such that the majority of the illumination will be directed towards the wharf deck, extending over water approximately 100 ft (30.5 m). All actions related to development and improvement of waterfront facilities will occur in currently paved or landscaped areas. All utility distribution lines and ductwork will be located underground, generally within existing utility corridors.

The DON will develop permanent and temporary wash down, quarantine, and inspection sites at arrival areas at Apra Harbor (ship and amphibious vehicle loading and unloading) (USFWS 2015a, p. 31-33) as follows.

1. A wash down, quarantine, and inspection facility will be built at Apra Harbor within 600 ft (183 m) of Victor Wharf to reduce the risk of exposure to invasive species after leaving the clean, biosecure area. During construction, invasive species and debris will be removed from the site. Prior to operation, the biosecure area will be inspected

to ensure the area is free of invasive species. These facilities will provide for vehicle cargo quarantine, inspection, and storage. The areas will use BTS barriers and active trapping for BTS will occur. The facilities will include a pre-wash down area, vacuum equipment, wash racks (raised platforms with ramps at either end that facilitate cleaning and inspection of undercarriages), an inspection building, and fenced area that will meet the requirements for the use of inspection dogs and a cargo loading and inspection area. Specifically, these facilities will be built in a designated paved area with a wash down area and sufficient space for segregating "clean" from "dirty" equipment, cargo, and vehicles. The areas will be surrounded by BTS barriers following specifications received from the Service: The barriers will be 4.5 ft (1.4 m) tall; made from pre-cast concrete with an outward projecting lip to deter snakes; the barriers will have only two gates providing one-way flow of traffic through the site; each gate made from sliding chain-link with fabric barriers or comparable materials to prevent BTS ingress and egress.

2. When in Apra Harbor, the vehicles and equipment unloaded or loaded onto a ship will be inspected and receive a wash down on arrival and departure to prevent introduction of any pest or invasive species that may present a potential threat to agriculture, public health, or the natural resources of Guam or other Pacific Islands. All wash downs will be conducted and supervised by trained personnel in accordance with Armed Forces Pest Management Board, Technical Guide No. 31 (2017). Personnel from USDA may participate in inspections and BTS inspections will be conducted with involvement of USDA Animal and Plant Health Inspection Service (APHIS) personnel. Vehicles will be inspected (internally and externally) prior to passing into the biosecure area. The water used to wash vehicles will be captured and circulated through filters to prevent pests from spreading. All waste on board ships will continue to be steam sterilized prior to disposal in regulated landfills in accordance with base operating procedures.
3. Supplies for the USCG Cutters are delivered to the wharves from existing DON supply warehouses where all supplies and material have undergone required USDA inspections upon arrival and before being transferred out of the warehouse and onto a USCG ship. The USCG ships do not offload supplies onto Guam from other locations.
4. Truck traffic at the NBG wharf will be required to re-supply ships. Trucks may be from DON Supply or direct from commercial vendors. Equipment to move cargo will be brought to the wharf as needed. When an aircraft carrier is not berthed, the Port Operations building will be used for storage. All equipment and cargo will go through inspection procedures prior to being brought into "clean" areas or being loaded on to ships, regardless of vendor.
5. A wash down, quarantine, and inspection facility will also be built at the amphibious vehicle laydown area in Apra Harbor to reduce the risk of exposure to invasive species after leaving the clean, biosecure area. This facility will be adjacent to the shore so that amphibious craft can drive into the wash down, quarantine, and inspection facility. This facility will be built to the specifications described above for Victor Wharf with modifications to accommodate amphibious vehicles, specifically: the laydown area will have dedicated ramps for landing craft air cushion and amphibious assault vehicles in the quarantine area.

6. Typically, the Amphibious Task Force will arrive fully supplied to meet all training requirements or will be replenished as needed prior to training in the CNMI. If cargo is loaded or unloaded, inspection is required as described above for Victor Wharf. Cargo will be loaded and unloaded in the laydown area which will be of sufficient size to segregate "clean" from "dirty" cargos. If there is a training mission on Guam, the trucks will drive off the ships' stern ramps (and be inspected as described above). Other cargo may be offloaded by mobile crane. After inspection, cargo may be temporarily stored in a "clean" material handling equipment area at the waterfront.
7. For all facilities, the DON will attempt to include USDA APHIS at the earliest possible time to plan for BTS inspections. Planning for cargo storage will include considerations of the length of time for storage, risk of BTS or other invasive species, and origin and destination of cargo.

All amphibious (i.e., on water) training operations and conservation measures are assessed under the MITT BO (USFWS 2015b). Though new facilities would be constructed due to the proposed project, no additional amphibious training will occur in undisturbed areas, and no new or increased frequency of training is anticipated under the proposed action. Therefore, amphibious training will not be analyzed in this BO.

New aviation training for external loads will occur at Orote Airfield on NBG. The training requires access to pre-positioned cargo for practice, and ground access is needed for ground support team personnel. External loads cannot be carried across public roads or populated areas. External load training operations will involve one pass for landing zone orientation, followed by an approach of the landing zone, hovering approximately 30 ft (9 m) above ground level for approximately one minute while the ground support team attaches a load (e.g., concrete block, items in a cargo net, or a vehicle), departure of the landing zone vicinity with the load in tow, flying with the load in an arc, then returning to the landing zone with the load, and hovering for approximately 30 seconds while the ground support team retrieves the equipment, and then departing the landing zone vicinity. During each event, these operations will typically involve five repeated attachments and detachments of external loads at the same landing zone where the ground support team is positioned. Ground support teams will include up to 40 personnel at one time and will support landing zone operations. Approximately 10 to 12 wheeled vehicles (e.g., high mobility multipurpose wheeled vehicles) will be used by these teams.

Training Activities and Aircraft Operations within the Naval Munitions Site

The Naval Munitions Site (NMS) is approximately 8,646 ac (3,499 ha) with ground-training activities occurring in the Southern Land Navigation Area consisting of 3,357 ac (1,359 ha) and the Northern Land Navigation Area consisting of 508 ac (206 ha) (**Figure 1**). The NMS is comprised of primarily savanna, ravine forest and limestone forest vegetation communities. Company-level patrolling, jungle training, land navigation, and air-ground operations will occur on five to seven consecutive days, 12 weeks per year, day and night, for a total annual throughput at the NMS of 1,440 Marines. Sixteen events are authorized under the MITT BO (USFWS 2015b). The number of days and weeks described above represent an increase of training events per year due to the proposed action (revised total of 28 events per year). This site is rural and rugged, supporting land-navigation training primarily for Special Forces personnel.

Access to the NMS for training will occur via aircraft transport operations at proposed landing zones. Approximately eight CH-53 (heavy-lift transport helicopter) lifts will be required for a company-level training event. Personnel, hand-carried supplies, and equipment will typically be airlifted to the site on a Monday and lifted out on Friday of the same week. No other roads will be established and no vehicles will be used within the training site. The access road will have an associated parking area that will be periodically mowed to allow for parking and to reduce fuel loading and potential for fires. Foot trails will be established within the Southern Land Navigation Area of the NMS due to repeated use during maneuver training.

Terrain flight, ground threat reaction, defensive maneuvering, confined area landing, and external load training will occur at the NMS. Terrain flights require a route with varying terrain at 50 ft to 200 ft (15 m to 61 m) above ground level. Training for terrain flights will occur only within the southern portion of the NMS, south of the southern extent of Fena Reservoir. Aircraft will leave AAFB and transit to southern Guam using standard military flight procedures (i.e., greater than 1,000 ft. [305 m] above ground level). Aircraft may fly over land or over water on their way to the NMS. A typical training event may involve an aircraft leaving AAFB, moving to the east over the ocean, traveling along the coast at an altitude greater than 1,000 ft (305 m) until approximately the Talofofo River, and then flying up the river to the NMS still at an altitude equal to or greater than 1,000 ft (305 m). Flights may go up the Ugum River at altitudes of 1,000 ft (305 m) or greater above ground level until they reach 9,843 ft (3,000 m) from the mouth of the river at Highway 4 and then flights may conduct low-level terrain flights. Once aircraft cross into the NMS below Fena Reservoir (training restriction line), pilots will then be authorized to conduct low-level 50 ft to 200 ft (15 m to 61 m) above ground level terrain flights within the southern NMS. Low-level flights will not occur over munition bunkers, the main NMS, the area to the east of the munition bunkers, over Fena Reservoir, or over the Almagosa Springs.

Ground threat reaction training requires a tactical flight maneuver area or route (similar to terrain flight routes) where ground-based electromagnetic radiation threat simulators may be placed. Defensive maneuvers are also conducted along a route over land or water. Differing helicopter types (AH-1, CH-53E, UH-1) and the MV-22 tilt rotor aircraft, will be used to conduct terrain flights, ground threat reaction, and defensive maneuver training; however, terrain flight training operations are low altitude tactics and the ground threat reaction and defensive maneuver training are conducted more in a tactical navigation area than along a route. Ground threat reaction is also low-altitude training like terrain flights, while defensive maneuver training is higher in altitude (equal to or greater than 1,000 ft [305 m] above ground level). Approximately 100 terrain flights, 94 ground threat reaction flights, 94 defensive maneuvers, and 1,104 maneuver lift flights per year will occur in the NMS.

Confined area landing training operations will also occur at the NMS. Confined area landing training consists of one pass of the landing zone for orientation, a downwind approach, followed by the landing, and takeoff. To meet qualification requirements, confined area landing training events typically will have five associated operations. Typically, a number of different, closely located landing zones will be used during the training event. There will be approximately 125 confined area landing training operations per year at the NMS. Approximately 63 external load training operations per year will also occur at the NMS originating from NBG.

Conservation Measures to Avoid or Minimize Project Impacts

The project's conservation measures are designed to avoid or minimize project effects to listed species and their habitats or to contribute to the recovery of a listed species. The Conservation Measures in the 2015 BO (USFWS 2015a, p. 36-46) remain intact and binding unless noted below. Conservation measures are considered part of the proposed action and are vital to determining the scope of the proposed action.

Implementation of conservation measures is required under the terms of the proposed action. The Service's effects analyses and determinations assume proposed project conservation measures will be implemented in full. Any changes to, modifications of, or failure to implement these conservation measures may result in a need to reinitiate this consultation. Modifications to certain aspects of a conservation measure, described herein, may be substituted for those provided in this BO, so long as such modifications provide protection equal to or greater than the protection afforded by the measure, as it is proposed and analyzed in this BO, and the Service's written concurrence is given. All conservation measures must be implemented prior to or concurrent with construction, unless otherwise stated.

After the conservation measures have been fully implemented, the long-term management of the species addressed in this consultation within the project areas, must be incorporated into the final JRM INRMP.

The proposed action's conservation measures are organized into five categories listed below and described in subsequent sections.

- Measures to contribute to the recovery of listed species;
- Measures to minimize the effects of construction;
- Measures to minimize the effects of invasive species;
- Measures to minimize the effects of fire; and
- Measures to minimize the effects of training.

<u>Conservation Measures that will Contribute to the Recovery of Listed Species</u>

This subsection is organized into general measures, core measures, species specific targets, and a conceptual implementation plan. General measures are designed to protect listed species during construction and operation phases of the proposed action.

These general measures are as follows, and are also referred to in subsequent paragraphs that discuss specific species conservation measures (DON 2017a, pp. 34-36):

1. *Fencing of the Haputo Ecological Reserve Area (ERA) Access Trail, Signage, and Education*. The DON will fence the Haputo ERA access trail to manage access in order to assist in maintaining the characteristics and integrity of the ERA. The fencing will prevent overuse by military and civilian personnel and potential damage to terrestrial biological resources within the ERA. These measures are consistent with the goals and objectives of the Haputo ERA Management Plan (NAVFACMAR 2010). In addition, in

accordance with the Haputo ERA Management Plan, the DON will develop and install informational and educational signage on the cliff line above the Haputo ERA. The educational materials will educate military and civilian personnel on the sensitive biological resources within the Haputo ERA, and monitor and document visitor use of the area, and prevent overuse and potential damage to terrestrial biological resources.

2. *Pre-construction Surveys, General Listed Plant Salvage and Translocation*. The DON will conduct pre-construction surveys to identify all listed plant species prior to the commencement of construction activities. If pre-construction surveys identify a listed plant species present in the construction area and the individuals cannot be avoided or translocated, then healthy plant material will be salvaged or available seeds will be collected, and such material will be housed in the Native Plant Nursery or directly transplanted into protected habitat or Forest Enhancement Sites (**Figure 5**). The ability to salvage the plants or collect seeds would be dependent on the health of the plant and whether or not it would survive transplantation or whether the plant produces seed. An authorized biologist would make the determination of "health." Transplantation timing will be site specific. Plants that cannot be immediately transplanted shall be stored at the DON Native Plant Nursery.
3. *Native Plant Nursery*. The DON is developing a Native Plant Nursery within the proposed Main Cantonment (**Figure 5**), for the storage and propagation activities of native and listed plant species, associated with the proposed action. Temporary locations adjacent to the Forest Enhancement Sites may also be developed in order to assist in the hardening off process for plants as they transition from the long-term Nursery to Forest Enhancement Sites or other protected areas.
4. *Authorized Biologist Qualifications and Propagation/Translocation Authorization Process*. All authorized biologists shall be considered agents of the DON and the Service for the purposes of conducting Conservation Measures described in this BO. Authorized biologists shall report directly to DON regarding all compliance issues or questions; this includes all draft and final reports of noncompliance (DON 2017a, p. 35). Prior to commencing translocation of the Mariana eight spot butterfly, Guam tree snail, humped tree snail, fragile tree snail, *T. guamense*, *B. guamense*, *D. guamense*, *T. rotensis*, *C. micronesica*, or *H. longipetiolata* the DON shall submit a statement of qualifications for potential biologists to the Service. The Service will provide a response (either concurrence or a detailed explanation of why the person may not meet the qualifications) no later than 30 calendar days after the statement is sent. If after 30 calendar days there is no response from the Service, DON will assume concurrence from the Service. The qualifications to work with the aforementioned species include the following:
    a. A bachelor's degree with an emphasis in botany, horticulture, ecology, or a related science;
    b. At least 100 documented hours of experience conducting propagation, translocation, transplantation, pest control, and monitoring of the aforementioned species or a closely related species; and
    c. Applicant must provide contact information of three references familiar with their work related to b (above).
5. *Annual Reporting of Conservation Measures*. The authorized biologist shall record each observation of each species handled in annual monitoring reports. The authorized

biologist will also include the type of activities (e.g., propagation, translocation) being conducted on each species and if relocated to another area, provide the location.

6. *Avoidance of Listed Orchid Species in a Small Location at Finegayan*. The DON will not construct within the area designated as "No Construction Area" within the proposed Main Cantonment because the location is not suitable for construction (**Figure 5**). The area is known to contain approximately 816 *T. guamense* and one *D. guamense*.

Forest Enhancement Sites, Ungulate Eradication Areas, and BTS Exclusion Fences

The core of DON's conservation measures that are intended to contribute to the recovery of listed species are focused on two Forest Enhancement Sites (North Finegayan and Finegayan), the NWF Ungulate Control Area, and two BTS Exclusion Fences (North Unit and South Unit) (**Figure 5**). The BTS Exclusion Fences would be located within the Forest Enhancment Sites. The DON's primary goal is to take an ecosystem approach to restoring, enhancing, and managing the limestone forest on DoD lands in support of range sustainment efforts on Guam (DON 2017b).

Forest Enhancement Sites

As stated in the 2015 BO (USFWS 2015a, p. 37), the DON will implement a forest enhancement project to enhance a minimum of 1,000 acres (404.7 ha) in Finegayan. The total minimum size of the Forest Enhancement Sites was determined under the 2015 BO in order to offset the loss of recovery habitat for the Guam Micronesian kingfisher, Mariana crow, Guam rail, and Mariana fruit bat (USFWS 2015a, p. 107).

Since 2015, the DON has refined the Forest Enhancement Conservation Measure to identify the sites and include the following:

1. The North Finegayan Forest Enhancement Site is approximately 650 ac (263 ha) and will be fully enclosed by an ungulate exclusion fence (**Figure 5**) that will be maintained and monitored throughout the life of the project.
2. The Finegayan Forest Enhancement Site (also referred to as the Finegayan Outplanting Site) is approximately 455 ac (184 ha) and will be located within the Main Cantonment area of Finegayan. This entire site will include ungulate control and be enclosed with a permanent fence (**Figure 5**) that will be maintained and monitored throughout the life of the project. Signage and other educational measures would be implemented to limit access to the Finegayan Outplanting Site.

Forest Enhancement activities will include the following:

- Installation of ungulate exclusion fences around approximately 1,000 acres (404.7 ha);
- Active removal of ungulates (i.e., trapping, snaring, shooting) with the goal of eradication within the fenced areas;
- Invasive plant removal; and
- Propagation, planting, and establishment of dominant and rare species characteristic of native limestone forest habitats (e.g., *A. mariannensis*, *B.*

> *guamense*, *D. guamense*, *E. calcareum*, *G. mariannae*, *F. prolixa*, *M. citrifolia*, *C. micronesica*, *W. elliptica*, *S. nelsonii*, *H. longipetiolata*, *P. pedunculata*, *T. rotensis*, and *T. guamense*).

The Conservation Measure has been modified from the 2015 BO (USFWS 2015a, p. 37) to allow for the translocation and outplanting of *T. guamense*, *D. guamense*, *B. guamense*, and Mariana eight spot butterfly host plants, *P. pedunculata* and *E. calcareum* within the Forest Enhancement Sites.

The process for initiating Forest Enhancement activities remains unchanged from the 2015 BO, "when a DON-related project is initiated that results in clearing of habitat that could aid int the recovery of listed species, a commensurate amount of forest enhancement will begin. The exact amount of recovery habitat that will be cleared will depend on final design specifications. The DON's Forest Enhancement project will enhance at least the same number of acres of recovery habitat as that cleared by the proposed action. The DON expects that approximately 1,000 acres of forest will need to be enhanced as part of the Project Description. The timeline for initiation of Forest Enhancement projects will be based on the construction timeline for the proposed action. The first construction project that will clear recovery habitat will trigger the initiation of forest enhancement. The sequence of forest enhancement will be: (1) ungulate exclusion fence, (2) ungulate removal, (3) invasive plant control, and (4) native plant establishment (USFWS 2015a, p. 37).

An overview of the DON's general process for forest enhancement and restoration activities is outlined below (DON 2017b):

1. Identify forest restoration/enhancement blocks.
2. Map the proposed forest restoration/enhancement area boundaries.
3. Receive authorization for specific area of forest to be restored or enhanced and vegetation clearance approach for permanent ungulate fences, access-grid trails, and temporary cross fencing.
4. Obtain clearance for any ground disturbing activities from UXO specialist.
5. Perform forest inventory for species density and dominance.
6. Construct permanent ungulate exclusion fence around perimeter of the enhancement site.
7. When fencing is complete, begin ungulate removal program.
8. Monitor ungulate removal program. Based on ungulate monitoring results, implement further ungulate control activities to achieve ungulate eradication.
9. Develop an invasive plant removal and native plant species outplanting and establishment plan based on the forest inventory.
10. Once ungulates are eradicated from the enhancement site, begin invasive species removal.
11. During the wet season, implement the out-planting of the enhancement site(s).
12. Annually, conduct vegetation and ungulate monitoring and if necessary, repair fencing, implement further ungulate removal activities, invasive plant removal and outplanting.
13. If a typhoon occurs during the forest enhancement process, fences will be inspected, repaired and if fences have been breached, conduct necessary ungulate control.

The DON understands that restoration/enhancement of a forest is a long-term program, requiring a sustained effort for 30 or more years (DON 2017b, p.1). Ongoing projects and management efforts will be coordinated and integrated with future management efforts to achieve the long-term goal of restoring and enhancing habitats for native species, including listed species.

Brown Tree Snake Exclusion Fences

The DON has initiated support for large-scale, long-term efforts to refine methods for BTS control that will reduce the BTS population on a landscape level more cost effectively and increase the efficacy of capturing BTS in low-density situations. In early 2012, the DON coordinated with the Service, USDA, and USGS on priority BTS projects. The development of a bait formulation for BTS suppression was determined to be the highest priority project need. The USDA National Wildlife Research Center (NWRC) was funded for a multi-year project by the DON at the start of fiscal year 2013 to implement the bait formulation project.

The DON will implement selected projects identified as priorities in the BTS Technical Working Group Strategic Plan that is compatible with the military mission on Guam for up to 10 years from the start of Main Cantonment construction, subject to Congressional funding guidelines and restrictions. DON and the Service acknowledge financial support is subject to the availability of funds, and no provision herein shall be interpreted to require obligation of payment of funds, in accordance with the Anti-Deficiency Act of 1982 (31 U.S.C. §§1341).

The DON's purpose for BTS control projects is to identify and use successful technology to severely suppress or eradicate BTS. To accomplish this goal, DON will install a BTS barrier surrounding the South Unit (**Figure 5**), to exclude BTS from approximately 160 acres (65 ha). Construction of the South Unit-BTS Exclusion Fence would begin after current experimental BTS suppression activities are deemed successful. Experimental BTS suppression activities, conducted by USDA Wildlife Services (USFWS 2011a, 2011b) are occurring within the existing 136-acre (55 ha) Habitat Management Unit (HMU) (**Figure 5**). The HMU is enclosed by a BTS exclusion fence. The Service and DON biologists are working closely to evaluate progression of experimental BTS suppression activities within the HMU.

Upon demonstrated reduction of BTS within the South Unit, the DON will initiate the construction of the North Unit- BTS Exclusion Fence, to exclude BTS from approximately 300 ac (121 ha). If landscape scale experimental BTS suppression activities are unsuccessful at any stage and as a result, large BTS Exclusion Fences would be ineffective, then DON would not construct new BTS Exclusion Fences and instead would manage those areas as Forest Enhancement Sites.

In response to decreased BTS densities, the rodent and feral cat populations are expected to increase. In order to address this anticipated increase the DON will implement rodent and feral cat control within necessary areas of DoD property.

Northwest Field (NWF) Ungulate Control Area

The DON will construct an ungulate exclusion fence to exclude feral ungulates from the LFTRC in the NWF (**Figure 5**). The ungulate exclusion fence would be approximately 3.69 kilometers (2.3 mi) in length and would tie-in to topographic barriers (i.e., cliffs) on each end. The DON is proposing to construct the LFTRC in the last remaining contiguous primary limestone forest habitat on Guam; therefore by constructing the NWF Ungulate Fence, habitat not within the proposed range footprint would be protected from ungulates. Approximately 218 ac (88.2 ha), 66.7 ac (27.0 ha), and 97.1 ac (39.3 ha) of primary limestone forest, secondary limestone forest, and herbaceous scrub, respectively would be protected from ungulates over the life of the project.

Ungulate control in the LFTRC may occur prior to NWF Ungulate Fence construction. All ungulate control and eradication activities, including those occurring in Finegayan may use any number of established ungulate control/eradication techniques: Ground Hunting by professional sharpshooters; Aerial Hunting; Recreational Hunters; Ungulate Control Specialists; Hunting with Dogs; Live trapping (including corrals); Snares; Lethal Baits; Nontoxic Baits to Attract Target Species; Divider Fencing; Radiotelemetry (Judas animals); and Fertility Control. The DON's objective of constructing the ungulate exclusion fences is to eradicate all ungulates within the fence.

In addition, the DON will adhere to the following 2015 BO Conservation Measures (USFWS 2015a, p. 38):

- The NWF Ungulate Control Fence will be completed within two years of awarding the contract for construction of the portion of LFTRC that removes the existing Ritidian Ungulate Fence (**Figure 3**).
- The DON will remove all ungulates from the NWF Ungulate Control Area within six months after completing the NWF Ungulate Fence (**Figure 5**).

Conservation Measures for Specific Species

Mariana eight spot butterfly

The DON will conduct pre-construction surveys to identify any stages of the Mariana eight spot butterfly prior to the commencement of construction activities. If any life stage of the Mariana eight spot butterfly (e.g., eggs, caterpillar, and chrysalis) is located within a project footprint during pre-construction surveys, it will be relocated onto an appropriate host plant (e.g., relocate pre-diapause larvae to *Procris pedunculata* or *Elatostema calcareum*) within similar sites away from the project footprint. This can be conducted by clipping the host plant and grafting the plant to another plant outside the project footprint (Cook and Delisle 2010). This method has been conducted successfully for the Sacramento Mountains checkerspot butterfly (*Euphydryas anicia cloudcrofti*) (USWFS 2002a, 2002b).

The DON will plant the Mariana eight spot host plants (*P. pedunculata* and *E. calcareum*) within the Forest Enhancement Sites and on the backside of the earthen berms of LFTRC ranges. The primary objective is to provide habitat corridors for the Mariana eight spot butterfly. The number of host plants that will be planted would be commensurate with the amount of Mariana eight spot host plants that are removed within the footprint of the LFTRC.

Guam tree snail, fragile tree snail, and the *humped tree snail*

The DON will conduct pre-construction surveys to identify any Guam tree snail, fragile tree snail, or humped tree snail within the project footprint prior to the commencement of construction activities. If any listed snail is found, the authorized biologist will translocate the listed snail away from the project footprint and into suitable habitat.

Mariana fruit bat

For projects within or in the vicinity of suitable Mariana fruit bat habitat, surveys following the Service-recommended JRM protocol (USFWS 2009) will be conducted one week prior to the onset of work (USFWS 2015a, p. 40). If a Mariana fruit bat is present within 492 ft (150 m) of the project site, the work will be postponed until the bat has left the area. The measure is intended to prevent, avoid and minimize potential effects to fruit bats, and will be implemented during pre-construction and construction activities.

Listed Plant Species

DON expects that six endangered or threatened plant species (*B. guamense*, *C. micronesica*, *D. guamense*, *H. longipetiolata*, *T. rotensis*, and *T. guamense*) would be affected by the proposed action. Effects are expected to be in the form of entire habitat removal (i.e., clearing of vegetation and grading). The DON will conduct conservation measures specifically designed to address each listed plant species (**Table 6**). Healthy listed plants located within a project footprint will be transplanted into Forest Enhancement Sites or other suitable protected areas (e.g., NWF Ungulate Control Area) prior to clearing. The ability to salvage the plants would be dependent on the health of the plant and whether or not it would survive transplantation. An authorized biologist will make the determination of "health." If DON is not able to meet the minimum percent survival ratio with whole plants or viable seeds from within the project footprint, then DON will pursue seed collection, tissue germination, and plant division and/or stem cuttings, as suitable to the species, from other sources outside the project footprint to provide seedlings to meet out-planting success targets (**Table 6**).

Table 6. Conservation measures for listed plant species, including out-planting site selection, monitoring and success criteria (DON 2017c).

Scientific Name	No. of Plants Subject to Removal	% Survival Ratio of Salvaged Material[1]	Targeted No. of Plants to Survive[2]	Out-planting Site Selection Criteria	Maintenance	Monitoring
Bulbophyllum guamense	3	50%	2	1. Wind: reduce wind influence by planting in forest with intact canopy; 2. Host: native host trees, large trees (*Heritiera* spp., *Ficus* spp.); 3. Sunlight/moisture: lower branches of canopy tree in disturbed forests, higher branches of canopy tree in high humidity microclimates; 4. Orientation on host branch/trunk: top of horizontal/wide lateral branches in lower/mid-canopy of large host trees; 5. Stage of life: adult/large specimens can be affixed to bark of branches directly and secured; and 6. Habitat: disturbed limestone forest.	One year of maintenance (e.g., supplemental watering, hand-weed removal, pest removal, treatments with insecticide, installation of fence protectors; etc.) after transplantation to ensure a minimum of 50% survivorship.	One year of monitoring for growth and establishment shall be conducted regularly to determine the status of the species, at least monthly and more frequently depending on the conditions of the out-planted plants.

Scientific Name	No. of Plants Subject to Removal	% Survival Ratio of Salvaged Material[1]	Targeted No. of Plants to Survive[2]	Out-planting Site Selection Criteria	Maintenance	Monitoring
Cycas micronesica	3,191	50%	1,596	1. Wind: reduce wind influence by planting in forest gaps; 2. Sunlight: half day sunlight, in forest gaps and along western forest edges that receive less wind flow; 3. Spacing: place in groupings (groves) with ~10 ft. between trunk centers; 4. Culture methods: adult trees, remove fruit, old fronds, reduce new frond length by half for remainder of fronds, or remove all fronds if tree is infested with cycad scale; and 5. Habitat: limestone forest, coastal limestone.	One year of maintenance (e.g., supplemental watering, hand-weed removal, pest removal, treatments with insecticide, installation of fence protectors; etc.) after transplantation to ensure a minimum of 50% survivorship.	One year of monitoring for growth and establishment shall be conducted regularly to determine the status of the species, at least monthly and more frequently depending on the conditions of the out-planted plants.

Scientific Name	No. of Plants Subject to Removal	% Survival Ratio of Salvaged Material[1]	Targeted No. of Plants to Survive[2]	Out-planting Site Selection Criteria	Maintenance	Monitoring
Dendrobium guamense	18	50%	9	1. Wind: able to withstand exposed positions in tree canopies; 2. Orientation on host branch/trunk: top of horizontal/wide lateral branches, branch crotches and on upright branches in mid to upper canopy of large host trees; 3. Host: native host trees, large trees (*Heritiera* spp., *Ficus* spp.); 4. Sunlight: Require dappled to direct sunlight of upper tree canopy; 5. Stage of life: adult clumps can be removed as a clump and affixed to branch of tree directly and secured, juvenile specimens should be affixed on branch with moss around roots to prevent desiccation; and 6. Habitat: degraded/disturbed native limestone forest.	One year of maintenance (e.g., supplemental watering, hand-weed removal, pest removal, treatments with insecticide, installation of fence protectors; etc.) after transplantation to ensure a minimum of 50% survivorship.	One year of monitoring for growth and establishment shall be conducted regularly to determine the status of the species, at least monthly and more frequently depending on the conditions of the out-planted plants.

Scientific Name	No. of Plants Subject to Removal	% Survival Ratio of Salvaged Material[1]	Targeted No. of Plants to Survive[2]	Out-planting Site Selection Criteria	Maintenance	Monitoring
Heritiera longipetiolata	7	50% viable seed	4	1. Sunlight: require half day sunlight, in forest gaps and along western forest edges that receive less wind flow; 2. Spacing: should have 10-15 ft. of growing room for adequate sunlight exposure. Due to large mature size should be spaced at a minimum of 50-ft. apart if planting more than one specimen in the same plot; 3. Habitat: Disturbed limestone forest; cliff sides, terraces, coastal limestone.	One year of maintenance (e.g., supplemental watering, hand-weed removal, pest removal, treatments with insecticide, installation of fence protectors; etc.) after transplantation to ensure a minimum of 50% survivorship.	One year of monitoring for growth and establishment shall be conducted regularly to determine the status of the species, at least monthly and more frequently depending on the conditions of the out-planted plants.
Tabernaemontana rotensis	217	50% viable seed	109	1. Wind: can withstand moderate wind exposure; 2. Sunlight: requires high sunlight levels; 3. Spacing: place in groupings (groves) with ~10-ft. between trunk centers; and 3. Habitat: disturbed limestone forest, gaps, edges, terraces.	One year of maintenance (e.g., supplemental watering, hand-weed removal, pest removal, treatments with insecticide, installation of braces; etc.) after transplantation to ensure a minimum of 50% survivorship.	One year of monitoring for growth and establishment shall be conducted regularly to determine the status of the species, at least monthly and more frequently depending on the conditions of the out-planted plants.

Scientific Name	No. of Plants Subject to Removal	% Survival Ratio of Salvaged Material[1]	Targeted No. of Plants to Survive[2]	Out-planting Site Selection Criteria	Maintenance	Monitoring
Tuberolabium guamense	4,922[3]	50%	1,000	1. Wind: plant in forest with intact canopy; 2. Host: native host trees, large trees (*Heritiera* spp., *Ficus* spp.); 3. Sunlight/moisture: lower branches of canopy tree in disturbed forests, higher branches of canopy tree in high humidity microclimates; 4. Orientation on host branch/trunk: top of horizontal/wide lateral branches in lower/mid-canopy of large host trees; 5. Stage of life: adult/large specimens can be affixed to bark/branches; 6. Habitat: disturbed limestone forest.	One year of maintenance (e.g., supplemental watering, hand-weed removal, pest removal, treatments with insecticide, installation of fence protectors; etc.) after transplantation to ensure a minimum of 50% survivorship.	One year of monitoring for growth and establishment shall be conducted regularly to determine the status of the species, at least monthly and more frequently depending on the conditions of the out-planted plants.

[1]Salvaged material from plants of the Orchid family (Orchidaceae) will be in the form of whole plants, whereas salvaged material from *H. longipetiolata* and *T. rotensis* will be in the form of seeds, and *C. micronesica* will be in form of whole plants or basal suckers, known as cycad pups.
[2]Survived is defined for Orchidaceae species as the documented observation of new root growth after transplantation into a protected area, or for *H. longipetiolata, T. rotensis*, and *C. micronesica* 'survived' is defined as the documented observation that the plant is ready to set fruit or flower.
[3]The DON has committed to relocating as many individuals of *T. guamense* as is feasible; however a minimum of 1,000 *T. guamense* individuals will survive.

Conservation Measures to Minimize the Effects of Construction

Construction activities would range from simple improvements to extensive clearing and earthmoving activities. For this reason, specific conservation measures have been designed to minimize the effects of construction:

1. *Contractor Education Program*. The DON will implement a contractor education program to ensure that construction contractor personnel are informed of the biological resources in the project area, including invasive species, special-status species, avoidance measures, and reporting requirements. The measure is intended to prevent inadvertent effects to terrestrial biological resources due to lack of awareness of resource presence, habitat requirements, and protective measures. The measure will be implemented during preconstruction and construction.
2. *Contractor Plans and Specifications*. DON will ensure that all construction activities will occur within the limits of construction shown in the plans and specifications. This measure is intended to prevent additional habitat loss. The measure will be implemented during pre-construction and construction.
3. *Access and Location Constraints*. Construction of the Main Cantonment components will take place on the upper plateau area of Finegayan and will not occur in the Haputo Ecological Reserve Area (ERA). Construction personnel are issued base passes for official business only within construction areas; these restrictions are specified in construction contracts.
4. *Guam Landscaping Guidelines*. Appropriate or non-invasive species will be planted in all new landscapes. This measure is intended to promote habitat for native species, reduce water consumption, and reduce the need for fertilizers. The measure will be implemented during construction.
5. *LFTRC Range Berm Controls*. LFTRC range berms will contain native or non-invasive herbaceous vegetation, and other measures as appropriate for listed species (see Conservation Measures to Contribute to the Recovery of Listed Species). This measure will help to manage storm water runoff and control erosion, and the berm will minimize the number of bullets in certain ranges that may fall outside the range footprint. The measure will be implemented during construction.
6. *Lighting Installations*. Lighting will be designed to meet minimum safety, sustainability, antiterrorism, and force protection requirements. Hooded-lights will be used to the maximum extent practicable at all new roads and facilities within known sea turtle land habitat and Mariana fruit bat roost areas. Either hooded or "night-adapted" lights will be installed at the LFTRC. Illumination of forest, coastline, or beach will be consistent with range safety and security requirements and kept to an absolute minimum including the shielding of lights and directing lighting away from the forest, shorelines and other wildlife habitat areas. This measure will be implemented during pre-construction, construction, and during all DON operations.
7. *Monitoring Construction Contractors*. The DON will be responsible for oversight of avoidance, minimization, and conservation measures implementation by the contractors for projects associated with the proposed action. The DON shall ensure that construction remains within the limits of construction and that sensitive resources are avoided, unless

otherwise specified in this Project Description. This measure will be implemented during pre-construction, construction, and operations.

Conservation Measures to Minimize the Effects of Invasive Species

To reduce the spread of invasive species and encourage a more holistic approach to managing invasive species including their pathways and other vectors, as part of the proposed action the DON funded the development of a Regional Biosecurity Plan (RBP) for Micronesia and Hawaii (formerly referred to as the Micronesia Biosecurity Plan). The RBP was completed in March 2015 with various contributions from government agencies, organizations, and individuals (DON 2015c). The goal of the RBP is to provide stakeholders in Micronesia and Hawaii with a platform for coordination and integration of interagency invasive species management efforts such as control, interdiction, eradication, and research. Several of the RBP recommendations are incorporated into this Project Description as best management practices (DON 2017a, p. 31-32). These best management practices include:

1. *Vegetation Waste Management Procedures*. Green waste will be handled by the contractors at designated onsite laydown areas within the limits of construction. Contractors will be required to divert all green waste. The larger-sized green waste consisting of trees and stumps will be processed into mulch and the smaller sized green waste will be processed into compost. Green waste would be processed in accordance with MCAG management procedures to prevent and reduce the spread of the invasive coconut rhinoceros beetle and little fire ant (DON 2016). A proposed green waste processing facility at NBG Landfill may also be used to process green waste generated during construction. The DoD will seek permit authorization from the GEPA for the proposed green waste processing facility.
2. *Implementation of Landscaping Guidelines*. The DON has developed an instruction manual providing landscaping design guidelines specific to appropriate plant selection and establishment for all the DON construction activities on Guam (DON 2011). This manual implements required DON policies including, but not limited to:
   - use of native regional plants for landscaping;
   - design, use, and promoting construction practices that minimize adverse effects on natural habitat;
   - pollution prevention by reducing fertilizer and pesticide use, integrated pest management practices, recycling green waste (composting), and minimizing runoff;
   - implementing efficient water practices; and
   - preventing the introduction of invasive species.

   The above measure is intended to reduce potential effects associated with non-native vegetation, promote habitat for native species, reduce water consumption, and reduce the need for fertilizers.
3. *Biosecurity Outreach and Education*. The DON has initiated and will continue to implement a targeted, comprehensive outreach and education program for DoD and civilian populations for biosecurity education focused on prevention. As a starting point, the DON initiated a contract for the development of biosecurity outreach and education materials. The contractor has designed and produced an activity booklet, a two-sided, tri-fold, educational brochure with an associated poster that differentiates native from

introduced species, defines invasive species, describes the known impacts of invasive species on native species and ecosystems, and what can be done to prevent and control invasive species. The DON will develop additional informational videos, expand the radio public service announcement (PSA) broadcasts, and other print media as well as active public outreach concurrent with the arrival of the first major influx of USMC personnel anticipated in 2020 and continue the educational outreach at this level for an additional 5 years.

4. *HACCP Planning*. Hazard Analysis Critical Control Point (HACCP) planning is a site specific pathway management tool implemented by the DON that provides a comprehensive method to identify risks and focus procedures to prevent spread of species through likely pathways. Construction work could unintentionally spread non-target (potentially invasive) species. These non-targets could hitchhike on construction equipment or be included in shipments of materials and supplies from locations outside of Guam. The pathways used by invasive species to move into new locations are not always obvious. Many problematic species, diseases, and parasites have been transferred to new locations as undetected (and unplanned) hitchhikers. Understanding pathways and developing plans to reduce non-target species and prevent biological contamination is necessary to avoid unintended spread of species. To achieve this goal, the DON will conduct the following steps related to HACCP planning:
    a. All construction contracts will contain a requirement to develop a HACCP Plan which will identify risks and potential pathways for non-native species and will outline procedures for controlling and removing risks identified. Construction contractors are required to provide documentation that supports prevention, worker awareness training, and control of non-native invasive and pest species in the project area and efforts to prevent the movement of non-native invasive species to areas outside the project area, whether in a purposeful or inadvertent manner. The contractor is responsible for ensuring that employees receive applicable environmental and occupational health and safety training and are up to date on all regulatory requirements for specific training for the type of work to be conducted onsite.
    b. Construction contracts will contain a requirement for inspections and proper re-use or disposal of vegetation to avoid contributing to the further spread of the coconut rhinoceros beetle. The construction contractors are to identify and implement control measures to prevent the inadvertent movement of non-native, invasive species to Guam and to and from the project site to other locations on Guam. The contractor is required to establish appropriate facilities that comply with all environmental laws and regulations, provide training for proper vehicle hygiene, and promptly take corrective and preventative actions for noncompliance. This includes thorough vehicle wash down and inspection for soil and other materials prior to leaving or entering a new project site.
    c. All HACCP planning and implementation related to the proposed action will be the responsibility of the awarded project contractor(s) to ensure that proper control measures are used throughout the construction activities to prevent the inadvertent movement of invasive species from one location to the project site, and/or from the project site to other locations. It will be the responsibility of DON to review and

concur with the development phase of the HACCP planning process to ensure proper compliance by contractors.

d. HACCP plans will be approved and inspected by the DON.

5. *Monitoring to Evaluate Effectiveness of HACCPs*. The DON shall provide training, review, and technical guidance on HACCP plan development, implementation, and revision during the construction phase of the buildup on Guam. The HACCP planning covers Guam-related rapid response actions. The DON contracted a baseline ecosystem monitoring study for projects on AAFB in 2011. Transects were focused on areas where newly introduced species were most likely to occur. The intent of the project was to establish a baseline of both native and non-native plants present prior to the beginning of planned construction activities. The baseline will serve as a reference for subsequent monitoring efforts conducted concurrently with construction in order to aid in evaluating the success of implemented HACCP plans. The baseline and subsequent monitoring efforts will help to determine whether any non-native plant species detected during surveys are newly introduced or were present prior to the beginning of construction. The AAFB project was completed in December 2012.

   To document the effectiveness of HACCP implementation at construction sites, the DON has developed and will implement a long-term monitoring program for terrestrial vegetation. For any clearing of vegetation that is adjacent to or contiguous with recovery habitat, the perimeter and 98.4 ft (30 m) into the habitat will be surveyed to identify vegetation community species composition. This survey will be repeated six months and one year after vegetation removal to ensure effectiveness of the HACCP implementation (clean equipment, supplies, and materials) during construction activities. If new non-native, invasive species are detected, the DON will notify the Service and the DON will develop and implement an eradication plan or control effort to prevent infestation. The DON will develop an early detection and rapid response component to be implemented immediately when an incipient invasive species is discovered in the proposed action area.

6. *Brown Tree Snake Interdiction*. The JRM has established a comprehensive BTS interdiction program to ensure that military activities, including the transport of civilian and military personnel and equipment to and from Guam, do not contribute to the spread of the BTS to other islands or regions. The BTS interdiction requirements are specified in DoD instructions (i.e., *36 Wing Instruction 32-7004, BTS Control Plan and JTREGMARIANASINST 5090.10A, BTS Control and Interdiction*). The proposed action will continue to comply with these established procedures:

   a. The DON will fund any increase of current federally funded BTS interdiction measures (in Guam, CNMI, and Hawaii) where the need for the increase is to address direct or indirect effects related to the USMC relocation to Guam. The fiscal year (FY) 2010 level of funding for the Federal interagency BTS interdiction effort on Guam, CNMI, and Hawaii and 2010 transportation levels associated with outbound cargo from Guam for the U.S. or U.S. territories will be used as the baseline. The Service agrees that it is not DON's responsibility to fund increased interdiction measures that are identified more than one year after the end of the fiscal year in which the USMC relocation construction activities have ended and permanent non-transient USMC military units have completed their relocation to Guam. For the

purposes of this Project Description, interdiction is defined as: "to hinder, prohibit, or prevent the BTS from becoming established in new locations by conducting inspection and suppression processes." Since 2010, the DON has worked with USDA and the Service to determine BTS interdiction cost increases. To date, there has been no measurable increase in interdiction costs according to the USDA.

b. *Coordination with the USGS.* Close coordination between USGS and DON will continue to occur in support of the BTS Research Closed Population Facility at NWF (located adjacent to the LFTRC and within the SDZ). The DON will ensure through briefings or information packages that the personnel using the LFTRC know the importance of the facility and maintain the integrity of the fence. Standard operating procedures will be developed and incorporated into the Range Management Plan (RMP) for the LFTRC to ensure protection of the USGS BTS Closed Population Facility fence and require immediate notification to the proper authorities in the event that the fence is accidentally damaged, to allow for a quick repair.

Conservation Measures to Minimize the Effects of Fire

The DON will prepare a Range Fire Management Plan (RFMP) and provide the RFMP to the Service prior to LFTRC operations. The RFMP will include protocols for monitoring fire conditions and adjusting training as needed (e.g., certain types of training will be restricted under certain fire conditions) and include the location and management protocols for fire breaks, firefighting roads, and a firefighting water-system. In addition, military units undergoing training will be briefed on requirements suitable to the conditions of the day and protocols should a fire occur (e.g., fire suppression protocols and capabilities, and the priority of habitat protection in relation to all other factors considered in the plan).

Fire management is a key component of range management. The DON goal is to reduce the effects of fires by limiting their frequency, size, and severity while still allowing the USMC to maintain a high level of combat readiness. In order to avoid or minimize impacts to listed species or recovery habitat, the RFMP will include the following elements of fire management (DON 2017a, p. 33-34):

1. *Implementation of a Fire Danger Rating System*. A Fire Danger Rating System will be tailored to specific military uses (i.e., training activities) at the LFTRC and the local weather and fuel conditions will be established. Weather readings will be taken every hour by remote automated weather stations (RAWS) on the installation. This information is immediately available to Range Control, who will use the output from the remote automated weather stations to determine the level of fire danger. This, in turn, determines any restrictions placed on military training for that hour. Restrictions are relayed to troops in the field via radio transmission. By restricting highly fire prone activities during periods of high fire danger, the likelihood of a fire start is reduced. Additionally, fires that are ignited are more likely to occur during periods of low or moderate fire danger, making them easier to control and extinguish.
2. *Fuels Management*. All available fuel management techniques will be considered for fire break and fuel break maintenance, as well as fuel management control. Standard on-the-ground application is limited to mechanical cutting, herbicide application, and prescribed fire. If herbicide is to be applied, care will be taken to ensure there is no overspray into adjacent forested areas.

3. *Locations and Standards of Fire Breaks and Fuel Breaks*. Fire breaks are similar to four-wheel drive roads and are cleared of all vegetation to mineral soil. Fuel breaks are swaths of cut, burned, grazed or otherwise modified vegetation so that a fire's behavior is reduced. The fuel break widths are determined by fuels, topography, and prevailing winds. Fuel management corridors will be established and maintained providing areas through which fire will not carry. These corridors will provide several distinct areas where fire may be contained in order to prevent a catastrophic fire event. Each corridor will be approximately 328 ft to 985 ft (100 m to 300 m) wide, although terrain, safety concerns, or protected resources may constrain the width in some areas. Fire breaks and fuel breaks shall be established immediately adjacent to the forest edge, along the outer perimeter of each range, so that there is no herbaceous vegetation along the edge of the forest.

   Fuel specifications within the corridor require that canopy cover not exceed 20 percent. Cover of fuel within the fuel management corridors will be measured at a scale of 33 ft (10 m). Within the fuel management corridors, no 33 ft x 33 ft (10 m x 10 m) area will have greater than 20 percent cover of fuel. Cover 'starts/stops' at the edge of a plant clump's canopy. The clump includes the dead herbaceous fuel on the ground. The frequency of a fuel break's upkeep is dependent on the speed of regrowth and/or colonization. If the vegetation within the range footprint is less than 3 ft (1 m) tall, then no active management would be needed to maintain fuels below 3 ft (1 m) in height, within the 131 ft to 197 ft (40 m to 60 m) wide fuel break area.
4. *Standard Operating Procedures*. Standard Operating Procedures (SOPs) outline responsibilities for fire prevention, Fire Danger Rating System usage, staffing levels, equipment caches, fuel modifications, proper fire suppression actions, and post-fire reports. The SOPs also include fire prevention briefings to be given to range users prior to commencement of training, notification lists in case of fire, operational decision charts for fires, and maps of protected resources, fuels, fire breaks, and Fuel Management Areas.
5. *Range Control Approval and Guidance*. Prior to firing all pyrotechnics (including tracers), Range Control approval and guidance must be obtained. Fire Department and Range Control personnel will have the authority to stop live-fire training for non-compliance with any training regulation and/or SOPs.
6. *Fire Suppression*. Water trucks (pickup truck with a tank in the back) will be on-site as a first responder vehicle. Water trucks may be supported by a fire truck or helicopter, as warranted. All locations for fire suppression activities will be prioritized in order to minimize or prevent fire effects to listed species.
7. *USFWS Review*. The Service will be provided a 30-day review period, from the date of receipt of the Draft RFMP, to provide comments and recommendations for the DON's consideration. The RFMP will be finalized for the LFTRC prior to operation of the first range at the LFTRC.

Conservation Measures to Minimize the Effects of Training

1. *Aviation Training in NMS* (see NMS Operations). All aviation training will be conducted so that aircraft approach the southern portion of the NMS over the Talofofo River watershed and Fena Reservoir at heights of 1,000 ft (305 m) or greater above ground

level. Flights may go up the Ugum River at altitudes of 1,000 ft (305 m) or greater above ground level until they reach 9,843 ft (3,000 m) from the mouth of the river at Highway 4 and then aircraft may conduct low level terrain flights. Low-level training flights will be restricted to the southernmost portion of the NMS where Mariana swiftlets are not commonly present.

2. *Ground Training in NMS* (see NMS Operations). The DON will maintain 328 ft (100 m) 'No Training Buffers' around the known Mariana swiftlet nesting caves (*e.g.*, Mahlac Cave, Fachi Cave, Maemong Cave) in the NMS. This measure is intended to avoid and minimize effects to Mariana swiftlets, and will be implemented during operations.
3. *Designated No Wildlife Disturbance Areas.* The DON will ensure that military training units work in close coordination with JRM MITT to clearly define authorized training restrictions, and where appropriate, designate No Wildlife Disturbance (NWD) areas or other designations to prohibit training in sensitive sites. The DON will work closely with DON Biologists to identify new NWD areas, consistent with USMC combat readiness and training requirements. Proper designation of NWD areas will ensure that bivouacs do not cause additional disturbance to endangered species or tree snails.

Term of the Proposed Action

The DON will be using an adaptive management approach to adjust the schedule for construction and implementation of the various project components in order to reduce the peak workforce population, ensure conservation measures are initiated prior to or concurrently with specific project impacts, and allow the DON to adhere to contract and fiscal constraints. This approach precludes the need for a specific construction schedule that is difficult to estimate. All construction projects are anticipated to be completed by 2032 or within 15 years of signing of this Opinion. Maintenance, operations and monitoring measures may continue indefinitely. The Service anticipates that the long-term management of the species addressed in this consultation within the project areas, must be incorporated into the final JRM INRMP. Refer also to section 15, Reinitiation Closing Statement.

Action Area

The term "action area" is defined in the implementing regulations for section 7 at 50 C.F.R. §402.02 as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action." In delineating the action area, we evaluated the farthest reaching physical and biotic effects of the action on the environment, including all DON facilities, infrastructure and training activities, as well as conservation measures described in the Project Description.

The action area for this consultation is the island of Guam (**Figure 1**). The specific areas likely to be affected directly or indirectly by the proposed action are discussed in detail in the Revised 2017 BA (DON 2017a). In addition to what is detailed in the Revised 2017 BA, the following effects from the action may be Guam-wide: 1) effects from introduction of invasive species by the proposed action could spread throughout the whole island of Guam and 2) the population increase resulting from the proposed action will cause additional human disturbance throughout the island, including at recreation sites, hunting areas, traffic along roads, etc.

ANALYTICAL FRAMEWORK FOR THE JEOPARDY AND DESTRUCTION/ADVERSE MODIFICATION OF CRITICAL HABITAT ANALYSIS

Jeopardy Determination

In accordance with policy and regulation, the jeopardy analysis of this BO relies on four components: (1) Status of the Species, which evaluates the range-wide condition of the Mariana fruit bat, Mariana eight spot butterfly, Guam tree snail, humped tree snail, fragile tree snail, *B. guamense*, *C. micronesica*, *D. guamense*, *H. longipetiolata*, *T. rotensis*, and *T. guamense* and the factors responsible for that condition, and the survival and recovery needs of each species; (2) the Environmental Baseline, which evaluates the current condition of the species in the action area, the factors responsible for that condition, and the relationship of the action area to the survival and recovery of each affected species; (3) the Effects of the Action, which determines the direct and indirect effects of the proposed Federal action, along with any interrelated or interdependent effects, on these species; and (4) Cumulative Effects, which evaluates the effects of future, non-Federal activities in the action area on the species.

In accordance with policy and regulation, the jeopardy determination is made by evaluating the effects of the proposed Federal action in the context of the Mariana fruit bat, Mariana eight spot butterfly, Guam tree snail, humped tree snail, fragile tree snail, *B. guamense*, *C. micronesica*, *D. guamense*, *H. longipetiolata*, *T. rotensis*, and *T. guamense* current status, taking into account any cumulative effects, to determine if implementation of the proposed action is likely to cause an appreciable reduction in the likelihood of both the survival and recovery of the Mariana fruit bat, Mariana eight spot butterfly, Guam tree snail, humped tree snail, fragile tree snail, *B. guamense*, *C. micronesica*, *D. guamense*, *H. longipetiolata*, *T. rotensis*, and *T. guamense* in the wild.

The jeopardy analysis in this BO places an emphasis on consideration of the range-wide survival and recovery needs of the Mariana fruit bat, Mariana eight spot butterfly, Guam tree snail, humped tree snail, fragile tree snail, *B. guamense*, *C. micronesica*, *D. guamense*, *H. longipetiolata*, *T. rotensis*, and *T. guamense* and the role of the action area in the survival and recovery of these species as the context for evaluating the significance of the effects of the proposed Federal action, taken together with cumulative effects, for purposes of making the jeopardy determination.

Adverse Modification Determination

Past designations of critical habitat have used the terms “primary constituent elements” (PCEs), “physical or biological features” (PBFs) or “essential features” to characterize the key components of critical habitat that provide for the conservation of the listed species. The new definition of destruction or adverse modification of critical habitat was published as a final rule on February 11, 2016 (81 FR 7214) and discontinues the use of the terms PCEs or essential features, and relies exclusively on use of the term PBFs because that term is contained in the Act. However, the shift in terminology does not change the approach used in conducting a “destruction or adverse modification” analysis, which is the same regardless of whether the

original designation identified PCEs, PBFs or essential features. The only species addressed in this BO with designated critical habitat is the Mariana fruit bat. The adverse modification analysis for Mariana fruit bat critical habitat was conducted on the proposed Federal action in the 2015 BO (USFWS 2015a, pp. 103-104 and pp. 144-145). This analysis and the information used in the analysis remain unchanged and are referred to by reference in appropriate sections of this consultation.

STATUS OF THE SPECIES

Status of the Mariana fruit bat

Species Description

The Mariana fruit bat (fanihi in Chamorro) was listed as endangered in 1984, but was downlisted to threatened on January 6, 2005 when it was determined that all fruit bats on Guam and throughout the Commonwealth of the Northern Mariana Islands (CNMI) comprise a single subspecies (70 FR 1190). The Mariana fruit bat is the only fruit bat species under U.S. jurisdiction. In 2004, critical habitat for the fruit bat was designated at the GNWR in the Ritidian Unit (69 FR 62944).

The Mariana fruit bat is a medium-sized fruit bat in the family Pteropodidae, and weighs between 0.73 lb to 1.27 lb (331 g to 577 g). Male Mariana fruit bats are slightly larger than females. The underside (abdomen) is black to brown with gray hair interspersed that creates a grizzled appearance. The shoulders (mantle) and sides of the neck are bright golden brown, but may be paler in some individuals. The head varies from brown to dark brown. The well-formed, rounded ears and large eyes give the face a canine appearance (USFWS 2009 p. 4).

The paleotropical genus *Pteropus* is represented by approximately 63 species distributed across the Indian Ocean, Southern Asia, Australia, and in Oceania as far east as the Cook Islands (Almeida et al. 2014 p. 83). Most species in the genus *Pteropus* occur on islands or in coastal areas (Almeida et al. 2014 p. 84). Four species in the genus *Pteropus* are extinct and 38 species (60 percent of the genus) are considered critically endangered, endangered, threatened, near threatened, or vulnerable under the definitions of the IUCN (IUCN 2017). One of the four extinct species, *Pteropus tokudae,* occurred only on Guam and has not been detected since 1968 (Bonaccorso et al. 2008; USFWS 2009).

Flannery (1995) and Simmons (2005) consider the Mariana fruit bat as one of two subspecies of fruit bats restricted to the Mariana Archipelago, with the Mariana fruit bat inhabiting the islands from Guam to Saipan and *P. mariannus paganensis* occurring on Pagan and Alamagan islands. However, subsequent genetic analysis conducted by Brown et al. (2011) indicate no genetic differentiation among islands within the Mariana Archipelago and that the bats on these islands, currently classified as two subspecies, should be managed as a single subspecies, *P. mariannus mariannus* (p. 940). In addition to the Mariana fruit bat, there are several other subspecies of *P. mariannus* endemic to other archipelagos, including the Caroline Islands and the Palau Archipelago (Brown et al. 2011 p. 934).

Critical Habitat Description

Approximately 376 ac (152 ha) were designated as critical habitat for the Mariana fruit bat on Guam (USFWS 2004, 46 pp). Critical habitat was identified using the guidelines provided by the Mariana fruit bat recovery plan (1990). Although the current population of Mariana fruit bats on Guam is small, and most Mariana fruit bats roost in a limited area, the foraging behavior and diverse diet of the Mariana fruit bats cause them to use most of the island for foraging (Wiles et al. 1995). Thus, all of the designated critical habitat for this species is used for foraging and/or roosting and is considered occupied.

Guam Critical Habitat Unit

The Guam critical habitat unit consists of approximately 376 ac (152 ha) of land in the fee simple portion of the GNWR. The vegetation in this unit consists of coastal, limestone, and secondary limestone forests, composed of native and introduced plant species and contains the full range of physical or biological features needed for the conservation of the Mariana fruit bat. This area is important because it contains areas used for foraging by the last known Mariana fruit bat colony (currently abandoned) on Guam. This area also contains roosting and foraging sites historically and currently used by Mariana fruit bats (USFWS 2004, p. 62951; J. Schwagerl, Service, pers. comm. 2015). This unit also encompasses essential conservation areas identified in the Mariana fruit bat recovery plan (USFWS 1990b). The draft revised recovery plan (USFWS 2009d) does not contain specific areas for recovery.

Current threats to Guam critical habitat unit include habitat loss, degradation, and fragmentation due to development, military training, and fire, human disturbance, introduced ungulates, invasive plants, and non-native predators. Actions that exacerbate these threats or result in new threats, individually or in combination, may result in appreciably decreasing habitat value or quality of habitat necessary for the recovery and survival of Mariana fruit bats on Guam.

Recent conservation actions in the Guam critical habitat unit include construction of a multi-species enclosure fence at the GNWR at Ritidian Point, BTS trapping and ungulate removal within the enclosure fence; and out-planting of native plants including *S. nelsonii*.

Physical or Biological Features

The physical or biological features required by the Mariana fruit bat for the biological needs of foraging, sheltering, roosting, and rearing of young are found in areas supporting limestone, secondary, ravine, swamp, agricultural, and coastal forests composed of native and introduced plant species. These forest types provide the physical or biological features of:

- Plant species used for foraging, such as *Artocarpus* spp., *Carica papaya*, *Cycas micronesica*, *Ficus* spp., *Pandanus tectorius*, *Cocos nucifera*, and *Terminalia catappa*; and
- Remote locations, often within 328 ft. (100 m) of cliff lines that are 260 to 590 ft. (80 to 180 m) tall, with limited exposure to human disturbance and that contain mature *Ficus* spp., *Mammea odorata*, *Casuarina equisetifolia*, *Macaranga*

thompsonii, *Guettarda speciosa*, *Neisosperma oppositifolia*, and other tree species that are used for roosting and reproductive activity.

Life History

Mariana fruit bats, similar to other bats in the Pteropodidae family, do not use laryngeal echolocation, instead relying primarily on vision and smell to avoid obstacles and locate food sources (Almeida et al. 2014) . Mariana fruit bats vocalize readily within colonies and when roosting. The diet of the Mariana fruit bat is comprised of fruits, nectar, pollen, and some leaves from at least 45 different plant species (Mildenstein & Johnson 2017) . Rapid digestion and metabolism of such foods makes these animals reliant on forest habitat with diverse food resources available throughout the year (USFWS 2009 p. vi). Mariana fruit bats use several forest types for foraging, roosting, and breeding, including native primary and secondary limestone forest, volcanic (or ravine) forest, old coconut plantations, and groves of *Casuarina equisetifolia* (Rice & Taisacan 1988; Worthington et al. 2001 p. 137; Wiles & Johnson 2004 p. 589,591). Most Mariana fruit bats roost during the day in maternity colonies at sites to which they show a high level of fidelity (unless disturbed). A small proportion of Mariana fruit bats, usually males, roost alone or in small groups called bachelor colonies. Within colonies, Mariana fruit bats typically group themselves into harems (one male and 2-15 females) or bachelor groups (predominantly males) (Wiles 1987).

Population Dynamics

Population demographic information for the Mariana fruit bat is limited. Based on three-years of field observations on Guam similar to other Pteropodidae species, female Mariana fruit bats rear up to one pup annually (USFWS 2009) and likely have a gestation period of approximately 4.6 to 6.3 months (Pierson & Rainey 1992 pp. 1–17). Many *Pteropus* species typically do not give birth until 18 months of age (Pierson & Rainey 1992 pp. 1–17; McIlwee & Martin 2002 p. 76). Lifespan of substantially larger species, *P. alecto*, in Australia is four to five years, with a maximum of eight years (Vardon & Tidemann 2000).

Based on this demographic information, several authors have suggested that *Pteropus* bats have a low maximum population growth rate and thus a slow rate of recovery when a population is diminished (Pierson & Rainey 1992 p. 76; McIlwee & Martin 2002). **Table 7** provides current population sizes per island and other demographic data (Mildenstein & Johnson 2017 p. 20).

Table 7. Mariana fruit bat population sizes and density by island.

Island	Forest Habitat (ha)	No. of Bats	Density
Guam	25,711	45	0.00
Rota	6,663	4,149	0.62
Aguiguan	302	50	0.17
Tinian	6,481	< 25	0.00
Saipan	5,355	< 50	0.01
Farallon de Medinilla	< 1	< 5	--
Anatahan	N/A[2]	150	--

Sarigan	169	157	0.93
Guguan	170	226	1.33
Alamagan	485	86	0.18
Pagan	1,971	1,017	0.52
Agrihan	2,336	858	0.37
Asuncion	316	573	1.81
Maug	48	11[1]	

[1]Insufficient data available.

Status and Distribution

The Mariana fruit bat is endemic to the Mariana Archipelago (**Figure 6**). The Mariana Archipelago extends across 459 nautical miles (nmi) (850 km) and is comprised of the U.S. Territory of Guam and 14 islands constituting the CNMI. The Mariana fruit bat is found on all 15 islands within the Marianas, except for Uracas, the northernmost island (Wiles et al. 1989 p. 69). The Mariana fruit bat is currently thought to be extirpated from Tinian (USFWS 2014 p. 3). A single Mariana fruit bat was photographed on Farallon de Medinilla on two occasions, in 1996 and in 2008 (DON 2013 pp. 4–123).

Mariana fruit bats in general are strong fliers and highly mobile and small groups have been observed flying over the ocean between islands (Wiles & Glass 1990 p. 2; Wiles & Johnson 2004 p. 593). Distances between are: Guam to Rota, 32.3 nmi (60 km); Rota to Aguijan, 42.1 nmi (78 km); Aguijan to Tinian, 4.9 nmi (9 km); Tinian to Saipan, 2.7 nmi (5 km); Saipan to Farallon de Medinilla, 45.9 nmi (85 km); and Saipan to Anatahan, 64.3 nmi (119 km). In the remaining northern Marianas, interisland distances range from 15.7 nmi to 54.0 nmi (29 km to 100 km). All islands have a maximum elevation ranging from 551 ft to 3,166 ft (168 m to 965 m) with the exception of Farallon de Medinilla, which has a maximum elevation of 266 ft (81 m). All islands are visible in clear weather from the tops of adjacent islands (Wiles & Glass 1990 p. 1).

Distribution of occupied Mariana fruit bat roost sites have fluctuated sharply in the southern islands and are thought to be due to variations in survey methods, coverage, and movements of Mariana fruit bats between islands (USFWS 2009 p. 9). Initial observations of Mariana fruit bats in the southern islands (Aguiguan, Tinian, and Saipan) in 1983 and 1984 revealed populations of less than 25 to 50 Mariana fruit bats on each island. Mariana fruit bat numbers increased to about 75 to 100 individuals on Saipan in 1986 and to about 300 individuals on Aguiguan by 1988 (Wiles & Glass 1990 p. 2). Mariana fruit bats on Rota are believed to move periodically among the southern islands, and thus Rota is considered to be important to the long-term stability of the species in the southern part of the Marianas (Wiles & Glass 1990 p. 2; Wiles et al. 1995). Historic numbers of Mariana fruit bats on Guam have been between 400 and 800 since 1984, but have since been decreasing. By the early 1980s nearly all Mariana fruit bats on Guam lived in Northern Guam in a single colony, which occasionally divided into several smaller aggregations (Wiles & Glass 1990 p. 2; Mildenstein & Johnson 2017 p. 25).

Survey data in the northern islands (Anatahan, Sarigan, Guguan, Alamagan, Pagan, and Agrihan; excluding Asuncion and Maug, which were not surveyed during this time period), indicate a 40

percent decline in Mariana fruit bat numbers between 1983 and 2000 (USFWS 2009 p. 11). In the 2014 5-year review, Mariana fruit bats were found to be stable or declining throughout most of their range; the only exception being on Rota where populations were increasing since 2008 due to increased enforcement of wildlife reguations (USFWS 2014). Approximately 42 percent and 58 percent of the entire Mariana fruit bat population resides in the northern and southern islands, respectively (**Figure 6**; (Mildenstein & Johnson 2017)).

Threats

Illegal hunting, loss of native forest, predation by the BTS on Guam, and the increased risk of extirpation or extinction faced by small, fragmented populations are the most significant threats to the survival of the Mariana fruit bat (USFWS 2014). These current known and potential threats are discussed below.

Threats:

- Loss or Degradation of Habitat:
    - Human development is a factor in habitat loss on all inhabited southern islands and on northern islands with military activity.
    - Feral ungulates and Philippine sambar deer (*Rusa marianna*) degrade habitat on many of the Mariana Islands. The successful eradication of feral ungulates from Sarigan and Anatahan suggests that similar projects may succeed on other islands. However, once grazing and browsing pressure is removed, the potential invasion of native forest by alien plants may be a more difficult and long-term recovery issue.
- Human Disturbance:
    - Illegal hunting is a threat to Mariana fruit bats throughout its range. Although law enforcement activity has increased since 2009 (CNMI -DLNR 2008; CNMI-DLNR 2009a, 2009b, 2010), illegal hunting of Mariana fruit bats on Rota continues and will likely resume to historical levels unless consistent, effective law enforcement efforts in tandem with education and outreach programs continue. Mariana fruit bats appear to be declining on Tinian, Saipan and Guam, and illegal hunting is thought to have greatly contributed to the decimation or decline of those populations (Wiles & Payne 1986; Wiles & Glass 1990; Sheeline 1991; Stinson & Glass 1992; Esselstyn et al. 2006). As with Rota, recovery of the Mariana fruit bat on human-inhabited islands will not likely be possible without strong education programs combined with effective control of illegal hunting.
- Nonnative Snake Predation:
    - Brown tree snakes prey on non-volant young left at the roost during the night, thus preventing the recruitment of young bats into the breeding population. Effective control of BTS must be achieved before the Mariana fruit bat population on Guam can recover. The interdiction, control, and ultimate eradication of BTS in the archipelago are the focus of major, ongoing projects, and the Mariana fruit bat is likely to benefit from these efforts in the long term. This prognosis would change drastically if the BTS were to become established widely throughout the archipelago.
- Stochastic Events:

- Typhoons and volcanic eruptions result in mortality, reduced population viability, and habitat loss. Natural disasters can be especially damaging to the viability of smaller Mariana fruit bat populations (e.g., on Guam, Saipan, Aguiguan, and Maug). The significant loss of habitat on Anatahan after the volcanic eruption in 2003 resulted in the loss of a substantial Mariana fruit bat population that has not yet recovered.

Mariana Fruit Bat Recovery Criteria

A draft revised recovery plan for the Mariana fruit bat (USFWS 2009d) addressed actions needed for the survival and recovery needs of the Mariana fruit bat. Since publication of the draft revised recovery plan, new information on the Mariana fruit bat has resulted in changes to how we look at recovery for the species. We now consider recovery in terms of stable or increasing subpopulations of sufficient size distributed across Guam and the Mariana Islands. To meet recovery objectives, stable or increasing fruit bat subpopulations should at a minimum be distributed on the islands that currently have extant populations (USFWS 2009d). Actions that reduce or eliminate the potential for self-sustaining populations of resident Mariana fruit bats on Guam may hamper or preclude recovery of the species. The reduction or elimination of this potential may take many forms: degradation or loss of habitat and resources required by the fruit bat for foraging, roosting, and reproduction; increased exposure of fruit bats to illegal hunting and other sources of human disturbance; and introduction of non-native predators that prey upon fruit bats. In order for the Mariana fruit bat's population to recover on Guam, sufficient amounts of functional habitat will need to be protected and restored on Guam (USFWS 2009d).

Guam contains a large proportion of the remaining native limestone forest in the southern inhabited Mariana Islands, and most of that habitat is located within DoD lands. Habitat loss and degradation, illegal hunting, predation by non-native predators, and human disturbance currently impact fruit bats within the action area. If threat levels increase within Mariana fruit bat habitat in the action area, it may further inhibit the potential for the species to recover.

Survival and Recovery Needs

Before the Mariana fruit bat is considered for delisting, the Service proposes that stable or increasing populations should exist on three of the five southern islands (Saipan, Tinian, Aguiguan, Rota, and Guam), and six of the northern islands where Mariana fruit bats have persisted historically (Anatahan, Sarigan, Guguan, Alamagan, Pagan, Agrihan, Asuncion, and Maug; (USFWS 2009 pp. 40–41). Of the six northern islands that require stable or increasing numbers, two of these must include Pagan, Anatahan, or Agrihan. Since publication of the draft revised recovery plan in 2009 (USFWS 2009), new information on the Mariana fruit bat has resulted in changes to how we look at recovery for the species. We now consider recovery in terms of stable or increasing subpopulations of sufficient size distributed across Guam and the Mariana Islands. To meet recovery objectives, stable or increasing Mariana fruit bat subpopulations should at a minimum be distributed on the islands that currently have extant populations (USFWS 2009). The final version of the Mariana fruit bat recovery plan is currently in review, and recovery criteria stated here may change upon completion of the final plan.

Of the six northern islands, the only evidence for a possibly increasing population is on Asuncion (USGS 2010 p. 33). Of the five southern islands, only Rota has achieved an increasing population. Although a conservation area containing some important habitat for Mariana fruit bats was established on Rota (USFWS 2011 p. 1), there is not currently enough protected Mariana fruit bat habitat on Rota, Guam, Tinian, or Saipan to support substantial population recovery on any of those islands. Even if sufficient habitat is set aside in conservation to support recovery of populations, controlling illegal hunting may continue to be a challenge that limits recovery of the species (USFWS 2014 p. 5).

Status of the Mariana eight spot butterfly

Species Description

The Mariana eight spot butterfly (abbabang in Chamorro, or libweibwogh in Carolinian) was federally listed as endangered under the Act on October 1, 2015 (80 FR 59423). No critical habitat has been designated for this species. A recovery plan for the Mariana eight spot butterfly has not been completed.

The Mariana eight spot butterfly is a medium-sized butterfly in the Nymphalidae family (Schreiner & Nafus 1997 p. 28). The Mariana eight spot butterfly was originally described by Butler in 1869 and is recognized as a distinct taxon in Swezey (1942 p. 35), the most recent and accepted taxonomy for this subspecies. In addition to the Mariana eight spot butterfly, there are several other subspecies endemic to specific archipelagos, including New Caledonia, Vanuatu, and Palau (Samson 1986 p. 16; Schreiner & Nafus 1997 p. 36).

Like most nymphalid butterflies, orange and black are the two primary colors exhibited by Mariana eight spot butterfly. Unlike other species in the genus *Hypolimnas*, male and female Mariana eight spot butterflies are similar and exhibit no sexual dimorphism (Schreiner & Nafus 1996 p. 36; Campora & Lee 2009 p. 5). The larvae of Mariana eight spot butterfly maintains a black head through all instars, and their spines are more red than orange (Schreiner & Nafus 1997 p. 36). This characteristic sets them apart from larvae of the non-native *H. bolina* from New Zealand and *H. anomala* from Malaysia, both which occur on Guam. All three species (*H. bolina*, *H. anomala*, and the Mariana eight spot butterfly) have larvae that look similar in appearance during their immature stages (Schreiner & Nafus 1997 p. 36; Campora & Lee 2009 p. 4; Lindstrom & Benedict 2014 p. 18).

Life History

The Mariana eight spot butterfly undergoes seven life stages before pupating into a reproductive adult (**Table 8**) (Schreiner & Nafus 1996 pp. 3–5). Large sixth instar caterpillars of the Mariana eight spot butterfly often travel farther distances in search of food and will find a cryptic location for pupation (Schreiner & Nafus 1996 p. 3). As a result, the length of time spent as a pupa and longevity of adults is unknown (Moore 2014 p. B17). Adult Mariana eight spot butterflies are most abundant between December and February (Moore 2014 p. B16). These months include the end of the rainy season and the beginning of the dry season on Guam.

Butterflies in general require sufficient food resources to support various stages of growth. Larval feeding first supports growth of the larval insect, and at subsequent instar stages, growth stops and accumulated larval nutrients are stored for proper adult growth (Boggs & Freeman 2005 p. 353). Boggs and Freeman (2005) found that restricting the food intake at the larval stage decreased adult longevity and female fecundity levels (p. 359).

Table 8. Estimated life stages of the Mariana eight spot butterfly and mortality rates at each stage, based on a year-long study at a single site on Guam.

Stage	Duration (days)	No. Found	No. Found After Hatching / Molting to Next Stage	Percent Recovered
Egg	6	445	45	10
1st Instar	2.4 ± 0.6	47	21	44
2nd Instar	2.0 ± 0.7	37	21	57
3rd Instar	2.5 ± 0.8	36	32	88
4th Instar	2.9 ± 0.8	46	30	65
5th Instar	3.7 ± 1.0	46	33	72
6th Instar	6.1 ± 1.5	51	15	29

Population Dynamics

Little is known about the factors affecting population dynamics of the Mariana eight spot butterfly. However, recently Rubinoff (2016) suggested that Mariana eight spot butterflies show metapopulation dynamics (pp. 4-5). Because most insects are short-lived in the adult stage, and cryptic in other stages, detection and assessment of minimum viable habitat size may require repeated visits over multiple years to properly assess occupied patches that may depend on varying environmental conditions or site characteristics (Eiben & Rubinoff 2014 p. 1077). Some sites on Guam are used occasionally by populations of the Mariana eight spot butterfly or may be used to support connectivity across the landscape (Rubinoff 2016 p. 5).

Within a population, Schreiner and Nafus (1996; Table 11) found that mortality rates are high in the juvenile stages. The Mariana eight spot butterfly occurs in low numbers (Moore 2014 pp. B7-16) likely in response to habitat loss and fragmentation that has reduced the distribution and abundance of host plants, and reduced the connectivity between extant, but discrete local populations. For example, over a year-long survey on Guam across 12 different sites, a maximum total of six adult Mariana eight spot butterflies were observed in one day (Schreiner & Nafus 1996 p. 2). If the distribution and abundance of host plants and the connectivity between Mariana eight spot butterfly populations continue to decline and they become increasingly isolated in distribution, the distance between patches of suitable habitat may become too great to sustain the species (Rubinoff 2016 p. 6).

Status and Distribution

The Mariana eight spot butterfly is endemic to Guam and Saipan (Lindstrom & Benedict 2014 p. 9). The Mariana eight spot butterfly is likely extirpated from Saipan (Schreiner & Nafus 1997 p. 36; Moore 2014 pp. B7–B10). In 2014, *H. octocula marianensis* was known from six locations on Guam: Orote Point, Hilaan, Tweed's Cave area, Pagat Cave area, Mangilao golf course and

Fadian cove (Lindstrom & Benedict 2014 p. 9). Other locations have also been reported by Dr. Curt Fiedler (pers comm 2017). Dr. Fiedler has reported observations in four additional locations: (1) east and (2) west of the GNWR headquarters along the base of the cliff at sea level, (3) patches of host plants near Taguan (1,000 steps trail), and (4) large patches of host plants inland at Faifai beach (northern edge of Tumon Bay). An estimate of a one-kilometer buffer is used to distinguish between subpopulations and represents maximum butterfly flight distance, based on similar species under similar conditions (Hill et al. 1996 p. 730).

The Mariana eight spot butterfly appears to be constrained by available host plants. Larvae of Mariana eight spot butterfly feed on two native plants: *Elatostema calcareum* and *Procris pedunculata* (Campora & Lee 2009 p. 1; Moore 2014 p. B16). Both host plants are from the family Urticaceae and occur in wet, native forest areas with exposed limestone karst. Schreiner and Nafus (1996) noted a close association in the occurrence of the butterfly's life stages with the presence of host plants (p. 2). On Guam, multi-year surveys show that *E. calcareum* and *P. pedunculata* are rare and usually are observed in small patches irregularly distributed almost exclusively along the cliff edges, or embedded in tall towers of karst along the shore or in forested areas, where nonnative ungulates cannot reach them easily (Moore 2014 p. B22).

Threats

The following list of factors influencing the current condition of the Mariana eight spot butterfly are based on the findings reported by (Lindstrom & Benedict 2014 pp. 34–35; Moore 2014 pp. B21-21; Rubinoff 2016 p. 4):

- Loss and Degradation of Habitat (especially host plants):
    - Urban and agricultural development, ungulates, military training, urbanization, the spread of nonnative plants that displace native plants, and inadvertent damage to host plants by humans (e.g., coconut crab hunters who deploy traps near host plants) – all contribute to the loss of habitat for *H. octocula marianensis*.
    - Loss or degradation of habitat causes the loss of important habitat corridors that function to support gene flow and maintain population connectivity.
- Predation from Non-native Species:
    - Two genera of parasitic wasps (*Ooencyrtus* sp. and *Telenomus* sp.) have been documented to cause mortality of *H. octocula marianensis* eggs.
    - Species of nonnative ants have also been documented predating on eggs and larvae.
- Stochastic Events:
    - Typhoons result in mortality, reduced population viability, and habitat loss. Natural disasters can be especially damaging to the viability of already fragmented populations.

Survival and Recovery Needs

The range-wide population of the Mariana eight spot butterfly is comprised of up to 10 known local populations. All of these local populations are small, geographically restricted, and subject to further decline due to habitat loss and predation from non-native species. The likelihood of this species surviving and recovering is dependent on ensuring a functional metapopulation of

Mariana eight spot butterflies. Given the current status of this species, achieving that condition requires maintaining and enhancing the viability of all ten known populations and the reestablishment of additional populations in forest habitat patches that facilitate connectivity between Mariana eight spot butterfly local populations. Avoiding or effectively offsetting adverse effects to butterfly-occupied habitat is critical to maintaining the diminished resiliency of the entire Mariana eight spot butterfly population during this population bottle-neck.

More specifically, the conservation needs of the Mariana eight spot butterfly are as follows:

1. Protection, restoration, and enhancement of interconnected patches of high quality butterfly habitat (containing host plants) that are distributed across the landscape of Guam within the flight range of dispersing Mariana eight spot butterflies is essential to its conservation. Based on best available information on the conservation biology of nymphalid butterflies (Bonebrake et al. 2010 pp. 1831–1841) and consideration of the basic principles of conservation biology (Groom et al. 2006 pp. 15–19), the Service finds that a minimum of six discrete populations that are spatially distributed to accommodate a sufficient degree of connectivity between populations are needed to sustain a persistent population of the Mariana eight spot butterfly on Guam. Habitat protection is essential to the Mariana eight spot butterfly. Habitat should be contiguous and include both nectar and known host plants, with the protection of occupied host plants given the highest priority (A. Moore, UOG, pers. comm. 2016; M. Richardson, USFWS, pers. comm. 2016.). Because the Mariana eight spot butterfly is dependent on two rare host plant species (*E. calcareum* and *P. pedunculata*), the Mariana eight spot butterfly is at a high risk of extinction on Guam from ongoing habitat loss and destruction. Because the population is currently small and geographically restricted, it is vulnerable to loss of genetic diversity, catastrophic environmental events, and random fluctuations in demographic parameters. Expansion of the existing metapopulation and reestablishment of populations in unoccupied suitable habitat is essential to protect this species against these threats.
2. Given its highly degraded and vulnerable status in the wild, a timely and effective captive propagation and reintroduction program for the Mariana eight spot butterfly is needed.
3. A high priority should be placed on the timely gathering of additional life history information on the Mariana eight spot butterfly, especially in terms of understanding the metapopulation structure and needs of the overall population. Maintaining adequate connectivity between and among habitat patches and local populations is essential to both its survival and recovery. If host plant populations continue to decline and become further isolated, the distance between patches may become too great to sustain the species (Rubinoff 2016 p. 6).
4. The exclusion of feral ungulates from, and the reintroduction of larval host plants to, limestone forest areas is a very important and promising conservation measure (Moore 2014 p. B22).
5. Control of non-native plants, ants, and slugs is also important for the Mariana eight spot butterfly's survival and recovery in the wild.

Status of the Partulid Snails

The family Partulidae consists of approximately 120 species of snails in three genera (*Eua*, *Samoana* and *Partula*) across the Pacific Islands, many of which are restricted to a single island. *Partula* is the most diverse genus with approximately 92 species described; there are 23 *Samoana* species and four *Eua* species (Lee et al. 2014). Partulid snails are endemic to the high islands of Oceania (i.e., islands with sufficient elevation to generate their own precipitation and support rain forest formation). Of the six partulid snail species described from the Mariana Islands, only three extant species remain: the Guam tree snail (*P. radiolata*), humped tree snail (*P. gibba*), and the fragile tree snail (*S. fragilis*).

Endemic Partulids have become increasingly exposed to continental predators as human settlement and globalization have facilitated these introductions. Some degree of biotic isolation that can be maintained can provide refuge for these tree snails and will contribute to the increased survival of species in their native habitats (Lee et al. 2014).

The Guam tree snail, humped tree snail, and fragile tree snail share similar life history characteristics described below and co-occur within extant populations. Species in the Partulidae family are predominantly nocturnal, arboreal, herbivorous and are relatively long-lived. They are also slow reproducing, ovoviviparous (give birth to live young), and cross- or self-fertilizing hermaphrodites (Cowie 1992). The life-expectancy of partulids can be greater than 5 years and reproduction of up to 18 young per year begins within the first year through the entire life-span (Cowie 1992).

Status of the Guam tree snail

Species Description

The Guam tree snail (akaleha or denden in Chamorro), is a member of the Partulidae family, was federally listed as endangered under the Act on October 1, 2015 (80 FR 59423). No critical habitat has been designated for this species. A recovery plan for the Guam tree snail has not been completed. The species was also listed as endangered by the Government of Guam in 2009.

Guam tree snail shells are dextral with an obtuse spire, and five whorls. The peristome is simple thin and white. The background color is pale straw with darker axial rays and brown lines. Adult length is 0.5 in to 0.7 in (13 mm to 18.5 mm), and 0.3 in to 0.5 in width (8 mm to 12 mm) (Smith et al. 2008). Juveniles can be mistaken for the fragile tree snail.

Life History

Little is known about the life history of the Guam tree snail. This species is found in bushes on the undersides of leaves. The preferred habitat is cool, shaded forest habitat with high humidity and reduced air movement that prevents excessive water loss. Increased mobility is associated with snails in habitats with greater humidity and precipitation. Partulids feed primarily on a range of living, dead or decaying plant material (Cowie 1992 p. 167) and there is no clear obligate relationship with any particular type of tree or bush. Guam tree snail populations showed a very low degree of genetic heterogeneity among all surveyed populations indicating some degree of population specific genetic diversity, there was no discernible colony specific/geographic patterns (Lindstrom & Benedict 2014).

Population Dynamics

The historic population size of the Guam tree snail is unknown; however, more than 2,000 individuals were collected across 37 sites in the 1920s (Crampton 1925). Lindstrom and Benedict (2014) indicated that the Guam tree snail was not found in many sites surveyed in 1989 (Hopper & Smith 1992). However, in both 1989 and 2013, the Guam tree snail was both the most widespread and common Partulid snail on Guam (Hopper & Smith 1992; Moore 2014). At the time of listing in 2015, there were no more than 26 colonies of Guam tree snails, with between 10 and 150 individuals per colony.

Surveys in 2013 on Guam provide the most complete population information that is currently available. On DoD property, 328 Guam tree snails were found in two locations (Lindstrom & Benedict 2014). In addition, a total of 38 live snails were documented in Anderson South in February 2017 (**Figure 10**). Outside of DoD property, more than 363 Guam tree snails were documented during timed searches in 11 different locations (Lindstrom & Benedict 2014).

Status and Distribution

The Guam tree snail is endemic to the island of Guam and is the most commonly encountered Partulid snail on the island. Historically, Guam tree snails occurred across the island in suitable and widely available strand vegetation, forested river borders and lowland and highland forests. The Guam tree snail has been found in coconut forests, similar to the humped tree snail; however, the Guam tree snail's range also includes range into scrub forests and limestone forests, especially those dominated by *O. oppositifolia*. They have been found on a wide variety of plants including both natives and nonnatives (Lindstrom & Benedict 2014).

Threats

The following threats to the species contributed to its listing or were identified subsequent to listing and continue to to be an issue in the ability of the species to recover.

- Loss or degradation of habitat
    - Ungulates not only graze upon snail host plant species (both native and nonnative), but cause profound changes to the understory of forest habitats, which in turn affect tree snail populations (Smith et al. 2008; Smith 2013).
    - *Leucaena leucocephala*, an introduced shrub or tree, grows quickly and forms dense thickets that crowd out native canopy trees. This transition has created a drier understory which is likely less suitable for the Guam tree snail and other listed tree snails (Hopper & Smith 1992).
    - Human development, urbanization and military activity threaten all Partulid populations on both inhabited and uninhabited islands as they result in a loss, fragmentation and/or degradation of native forest habitat and the plants on which the tree snails live.
- Low population numbers

    - The low degree of genetic heterogeneity throughout the island makes the species less resilient evolutionarily and more prone to extinction pressures
    - Stochastic events (i.e. typhoons, disease) are likely to have disproportionate effects on small populations and/or those with little to no genetic diversity
- Nonnative species predation
    - The alien carnivorious flatworm (i.e. manokwari flatworm), predatory snails (i.e. rosy wolf snail and *Gonaxis* spp.) and rats significantly threaten tree snail persistence.
- Direct human impact
    - The collection of snail shells for trade may contribute to additional decline of the Guam tree snail.

Survival and Recovery Needs

The eradication of ungulates from occupied sites, as well as sites that previously contained the Guam tree snail (Crampton 1925; Hopper & Smith 1992), will serve both to enhance conditions for populations already present and contribute to additional habitat that may become occupied.

Predation rates and sources of predation must be assessed in order to minimize their impact when possible and effectively manage Partulid snail populations on Guam. It is necessary to further characterize the impact of the flatworm, by assessing their activity patterns, habitat and dietary preferences, distribution and reproductive capacity in order to reduce predation by the nonnative species.

Comprehensive studies are needed on the basic biology of the Guam tree snail. Relatively little is known about their life history and much needs to be learned before their conservation can be effectively addressed. There is very little knowledge about basic biological requirements, reproductive output, survival rates, longevity, predation risks, activity patterns, feeding behavior, and seasonal patterns of abundance.

Additional surveys focused in locations that have not yet been adequately surveyed should be prioritized. Surveys are needed to examine locations that are isolated and physically difficult to access on Guam, or determine the presence and status of populations on other Mariana Islands. However, conducting repetitive exploratory surveys in the same locations on Guam at the expense of general biological studies and protecting current occurrence locations could divert resources away from where they are needed most.

Status of the Humped Tree Snail

Species Description

The humped tree snail (akaleha or denden in Chamorro) was federally listed as endangered on October 1, 2015 (80 FR 59423). No critical habitat has been designated for this species. A recovery plan for the humped tree snail has not been completed. The species was also listed as endangered by the Government of Guam in 2009. The species is part of the Partulidae family, as described above.

Humped tree snail shells are primarily dextral with an acute spire, 4 to 4 ½ whorls with the last whorl gibbous. Humped tree snail whorls are various shades of white or brown with the background color variable, chestnut brown to whitish-yellow, and purple. Adult length is 14 to 18 mm, and width 10 to 14 mm (Smith et al. 2008).

Life History

Little is known about the life history of the humped tree snail. Humped tree snails are generally an arboreal species, found in the sub-canopy of mixed native forests with good understory and ground cover (Hopper & Smith 1992; Smith et al. 2008; Hadfield 2010). There is no particular obligate relationship with any particular type of tree or bush; however, they are most often found on the endemic *Piper guamensis*. They are also commonly found on coconut palms and ferns, including *Microsorium punctatum*, on Guam. Compared to the Guam tree snail, humped tree sanils were generally observed on fewer host species (Hopper & Smith 1992).

Increased mobility is associated with snails in habitats with greater humidity and precipitation. Humped tree snails feed primarily on a wide range of living, dead or decaying plant material (Cowie 1992 p. 167). The humped tree snail has also been observed consuming Mariana fruit bat ejecta (Berry 2016).

Population Dynamics

Partulid snails face a significant conservation crisis across the Pacific, as seen by declines in abundance and a number of extinctions (Lydeard et al. 2004). In 1992, Hopper and Smith described their concern for the apparent drastic loss of humped tree snails since the initial 1920 survey (Crampton 1925). At the time of listing in 2015, the population of humped tree snails on Guam declined to approximately 100 individuals and today, the humped tree snail is only found at one location, Haputo Beach (Lindstrom & Benedict 2014). The humped tree snail is the least common of the three listed tree snail species on Guam. By 2008, no humped tree snails were found on Rota, Tinian, or Aguiguan potentially due to extensive deforestation and agriculture (Smith et al. 2008; Hadfield 2010). Population decline of humped tree snails has been reported on most islands of the CNMI; however, population estimates on the islands are unknown (CNMI-DLNR 2015).

Status and Distribution

The humped tree snail was the first *Partula* described from the Mariana Islands in 1821 and was distributed across the archipelago (Kerr 2013). The range of the humped tree snail includes Guam, Rota, Aguiguan, Tinian, Saipan, Anatahan, Sarigan, Alamagan, and Pagan (Kurozumi 1994; Smith et al. 2008). Current comprehensive surveys have not been conducted, however data indicate that the humped tree snail is declining across its range but may still be common on some northern islands, such as Pagan and Sarigan (Kerr 2013).

In 1920, humped tree snails were initially observed on Guam in at least 39 sites. By 1989, the humped tree snail was known from only one location, Haputo Beach which was not originally

identified as an occupied site (Hopper & Smith 1992). At the time of listing in 2015, humped tree snails were no longer found on Anatahan, possibly due to volcanic activity and were also not found on Aguiguan.

Threats

The following threats to the species contributed to its listing and continue to be an issue in the ability of the species to recover.

- Loss or degradation of habitat
    - Ungulates not only graze upon the host plant species, but cause profound changes to the understory of forest habitats, which in turn affect tree snail populations (Smith et al. 2008; Smith 2013).
    - *Leucaena leucocephala*, an introduced shrub or tree, grows quickly and forms dense thickets that crowd out native canopy trees. This transition has created a drier understory which is likely less suitable for the humped tree snail and other listed tree snails (Hopper & Smith 1992).
    - Human development, urbanization and military activity threaten all Partulid populations on both inhabited and uninhabited islands as they result in a loss, fragmentation and/or degradation of native forest habitat and the plants on which the tree snails live.
- Low population numbers
    - A single humped tree snail colony with few individuals likely exhibits little to no genetic diversity and is thus at extreme risk of extirpation as it is less resilient evolutionarily and more prone to extinction pressures.
    - Stochastic events (i.e. typhoons, disease) are likely to have disproportionate effects on small populations and/or those with little to no genetic diversity
- Nonnative species predation
    - The alien carnivorious flatworm (i.e. manokwari flatworm), predatory snails (i.e. rosy wolf snail and *Gonaxis* spp) and rats significantly threaten tree snail persistence.
- Direct human impact
    - The collection of snail shells for trade may contribute to additional decline of the humped tree snail.

Survival and Recovery Needs

The eradication of feral ungulates from sites that contain tree snails, as well as those that previously contained them, will serve both to enhance conditions for populations already present, and contribute to additional habitat that may become occupied. Tarague Basin was reported by Crampton in 1925 to have had all three snail species present. The area is still occupied by the Guam tree snail and may be a suitable habitat for the humped tree snail, as well as the fragile tree snail if ungulates are removed from the area (Crampton 1925; Lindstrom & Benedict 2014).

Predation rates and sources of predation must be assessed in order to minimize their impact when possible and effectively manage Partulid snail populations on Guam. It is necessary to further

characterize the impact of the flatworm, by assessing their activity patterns, habitat and dietary preferences, distribution and reproductive capacity in order to reduce predation by the nonnative species.

Comprehensive studies on the basic biology of the fragile tree snail are needed. Relatively little is known about their life history, and more needs to be learned before their conservation can be effectively addressed. There is very little knowledge about basic biological requirements, reproductive output, survival rates, longevity, predation risks, activity patterns, feeding behavior, and seasonal patterns of abundance. Thoroughly quantified population assessments of the humped tree snail across the range are needed to understand population trends.

Additional surveys focused in locations that have not yet been adequately surveyed should be prioritized. Surveys are needed to examine locations that are isolated and physically difficult to access on Guam, or determine the presence and status of populations of species on other Mariana Islands. However, conducting repetitive exploratory surveys in the same locations on Guam at the expense of general biological studies and protecting current occurrence locations could divert resources away from where they are needed most.

Status of the Fragile tree snail

Species Description

The fragile tree snail (akaleha or denden in Chamorro) was federally listed as endangered under the ESA on October 1, 2015 (80 FR 59423). No critical habitat has been designated for this species. A recovery plan for the fragile tree snail has not been completed. The species was also listed as endangered by the Government of Guam in 2009. The fragile tree snail is a member of the Partulidae family as described above.

The *Samoana* genus has a disjunct distribution: extensively distributed throughout Samoa to the Marquesas Islands in Polynesia. However, the fragile tree snail is the solitary western species, the only *Samoana* species to occur outside of southeastern Polynesia, 5,000 kilometers from its nearest congener in Fiji (Lee et al. 2014). It is now believed that the evolutionary origin of the *Samoana* genus is in the far western portion of the range. In the portion of the range, the fragile tree snail is only one of 22 species in the genus which can still be found (Lee et al. 2014). One hypothesis for the absence of the genus *Samoana* from much of the Western range of the genus may stem from (as yet unidentified) ecological factors that have driven original populations to extinction and prevented rare long-distant migrants from reestablishing new populations (Lee et al. 2014).

Fragile tree snail shells are dextral and pellucid with a conic spire, and four whorls. The peristome is thin but well expanded. The background color is buff with narrow darker maculations and whitish banding. Adult length is 12 to 16 mm, and width 10 to 12 mm. (Smith et al. 2008). Adults can be mistaken for juvenile Guam tree snails.

Life History

The life history of Mariana partulids is unknown. Cool, shaded forest with high humidity and reduced air movement that prevents excessive water loss is the preferred habitat. They live on subcanopy vegetation. Increased mobility is associated with snails in habitats with greater humidity and precipitation. Partulids feed on a range of living, dead or decaying plant material (Cowie 1992) and there is no clear obligate relationship with any particular type of tree or bush. However, the fragile tree snail was found on a smaller number of plants (approximately five) compared to the Guam tree snail (found on approximately 30 different plants) during one survey (Hopper & Smith 1992).

Thie fragile tree snail is unique among Mariana partulids in that the eggs are large (4.2 mm × 3.3 mm) and encapsulated by a calcareous shell. Further, the fragile tree snail reaches sexual maturity before growing a reflexed peristome, a trait not reported for any other partulid species (Crampton 1925).

Population Dynamics

Populations of the fragile tree snail have not been extensively quantified but are thought to be in decline compared to originally rare population sizes. Approximately 20 fragile tree snails were found in the two occurrences during recent surveys (Lindstrom & Benedict 2014). It was not possible to determine the maturity of individuals in the colony because of the unique characteristic of this species to reach maturity before the formation of the varical lip (Smith et al. 2008). In 1996, one colony of the fragile tree snail was found on the southern edge of the Sabana with unknown quantitative estimates of the number of individuals in the colony (Bauman 1996). The species has not been observed on Rota since 1996.

Status and Distribution

The fragile tree snail is endemic to Guam and Rota (Kerr 2013). Fragile tree snails are the only *Samoana* species to occur outside of southeastern Polynesia. Fragile tree snails are more commonly found in limestone forest habitat, but have also been found in beach back strand vegetation, generally dominated by the trees *Hernandia* spp. and *Cordia* spp., or in riverine forest where *Hibiscus tiliaceus* is predominant (Kerr 2013).

Historically, the fragile tree snail was known from 13 populations in northern Guam and one on Rota. It was originally described as rare and low in number (Crampton 1925; Easley 1970). In 1989, fragile tree snails were found only in the presence of the Guam tree snail and in only 6 of 26 surveyed sites distributed across Guam (Hopper & Smith 1992). By 2013, only two colonies were known on Guam (Pagua Point and Lost Pond) (Lindstrom & Benedict 2014) and one colony on Rota, but in a different location from the original colony (Bauman 1996). No genetic heterogeneity was found between the two fragile tree snail populations on Guam (Lindstrom & Benedict 2014).

Threats

The following threats to the species contributed to its listing or were identified subsequent to listing and continue to be an issue in the ability of the species to recover.

- Loss or degradation of habitat
    - Ungulates not only graze upon host plant species (both native and nonnative), but cause profound changes to the understory of forest habitats, which in turn affect tree snail populations (Smith et al. 2008; Smith 2013).
    - *Leucaena leucocephala*, an introduced shrub or tree, grows quickly and forms dense thickets that crowd out native canopy trees. This transition has created a drier understory which is likely less suitable for the fragile tree snail and other listed tree snails (Hopper & Smith 1992).
    - Human development, urbanization and military activity threaten all Partulid populations on both inhabited and uninhabited islands as they result in a loss, fragmentation and/or degradation of native forest habitat and the plants on which the tree snails live.
- Low population numbers
    - The two colonies of fragile tree snails showed no genetic heterogeneity, which is indicative of a small population that has recently undergone a population bottleneck and is isolated from other colonies. The lack of genetic diversity throughout the island makes the species less resilient evolutionarily and more prone to extinction pressures.
    - Stochastic events (i.e. typhoons, disease) are likely to have disproportionate effects on small populations and/or those with little to no genetic diversity.
- Nonnative species predation
    - The alien carnivorious bipaliid flatworm (*P. manokwari*), predatory snails (i.e., rosy wolf snail and *Gonaxis* spp.) as well as rats, significantly threaten tree snail persistence.
- Direct human impact
    - The collection of snail shells for trade may contribute to additional decline of the fragile tree snail.

Survival and Recovery Needs

The eradication of feral ungulates from sites that contain tree snails, as well as those that previously contained them, will serve both to enhance conditions for populations already present, and contribute to additional habitat that may become occupied. Tarague Basin was reported by Crampton in 1925 to have had all three snail species present. The area is still occupied by the Guam tree snail and may be a suitable habitat for the humped tree snail, as well as the fragile tree snail if ungulates are removed from the area (Crampton 1925; Lindstrom & Benedict 2014).

Predation rates and sources of predation must be assessed in order to minimize their impact when possible and effectively manage Partulid snail populations on Guam. It is necessary to further characterize the impact of the flatworm, by assessing their activity patterns, habitat and dietary preferences, distribution and reproductive capacity in order to reduce predation by the nonnative species.

Comprehensive studies on the basic biology of the fragile tree snail are needed. Relatively little is known about their life history, and more needs to be learned before their conservation can be effectively addressed. There is very little knowledge about basic biological requirements, reproductive output, survival rates, longevity, predation risks, activity patterns, feeding behavior, and seasonal patterns of abundance. Thoroughly quantified population assessments of the fragile tree snail across the range are needed to understand population trends.

Additional surveys focused in locations that have not yet been adequately surveyed should be prioritized. Surveys are needed to examine locations that are isolated and physically difficult to access on Guam, or determine the presence and status of populations of species on other Mariana Islands. However, conducting repetitive exploratory surveys in the same locations on Guam at the expense of general biological studies and protecting current occurrence locations could divert resources away from where they are needed most.

Status of the *Bulbophyllum guamense*

Species Description

Bulbophyllum guamense (siboyas hålum tåno in Chamorro) was federally listed as threatened under the Act on October 1, 2015 (80 FR 59423). No critical habitat has been designated for this species. A recovery plan for *B. guamense* has not been completed. *Bulbophyllum* is the largest genus in the Orchidaceae with an estimated 2,000 polymorphic epiphytes (growing on other plants), lithophytes (growing on rocks), or rarely terrestrial (growing on the ground) orchids (Costion & Lorence 2012).

Bulbophyllum guamense is an epiphytic orchid which occurs in large mat-like formations high on branches of big trees, as well as on smaller trees of coastal lowland/limestone forests. The pseudobulbs form a thick clump connected by very short rhizomes. *Bulbophyllum guamense* has leaves that are oblong, elliptic, 10 - 15 cm long and 2.6 - 3.8 mm wide (Stone 1970 p. 155). Flowers are single, fleshy, and greenish-yellow in color (Raulerson & Rinehart 1992 p. 90). The sepals are the most conspicuous part of the flower, while the yellow-green lip with its wine markings is hinged and extremely mobile (Raulerson & Rinehart 1992 p. 90).

Life History

Little is known about the life history of *B. guamense*. *Bulbophyllum guamense* is epiphytic and grows on trees within limestone forest type ecosystems. On Guam, *B. guamense* was found in the lower canopy of closed forests (about 10 feet {3 m}or less) (Zarones et al. 2015). On Rota, the species has been found at elevations greater than 984 ft (300 m) in the Sabana tableland, Sabana slopes and water cave regions, within tall and short limestone forest and secondary pandanus forest on emergent trees (Zarones et al. 2015). *Bulbophyllum guamense* has been observed in many native and non-native host tree species including: *Hernandia labyrinthica*, *Elaeocarpus joga, Premna serratifolia, Heritiera longipetiolata, Pisonia umbellifera*, *Persea Americana, Vitex parviflora, Areca catechu, Eugenia* spp., *Ficus* spp., *Dypsis* spp. or *Pandanus tetorius,* as well as in dead trees (Zarones et al. 2015; JRM 2016; DON 2017).

Typical to orchids in this genus, *B. guamense* has a carrion-like scent (Raulerson & Rinehart 1992 p. 90), and it is almost ever-blooming, as one flower drops, another replaces it until one is pollinated. The ovary then enlarges to form a ribbed capsule about five cm by one cm, where the dust-like seeds develop (Raulerson & Rinehart 1992 p. 90). *Bulbophyllum guamense* has a sympodial growth habit that form sequential pseudobulbs (with determinate growth). Research is currently being conducted to determine if the numbers of orchids can be increased vegetatively by division within a nursery environment (J. McConnell 2016).

Population Dynamics

At the time of listing in 2015, approximately 500 *B. guamense* individuals were identified throughout the species range, with approximately half on Guam and half on Rota, representing a population decline. There is limited information on the population structure on Guam. On Rota, approximately 200 *B. guamense* individuals were found with a population structure consisting of seedlings, juveniles, and flowering adults in a specialized niche habitat within the forest ecosystem (Zarones et al. 2015).

Status and Distribution

Bulbophyllum guamense is endemic to Guam and Rota and is widely-distributed (Raulerson & Rinehart 1992 p. 90). Historically, *B. guamense* was recorded on Guam from clifflines encircling the island, and on the slopes of Mt. Lamlam and Mt. Almagosa. In 1992, this species was reported to occur in large mat-like formations on trees "all over the island," (Guam) (Raulerson & Rinehart 1992 p. 90). At the time of listing in 2015, there were 12 known occurrences, three on Guam and nine on Rota, along Rota's Sabana tableland and slopes above 980 ft (300 m) elevation (Zarones et al. 2015).

Threats

The following threats to the species contributed to its listing or were identified subsequent to listing and continue to to be an issue in the ability of the species to recover.

- Loss or degradation of habitat
    - Ungulates grazing upon forest plant species impact many native plants resulting in profound changes to the forest habitat. In the absence of ungulates, healthier and more pristine forest habitats contain a broader species composition and structure on which epiphytic orchids depend.
    - Nonnative plants can degrade forest habitats. *B. guamense* has been found on both native and nonnative trees; however, the health and persistence of the orchid on native and nonnative trees is unknown.
    - Urbanization and development as well as natural or incidental fire, directly impact and reduce habitat availability for epiphytic orchids.
    - Edge effects due to disturbance and fragmentation have been shown to negatively impact orchids in cloud forests (Parra Sánchez et al. 2016).

- Stochastic Events, primarily typhoons degrade forest. Affected forest areas may require several years to become reestablished and this can be exacerbated if habitats are reduced or degraded.

Survival and Recovery Needs

In order to ensure the survival of *B. guamense*, wild populations and habitat needs to be protected and maintained on Guam and Rota. Control of nonnative ungulates will help restore native forest habitat and host trees for the species.

Status of the *Dendrobium guamense*

Species Description

Dendrobium guamense (no common name) was federally listed as threatened on October 1, 2015 (80 FR 59423). No critical habitat has been designated for this species. A recovery plan for *D. guamense* has not been completed.

Dendrobium guamense is an epiphyte in the orchid family (Orchidaceae). This orchid usually occurs on tree branches in forests in filtered sunlight. Stems are crowded and up to 60 cm long (Stone 1970). Leaves are arranged alternately in two opposite vertical rows, are up to 10 cm long and 7-15 mm wide (Stone 1970). Two small white flowers emerge between two leaves, and are open only one day, appearing as balls on the second day.

Life History

Dendrobium orchids typically produce large numbers of very small and easily dispersed seeds. These seeds contain almost no food reserves. Seedlings must quickly form mycorrhizal associations with appropriate fungi to supply them with needed nutrition as they develop (Lavarack et al. 2000). As an epiphytic orchid, *D. guamense* are supported by trunk and thick lower branches, sometimes in small twigs in the top of the canopy of trees. They cling strongly onto their hosts with a developed root system and use the moisture and organic debris caught in the crevices and bark of the host for nourishment. The humid tropical air is absorbed for additional moisture and nutrients. In northern Guam, individuals of *D. guamense* were observed mostly on *Ficus* spp. proximal about 10 ft. to 25 ft. (3 m to 7.6 m) high in the canopy (JRM 2016 p. 7). *Dendrobium* species take advantage of the microclimate, which are found on the trunk, lower branches, under the canopy, and prefer shade or moderate light. In the Naval Magazine in southern Guam, *D. guamense* was observed at all elevations along rivers and on ridges and plateaus, and on numerous tree species (JRM 2016).

Population Dynamics

Dendrobium guamense was identified as the most abundant of the three epiphytic orchids federally listed as threatened in 2015 and was found to be the most abundant of the three listed orchids on Rota (Zarones et al. 2015). Given the recent discovery of *D. guamense* on Aguiguan, it is possible that the species could be found on other northern islands of the CNMI if more

extensive surveys were done. In the 1980s, this species was common in trees on Guam and Rota, with more than 12 occurrences on Guam and 17 occurrences on Rota (Raulerson & Rinehart 1992 p. 98; Thomas & Rock 2015). At the time of listing in 2015, at least 21 locations totaling approximately 1,250 individuals were reported on Guam (4), Rota (15), Tinian (1) and Aguiguan (1).

On Guam, the four occurrences contain approximately 250 individuals, primarily in the Naval Magazine area and Andersen Air Force Base (Quinata 1994 p. 8). Three individuals were also found in Anao Pt. and Ipan outside of DoD property since the time of listing (GPEPP 2015). On Rota, a survey team reported more than 700 individuals of *D. guamense* on the western third of Rota, represented by seedlings, juveniles, and flowering adults (Zarones et al. 2015). The presence of multiple generations in a healthy population structure indicates that the status of *D. guamense* on Rota is better than previously known.

Status and Distribution

Dendrobium guamense occurs in the forest ecosystem on Guam, Rota, Saipan (historically), and Tinian, and recently recorded for the first time on Aguiguan (Raulerson & Rinehart 1992; Quinata 1994; Costion & Lorence 2012; Zarones et al. 2015). As recently as the 1980s, this species was common in trees on Guam and Rota, with more than 12 occurrences on Guam and 17 occurrences on Rota (Raulerson & Rinehart 1992; Thomas & Rock 2015).

Threats

The following threats to the species contributed to its listing or were identified subsequent to listing and continue to to be an issue in the ability of the species to recover.

- Loss or degradation of habitat
    - Ungulates graze upon forest plant species impacting many native plants resulting in profound changes to the forest habitat. In the absence of ungulates, healthier and more pristine forest habitats contain a broader species composition and structure on which epiphytic orchids depend.
    - As numbers of cattle and ranchers increase on Tinian, there may be a greater risk of cattle potentially escaping and becoming feral. Both feral and domestic cattle can drastically alter the landscape (Wiles et al. 1990 pp. 176, 177), and depending on the location and amount of land designated as pasture land for domestic cattle, negative impacts to the forest ecosystem may be observed in the future, minimizing the available habitat.
    - Nonnative plants can degrade forest habitats. *D. guamense* has been found on both native and nonnative trees; however, the health and persistence of the orchid on nonnative trees is unknown.
    - Urbanization and development as well as natural or incidental fire, directly impact and reduce habitat availability for epiphytic orchids.
    - Edge effects due to disturbance and fragmentation have been shown to negatively impact orchids in cloud forests

- Stochastic events, primarily typhoons degrade forest. Affected forest areas may require several years to become reestablished and this can be exacerbated if habitats are reduced or degraded.

Survival and Recovery Needs

In order to recover *T. guamense*, individuals of this species in the wild and their habitat need to be protected on islands throughout their range. Reducing or eliminating nonnative ungulates will help restore native forest habitat and host trees for the species.

Status of the *Tuberolabium guamense*

Species Description

Tuberolabium guamense (no common name) was federally listed as threatened under the Act on October 1, 2015 (80 FR 59423). No critical habitat has been designated for this species. A recovery plan for *T. guamense* has not been completed.

The genus *Tuberolabium* consists of 17 epiphytic orchid species. *T. guamense* has roots that elevate the leaves and flowers away from the tree trunk. Leaves are leathery, oblong, about 13 cm long and 1.5 cm wide. Small white flowers are on a rachis about 3.5 cm long (Raulerson & Rinehart 1992 p. 127).

Life History

Similar to other epiphytic orchids, *T. guamense* grows slowly and requires specific microclimates, which are found on the trunk, lower branches, and under the forest canopy. *Tuberolabium guamense* clings onto their host trees with a strong developed root system and uses the moisture in the air and organic debris caught in the crevices and bark of the host for nourishment (Tibbs 2008).

There is limited information on the life history and habitat preferences of *T. guamense*. The age of maturity and the lifespan of the species are unknown. However, McConnell (2016) indicated *T. guamense* grows slowly and is a long-lived plant. In addition, *T. guamense* exhibits a monopodial growth habit in which the stem may continue to grow indefinitely (McConnell 2016). Monopodial orchids lack pseudobulbs, which store water. They rely on high humidity in the air for water. Observations of *T. guamense* indicate that this species is associated with the native orchid *Taeniophyllum mariannense* (worm orchid) and moss on host trees. *T. guamense* has primarily been found in the shade of the forest canopy at a range of heights from one to 20 feet (JRM 2016). On Guam, *T. guamense* has been observed on a wide variety of host trees, both native and nonnative (more than 19 species) as well as on dead branches and trees. The majority have been found on *Vitex parviflora* and *Pandanus tectorius* depending on the dominant vegetation (JRM 2016; DON 2017).

On Rota, the *T. guamense* population occurs within a specialized niche of limestone forest within tall and short limestone forest and secondary pandanus forest at elevations greater than 300

meters of the Sabana region (Zarones et al. 2015). Forests located within the Sabana are often shrouded in clouds and mist, and some areas include healthy growths of epiphytes (Falanruw 1989 p. 6). *Tuberolabium guamense* has been found on seven native host plants: primarily *Hernandia labyrinthica*, *Premna obtusifolia, and Elaeocarpus joga* with fewer occurrences on: *Pipturus argenteus*, *Ficus prolixa*, *Macaranga thompsonii*, and *Pisonia umbellifera* (Zarones et al. 2015).

Population Dynamics

In 1992, Raulerson and Rinehart (p. 87) stated that although *T. guamense* may appear abundant on the limestone ridges, the habitats are limited and in reality these orchids are rare on Rota and Guam (1992). For example, the Rota *T. guamense* population occurs in clusters within limestone forest in the Sabana region. At the time of listing in 2015, *T. guamense* was known from seven occurrences: one occurrence of one individual on Guam and six occurrences of 239 individuals on Rota, in the forest ecosystem (80 FR 59423). On Guam, surveys since the time of listing conducted by DON identified over 12,800 individuals, a substantial increase in the known population size. (DON 2017). Because individuals were defined as a single plant, regardless if it was part of a large cluster or clump, more research should be done to determine if this is an effective measure to distinguish an individual of *T. guamense* to avoid over counting during surveys. Winker et al. (2009) suggests that epiphytic orchid clusters be defined as inhabiting a single tree, and that within each tree only reproductive individuals be counted for monitoring purposes (pp. 997-1003).

Status and Distribution

Tuberolabium guamense is predominantly known from the islands of Guam and Rota, with a few scattered historical occurrences on Tinian and Aguiguan (Raulerson & Rinehart 1992 p. 127; Thomas & Rock 2015). Most orchids are narrowly distributed in specific habitats (Cribb et al. 2003). In 1992, *T. guamense* was found in "trees and shrubs all over the island" (Raulerson & Rinehart 1992 p. 127), and the Consortium of Pacific Herbaria has records of 22 collections from Guam, five collections from Rota, 15 collections from Tinian, and three collections from Aguiguan (Thomas & Rock 2015). *Tuberolabium guamense* individuals are also not distributed uniformly throughout the forests; and where they occur, are often present in clusters.

Threats

The following threats to the species contributed to its listing or were identified subsequent to listing and continue to to be an issue in the ability of the species to recover.

- Loss or degradation of habitat
  - Ungulates graze upon forest plant species impacting many native plants resulting in profound changes to the forest habitat. In the absence of ungulates, healthier and more pristine forest habitats contain a broader species composition and structure on which epiphytic orchids depend.
  - Nonnative plants can degrade forest habitats. Invasive vines such as *Coccinia grandis* (ivy gourd) and *Antigonon leptopus* (chain of love) are aggressive invaders of

disturbed or edge habitat, and can form dense blankets that cover individuals of *T. guamense* (Space & Falanruw 1999).

- *Tuberolabium guamense* has been found on both native and nonnative trees; however, the health and persistence of the orchid on nonnative trees is unknown.
- Urbanization and development as well as natural or incidental fire, directly impact and reduce habitat availability for epiphytic orchids.
- Stochastic events, primarily typhoons degrade forest. Affected forest areas may require several years to become reestablished and this can be exacerbated if habitats are reduced or degraded.

Survival and Recovery Needs

In order to recover *T. guamense*, individuals of this species in the wild and their habitat need to be protected on islands throughout their range. Reducing or eliminating nonnative ungulates will help restore native forest habitat and host trees for the species.

Status of the *Cycas micronesica*

Species Description

Cycas micronesica (fadang in Chamorro) was federally listed as threatened under the ESA on October 1, 2015 (80 FR 59423). No critical habitat has been designated for this species. A recovery plan for *C. micronesica* has not been completed.

Cycas micronesica is part of the Cycadaceae family which contains only one genus, *Cycas*, a very ancient genus of trees dating back to the Jurassic period. Ninety-eight *Cycas* species are described, and 75 species (77 percent of the genus) are considered critically endangered, endangered, threatened, near threatened, or vulnerable under the definitions of the (IUCN 2017). All *Cycas* species are restricted to the equatorial regions.

Cycas micronesica is a palm-like plant, usually unbranched tree with a thick trunk. Adult stem lengths reach 8m, rarely to 12m, and 14-25 cm in diameter with pinnate leaves 150-180 cm long (Hill 1994).

Life History

Cycas micronesica is the only native gymnosperm in the Mariana Islands. Cycads are dioecious, and both sexes bear reproductive structures that are relatively massive amongst gymnosperms (e.g. conifers). *Cycas micronesica* occurs in limestone forests in Guam and Rota, with fewer occurrences in volcanic soils typical of southern Guam (Stone 1970 p. 65; Hill 1994). Few studies exist that describe cycad natural history and ecology in the Mariana Islands, and much of the current literature is focused on its decline and effects from introduced pests. However, *C. micronesica* (identified as *C. circinalis* at the time) is a food source for the Mariana fruit bat (*P. mariannus mariannus*), which feed on its fruits (Wiles & Fujita 1992 p. 27), as well as for the Chamorro people, who process the fruits to rid the naturally-occurring toxins (Whiting 1963). *Cycas micronesica* emits chemical cues to attract specialist insects for pollination (Schneider et

al. 2002); however, there is also evidence of wind as a pollen vector in open areas or forested areas with some wind on Guam (Terry et al. 2009 p. 96; Hamada et al. 2015).

Population Dynamics

At the time of listing, there were fewer than 516,000 individuals on Guam (Marler 2013). This number does not distinguish between successfully reproducing adults and juveniles (Marler 2013), which, because of the effects of the cycad aulacaspis scale (*Aulacaspis yasumatsui*), implies that the number of extant individuals that can successfully reproduce is much lower. Within Guam's AAFB, over 257,000 individuals were documented in July 2013; however, the population structure was dominated by adults with little recruitment and declining reproductive success (Marler 2014). In a separate survey, an unquantified number of *C. micronesica* individuals were found at 11 sites across Guam, some of which were on AAFB (Harrington et al. 2012). Between March 2015 and January 2017, natural resources personnel from the MCAG P&D office conducted surveys which identified 19,852 mature individuals (DON 2017). On Rota, fewer than 111,500 individuals are present across the four occurrences (Marler 2013). Nearly 300,000 *C. micronesica* trees were documented on Yap (Marler 2013). The number of *C. micronesica* across Palau is the smallest with approximately 2,500 individuals (Marler 2013). As of February 2016, the total outplanted population on Tinian was 903, half of which were small and required continued maintenance (NAVFACMAR 2016).

Status and Distribution

Cycas micronesica is known historically from Guam, Rota, Palau (politically the independent Republic of Palau) and Yap (geographically part of the Caroline Islands; politically part of the Federated States of Micronesia (Hill 2004; Hill et al. 2004) and has also been out-planted on Tinian (NAVFACMAR 2016). It was the most abundant tree on Guam forest inventory surveys in 2002 with over 1.5 million trees identified (Donnegan et al. 2004 p. 16) and was similarly common on Rota. At the time of listing in 2015, there were a total of 15 to 20 occurrences of *C. micronesica* with 900,000 to 950,000 individuals on Guam, Rota, Yap, and Palau (80 FR 59423). The number of occurrences per island (or group of islands) was as follows: four fragmented occurrences on Guam, three of which were in the north; four on Rota; three on the Yap islands; and four across Palau (80 FR 59423).

Threats

The following threats to the species contributed to its listing or were identified subsequent to listing and continue to to be an issue in the ability of the species to recover.

- Loss or degradation of habitat
    - Loss and degradation of habitat from development, urbanization, agriculture, as well as wild or incidental fire.
    - Exotic plants, trees, shrubs, and vines have all been found to compete with *C. micronesica* for space, reducing available habitat.
    - The presence of nonnative ungulates degrades remaining forest habitats through herbivory and physical damage impeding their ability to survive.

- Low population number
    - A lack of recruitment into the population which on Guam is currently dominated by adults increases the vulnerability of the species to maintain a population structure which can maintain or promote the population.
- Nonnative pest species
    - *Cycas micronesica* is severely affected by multiple pest species, with *A. yasumatsui*, an introduced cycad specialist armored scale insect, being the most significant threat (Marler & Muniappan 2006 p. 3). The cycad aulacaspis scale is causing rapid mortality of all life stages of the plant (Marler 2014). As of January 2013, *C. micronesica* mortality reached 92 percent on Guam, and cycads on Rota are experiencing a similar fate from the cycad aulacaspis scale (Marler 2013). *Aulacaspis yasumatsui* has also invaded Palau; however the effects of the invasion on *C. micronesica* have not yet been determined. All seedlings of *C. micronesica* in a study area were observed to die within 9 months of infestation by *A. yasumatsui* (Marler & Muniappan 2006 p. 3; Marler & Lawrence 2012 p. 233; WPTRC 2012 p. 4). A specialist scale predator beetle, *Rhyzobius lophanthae*, was introduced purposefully to treat the *A. yasumatsui* outbreak with some positive results (Marler & Lawrence 2012 pp. 234–238). However, a number of other insects, including cycad blue butterfly (*Chilades pandava*) and a native longhorn beetle that bores cycad stems (*Dihammus marianarum*), also contribute to declining health and mortality in Guam cycad populations (Marler & Muniappan 2006 p. 3; Marler & Lawrence 2012 pp. 238–240).
    - In the absence of subsequent disturbances (i.e. typhoons) a healthy *C. micronesica* plant is resilient to typhoon damage (Hirsh & Marler 2002). However, the poor health status of remaining trees indicates that the natural resilience of this taxon to typhoon effects has been decreased by the chronic *A. yasumatsui* damage.

Survival and Recovery Needs

In order to recover *C. micronesica*, individuals of this species need to be protected throughout its range. *Cycas micronesica* populations should have age structures consisting of seedlings, juveniles, and adult plants. Expanded trials with biocontrol, especially targeting *A. yasumatsui*, should be considered to help stabilize the population (Marler & Lawrence 2012 p. 240). In addition, future invasions from other pests must be prevented (Marler & Lawrence 2012 p. 240). Feral pigs and introduced deer are also threats through herbivory and physical damage, further compounding effects from insects (Marler & Lawrence 2012 p. 238); therefore, ungulate control and fencing restoration sites are also crucial steps in managing cycad populations.

Status of the *Heritiera longipetiolata*

Species Description

Heritiera longipetiolata (ufa halomtano in Chamorro) was federally listed as endangered under the Act on October 1, 2015 (80 FR 59423). No critical habitat has been designated for this species. A recovery plan for *H. longipetiolata* has not been completed.

Heritiera longipetiolata is part of the hibiscus family, Malvaceae, which are flowering plants. The family contains 244 genera with over 4,000 species. There are two *Heritiera* species on Guam (Stone 1970). *Heritiera longipetiolata* is a stout, medium-sized tree and the trunk is often twisted. The alternate ovate-oblong leaves are large (15-30 cm long and 8-15 cm wide) and borne on long petioles that are abruptly enlarged at the base of the leaf blade. The upper leaf surface is dark green and slightly glossy. Flowers are yellowish-tan in color. The fruits are brown, woody and about the size of a Brazil nut, with thick walls (Stone 1970; Raulerson & Rinehart 1991 p. 94).

Life History

Little is known about the life history of *H. longipetiolata*. This species can be propagated by seeds. It is never found in riverine or coast strands instead, it occurs rooted in crevices in dissected limestone slopes and plateaus in the Marianas (Costion & Lorence 2012). Stone (1970) reported that *H. longipetiolata* was rarely found in flower or fruit; however, 70percent of a population on Saipan was observed with flowers or fruit buds (EFC & Services 2002) On Guam, *H. longipetiolata* occurs mostly on limestone cliffs.

Population Dynamics

In 1997, there were about 1,000 individuals on Guam, several hundred on Tinian, and fewer than 100 on Saipan, with no known remaining individuals on Rota (Wiles 1998). At the time of listing in 2015, *H. longipetiolata* was known from 10 occurrences totaling approximately 200 individuals, on Guam, Saipan, Tinian, and Rota, all within the forest ecosystem (80 FR 59423). The total population of *H. longipetiolata* on Guam was approximately 90 individuals; on Tinian, there were between 30 and 40 individuals, and possibly more in forest areas; on Saipan, *H. longipetiolata* was known from three occurrences, totaling at least 53 individuals, with several hundred seedlings beneath the trees; and on Rota, more recent information indicates that there was at least one individual of *H. longipetiolata* (80 FR 59423).

Surveys since the time of listing documented 255 *H. longipetiolata* at four different DoD locations on Guam (DON 2017). Additionally, during surveys in 2014 and 2015, 1,816 individuals were tagged at five locations outside of DoD property on Guam, 149 of which were mature trees (GPEPP 2015).

Status and Distribution

Historically, *H. longipetiolata* is endemic to the islands of Guam, Rota, Saipan, and Tinian and the only location outside of the Mariana Islands is in Pohnpei (Stone 1970; Raulerson & Rinehart 1991; Costion & Lorence 2012).

Threats

The following threats to the species contributed to its listing or were identified subsequent to listing and continue to to be an issue in the ability of the species to recover.

- Loss or degradation of habitat
  - Incremental habitat loss due to wild fire, urbanization, and agricultural development is increasingly threatening the availability of habitat.
  - The presence of nonnative plants and other nonnative ungulates (pigs, goats, and water buffalo), and Philippine deer, is likely to further degrade remaining forest habitats, thus impeding their ability to survive.
  - The spatial distribution is a major concern, as so many individuals are growing in close proximity throughout AAFB. This aggregated pattern increases the vulnerability of the population, especially to the threat of habitat loss and is exacerbated by the fact that most individuals on AAFB are located in sites with less than 15percent slope, which is also terrain suitable for human development.
- Low population number
  - A small number of individuals in the population increases the likelihood of reduced genetic diversity, vulnerability to stochastic events (i.e. typhoons or disease) and ultimately extinction pressure.

Survival and Recovery Needs

In order to recover *H. longipetiolata*, the remaining populations or occurrences of this species need to be protected throughout its range. *Heritiera longipetiolata* populations should have age structures consisting of seedlings, juveniles, and adult plants. Ungulate control should be implemented throughout its range, especially on Guam since the majority of the rangewide population exists on the island. In addition, control of nonnative plants and invasive insects and outplanting of *H. longipetiolata* in protected areas are critical for its recovery. Restoration works should focus on outplanting saplings within protected and ungulate-free areas.

Status of the *Tabernaemontana rotensis*

Species Description

Tabernaemontana rotensis (no common name) was listed as threatened under the Act on October 1, 2015 (80 FR 59423). No critical habitat has been designated for this species. A recovery plan for *T. rotensis* has not been completed.

Tabernaemontana rotensis is in the dogbane family, Apocynaceae, which includes trees, shrubs, herbs, stem succulents, and vines. The family contains 366 genera, and the *Tabernaemontana* genus consists of 103 species (The Plant List 2013). *Tabernaemontana rotensis* is a small to medium-sized (8-10 m tall) tree with leaves that are thin, light green, opposite, and 15-30 cm long (Stone 1970). Flowers are white, elongate, slender, and branch from the tree. *Tabernaemontana rotensis* produce conspicuous orange fruit that are twinned or single and beaked (UOG 2007 p. 6; GPEPP 2015 p. 22).

Life History

Tabernaemontana rotensis occurs in forests with crevices of rough limestone (Raulerson & Rinehart 1991 p. 94) and are able to colonize sites that occur in full sun or in deep shade (UOG

2007 p. 16). The species has primarily been found in areas of little to no slope (<15%) (UOG 2007; JRM 2016). *Tabernaemontana rotensis* has been found in forest habitats most often co-occurring with *C. micronesica*; however, *T. rotensis* were not found in areas that were dominated by alien tree species (UOG 2007).

Tabernaemontana rotensis populations typically flower in August through October, followed by the production of immature or orange fruit (UOG 2007 p. 23). During this time period, 40 to 80 percent of trees were found to have at least some flowering occur every month (cite). The fruit of *T. rotensis* reaches full size approximately 30 to 35 days after flowering. Fruit color changes from bright green to dull green in subsequent months, and a dull orange color break occurs in 50 to 60 days after flowering (UOG 2007 p. 24).

Seed dispersal of *T. rotensis* is dependent on birds and therefore a lack of frugivore bird species on Guam has resulted in limited spatial distribution of *T. rotensis*. Today, *T. rotensis* is generally found clumped within confined areas, as seedling establishment is restricted to within the vicinity of the parent tree (UOG 2007). This phenomenon does not support seedling recruitment, as seedlings develop in extreme competition with one other, and many of them become stunted and die (UOG 2007 pp. 14, 22).

In typhoon conditions, *T. rotensis* develops a synchronized pulse of flowering about one month after the typhoon. This pulse of flowering leads to mast seeding event about four months after a typhoon (UOG 2007 p. 29). This species may behave like a pioneer species since germination and seedling emergence have been shown to be maximized in full sun conditions (i.e., after typhoon damage) (UOG 2007).

Population Dynamics

In a study specific to AAFB, the species occurred in clumped patches within 256 sites across the base (UOG 2007). The population structure of over 21,000 individuals included emerging seedlings, young juveniles, and reproductive mature individuals with an extensive canopy size. The species was observed in Northern Guam in the following areas: Ritidian Point, Pati Point, HMU, and central and southeast edge of AAFB (UOG 2007; JRM 2016). At least five individuals of *T. rotensis* also occur within the GNWR. At the time of listing, *T. rotensis* was known from six occurrences on Guam and nine individuals on Rota (80 FR 59423). Individuals on Rota varied in size between 0.5 m and 6 m (1.6 ft. to 19.7 ft.) spread across the western, southern, and eastern parts of the island (CNMI-DLNR 2015).

Since the time of listing, additional surveys have identified and tagged 196 total individuals (88 of which were mature) at two locations outside of DoD property (GPEPP 2015). A total of 23,325 individuals have been identified at six locations on DoD property, over 85percent of which are on AAFB (Department of Navy 2017).

Status and Distribution

Tabernaemontana rotensis is endemic to Guam and Rota and was suggested to be restricted to limestone forest habitat (Stone 1970). It was originally noted as very rare needing seed cultivation or cuttings to assure the existence of the species (Stone 1970).

Threats

The following threats to the species contributed to its listing or were identified subsequent to listing and continue to to be an issue in the ability of the species to recover.

- Loss or degradation of habitat
  - Incremental habitat loss due to wild fire, urbanization, and agricultural development is increasingly threatening the availability of habitat.
  - The presence of nonnative plants and other nonnative ungulates (pigs, goats, and water buffalo), and Philippine deer, is likely to further degrade remaining forest habitats, thus impeding their ability to survive.
  - The spatial distribution is a major concern, as so many individuals are growing in close proximity throughout AAFB. This aggregated pattern increases the vulnerability of the population, especially to the threat of habitat loss and is exacerbated by the fact that most individuals on AAFB are located in sites with less than 15percent slope, which is also terrain suitable for human development.
- Population recruitment
  - The lack of dispersal by birds restricts the spatial extent of the populations on Guam. Clustered populations can exhibit less genetic diversity becoming less resilient evolutionarily and more vulnerable to stochastic events causing a disproportionate effect (extreme events or disease) and thus prone to extinction pressures.
  - Typhoons will continue to degrade forest and the affected forest areas may require several years to regenerate. Typhoons may actually open canopy space to germinate *T. rotensis* seeds and promote the population; however, in order for successful regeneration following thyphoons is dependent on a viable seed bank and if there is regeneration, it will likely result in clustered spatial distribution (UOG 2007).

Survival and Recovery Needs

In order to recover *T. rotensis*, the remaining individuals of this species need to be protected on Guam and Rota. *Tabernaemontana rotensis* populations should have age structures consisting of seedlings, juveniles, and adult plants. Ungulate and invasive species control should be implemented throughout its range. On Guam, restoring areas with this species' natural dispersers (*e.g.*, native frugivore birds) would expand the distribution of *T. rotensis* population into new habitat niches, niches that would have likely been naturally occupied by the *T. rotensis* population prior to the loss of seed dispersal on Guam. Outplanting or relocation of wild seedlings within protect areas would help increase their abundance and distribution on Guam and Rota.

ENVIRONMENTAL BASELINE

General Environmental Baseline

A general overview of the status of, and threats to, limestone forest habitat within the action area, followed by species-specific environmental baseline sections, are presented below. This overview reflects the important role of forest habitat in the conservation of all the listed species addressed in this BO.

Overview of Guam

Guam is the largest and southernmost island of the Marianas Archipelago. It is almost 30 mi (50 km) long and from 4.3 mi to 9.3 mi (7 km to 15 km) wide. The northern part of Guam is a limestone plateau interrupted by a few low hills that are volcanic in nature and other hills that are exclusively coralline (formed from coral). The original forest on limestone was of large trees, with a thick canopy overhead (see below for further description). The northern part of the island gently slopes to the southward from about 656 ft (200 m) to about 328 ft (100 m) at the narrow waist of the island. There is no surface water in the northern part of the island (Fosberg 1960, pp. 51-52). Only in the southern and central parts of Guam are there permanent streams (Stone 1970, p. 12). The central part of Guam includes a mixture of volcanic and limestone substrate. The southern part of Guam is hilly, largely of volcanic origin (*e.g.*, basalts) but in several places the hills are capped with a layer of limestone (Stone 1970, p. 12). The southern half of the island is made up of deeply weathered volcanic material with patches of limestone and numerous streams (Fosberg 1960, p. 52). Forest habitat is broken up by ridges and flats covered by grass. The forests in these areas tend to resemble that on limestone; however, the forest is thicker and is dominated by lower stature trees (Fosberg 1960, p. 53; Stone 1970, p. 18). At lower elevations, forest occurs primarily in ravines, valley bottoms, and on steep slopes.

Limestone Karst Forests on Guam

Limestone karsts are sedimentary rock outcroppings consisting primarily of calcium carbonate and are recognized as important ecosystems with high species diversity (Mueller-Dombois and Fosberg 1998, p. 217; Clements et al. 2006, pp. 733-734). The high species diversity on karst arises from the numerous ecological niches created by complex terrains and variable micro-climatic conditions (Clements et al. 2006, p. 734). On Guam, karst is found on an uplifted plateau located on the northern half of the island and on uplifted weathered volcanic terrain in the southern half (Fosberg 1960, p. 54; Stone 1970, p. 12; Mueller-Dombois and Fosberg 1998, p. 241). The limestone soils of north and south Guam were historically forested (Stone 1970, p. 14; Mueller-Dombois and Fosberg 1998, p. 270; Guam Department of Agriculture 2010, p. 7), and limestone forest on Guam is composed primarily of mature growth of native trees and plants with a moderately dense canopy 33 ft to 98 ft (10 m to 30 m) in height (DAWR 2006, p. 19). We define primary limestone forest as forest with vegetation that was never cleared and is dominated by native species (Fosberg 1960, p. 56; DAWR 2006, p. 218).

Primary limestone forests are critically important to Guam's native flora and fauna (Stone 1970, p. 22; USFWS 2005a, p. iv; DAWR 2006, p. 28; DON 2014b, p. 3-40). They retain key functional components of native forests such as large native trees and high canopy cover (Fosberg 1960, p. 56; Mueller-Dombois and Fosberg 1998, p. 217 and 270; DON 2014b, p. 3-40), and are necessary for the recovery of Guam's terrestrial native species (DAWR 2006, p. 27; Jenkins 1983, p. 22; Michael 1987; Morton et al. 1999, p. 22). Intact primary limestone forests harbor greater tree species diversity than degraded habitat (Stone 1970, p. 22) and provide habitat for a broad diversity of wildlife. These forests are also highly productive and often store more carbon than degraded forests (Caves et al. 2013, p. 7). The primary limestone forest on AAFB is considered some of the highest quality native limestone forest left on Guam to serve as habitat for listed species (Morton 1996, p. 69).

Threats to Guam's Limestone Forests

Over the past several centuries, Guam has lost much of the native forest to agriculture, a growing human population, economic development, and military activities (Mueller-Dombois and Fosberg 1998, p. 270; USFWS 2009d, p. 27). The distribution of primary limestone forest on Guam has been steadily declining (Fosberg 1960, p. 54; DAWR 2006, p. 28). Although little is known about the nature of Guam's vegetation before World War II, progressive alteration of the island's vegetation clearly began with human colonization (Fosberg 1960, p. 54). On limestone soils, native forest was cleared and replaced by coconut plantations, open fields and gardens, pasture, and secondary forest (Mueller-Dombois and Fosberg 1998, p. 242). During World War II, large areas were cleared and some habitat was destroyed during heavy fighting (Fosberg 1960, p. 54).

Currently, the remaining limestone forests on Guam face numerous threats including habitat fragmentation and loss, lack of management, introduced ungulates, invasive species, typhoons, forest conversion, and loss of seed dispersers (USFWS 2005a, p. 27; DAWR 2006, p. 28; USFWS 2008a, p. 17-18). These combined threats are degrading the habitat quality of remaining limestone forests and limiting the acres of high quality primary limestone forest habitat available to recover listed species on Guam. Currently, forested areas cover approximately 48 percent of Guam (DAWR 2006, p. 31). Of this, about 13 percent consists of limestone forest habitat (Brown 2005 as cited in DAWR 2006, p. 28).

Forest Habitat Fragmentation, Degradation, and Loss

Habitat fragmentation is a change in habitat configuration caused by clearing, development, invasive species, typhoons, and ungulates that result in the remaining habitat to occur in patches intermixed with areas of non-habitat (Noss et al. 2006, p. 213). Habitat fragmentation creates edges that have different properties than the habitat itself. For example, edges often have different microclimate patterns that are drier, less shaded, and warmer than forest interiors. They are often areas with increased predation and serve as entry points into native habitats for invasive vegetation, pests, and pathogens (Noss et al. 2006, p. 228). The effects of edges that are caused by habitat fragmentation can occur up to 492 ft (150 m) into the forest (Murcia 1995, p. 59). Habitat fragmentation and edges can result in localized extirpations of species, shifts in community composition, increases in invasive species, increased predation, and in suitable

habitat becoming unsuitable due to pollution, invasive species, physical size, or barriers blocking access to habitats (Groom and Vynne 2006, p. 174; Noss et al. 2006, 38 pp). Habitat fragmentation has been implicated in reduced species richness, avian abundance, productivity, and food supply (Blake and Karr 1987, VanderWerf 1993, Burke and Nol 1998, Trine 1998, Porneluzi and Faaborg 1999). Overall, edges may have adverse effects to some wildlife populations and ecological processes (Murcia 1995, p. 58; Laurance 2000, p. 134) and may affect forests at larger landscape scales (Laurance 2000, p. 134).

Habitat degradation and loss on Guam has been caused by various human activities including agriculture, mining, forestry, fires, infrastructure development, military training, urbanization, industry, pollution (including light, noise, and toxic chemicals), and changes in community and ecosystem structure due to invasive species (Groom and Vynne 2006, p. 164; USFWS 2008a, p. 17). Habitat loss and degradation from human activities is a threat to the recovery of many listed species on Guam (USFWS 2008a, p. 17; USFWS 2012c, p. 3).

Feral Ungulates

Feral ungulate species that occur on Guam include pigs (*Sus scrofa*), Philippine deer (*Rusa marianna*), and the Asiatic water buffalo (*Bubalis bubalis*) and are not native to the island. Feral ungulates have caused severe damage to Guam's forests by browsing on plants, causing erosion, inhibiting plant growth and regeneration, and facilitating the establishment of invasive plants, which can impede forest regeneration by displacing or smothering native species (USFWS 2009d, p. 27). For example, deer and pigs foraging on fallen fruits and seedlings of the native breadfruit (*Artocarpus mariannensis*), an important Mariana fruit bat food, in combination with impacts from typhoons, have resulted in a decline in the number of native breadfruit trees on Guam (Wiles 2005, p. 509).

Feral pigs are extremely destructive and have both direct and indirect effects on native plant communities. While rooting in the soil in search of invertebrates and plant material, pigs directly affect native plants by disturbing and destroying vegetative cover and trampling plants and seedlings. They may also reduce or eliminate plant regeneration by damaging or eating seeds and seedlings. Pigs are a major vector for the establishment and spread of competing invasive non-native plant species, by dispersing plant seeds on their hooves and coats as well as through the spread of their feces (Matson 1990, p. 245; Siemann et al. 2009, p. 547). Feral pigs feed preferentially on the fruits of many non-native invasive plants, spreading the seeds of these species through their feces as they travel in search of food. In addition, rooting pigs contribute to erosion by clearing vegetation and creating large areas of disturbed soil, especially along hillsides (Smith 1985, pp. 190, 192, 196, 200, 204, 230–231; Stone 1985, pp. 254–255, 262–264; Medeiros et al. 1986, pp. 27–28; Scott et al. 1986, pp. 360–361; Tomich 1986, pp. 120–126; Cuddihy and Stone 1990, pp. 64–65; Aplet et al. 1991, p. 56; Gagne and Cuddihy 1999, p. 52).

On Guam, feral pigs were introduced in the 1600's, established a population by 1772, and were distributed island-wide by the early 1900's (Conry 1988, p. 26). As documented in other locations, wallowing, rooting, and trampling are common in most forested areas and can be locally severe (Conry 1988, p. 27). A large complex of wallows and feeding sites in Tarague Basin on AAFB measured over 5.7 ac (2.3 ha), and was stripped of all ground cover with no tree

regeneration (Conry 1988, p. 27). On AAFB, densities of Philippine deer and feral pigs were estimated at 0.8 deer per acre (1.8 deer per hectare) and 0.2 pigs per acre (0.4 pigs per hectare), which are some of the highest densities recorded in the world (Knutson and Vogt 2003, unpubl. manuscript).

Philippine deer were introduced to Guam in the 1770's (Safford 1905, p. 76), and are distributed throughout the island (Conry 1988, p. 27). Heavy browsing pressure has been documented and browse lines are common (Conry 1988, p. 27). Deer populations in the 1990s appeared to be expanding (Wiles et al. 1999, p. 193), and may be the largest in Micronesia (p. 200). Philippine deer have caused significant changes in forest structure and species composition in native ecosystems on Guam, and are not considered compatible with conservation of native ecosystems and recovery of endangered species (Wiles et al. 1999, p. 193).

The Asiatic water buffalo was introduced to Guam in the 1600's from the Philippines (Conry 1988, p. 27). High densities, and the gregarious habits of Asiatic water buffalo, have resulted in habitat damage such as mud wallows, broad trails, vegetation trampling, and tracks, with some areas so heavily trampled that ground cover has been denuded and soil erosion scars and slumping are evident (Conry 1988, pp. 27-28). The Asiatic water buffalo occurs primarily on the Ordnance Annex and surrounding non-Navy lands in southern Guam, with a population estimated at 50-60 animals (USFWS 2008a, p. 18).

Conversion of Forest to Savanna in Southern Guam

Savanna areas in southern Guam are enlarging into previously forested areas as a result of human-caused wildfires and grazing (Stone 1970, p. 14; Mueller-Dombois and Fosberg 1998, p. 242). To estimate the rate of historical forest conversion to savanna, Greenlee (2010) delineated areas that were dominated by forest vegetation in 1975 using aerial photographs and compared these areas to recent infrared imagery. Based on this analysis, approximately 1,119 ac (453 ha) of forest has been converted to savanna in southern Guam since 1975; this estimate indicates the average rate of forest loss in southern Guam is approximately 37 ac/year (15 ha/year) (Greenlee 2010).

Habitat Destruction and Modification by Typhoons

Guam has been affected by typhoons in 37 of the last 50 years (USFWS 2005a, p. 32). Super-typhoons (with wind gusts of over 150 mi (240 km) per hour) occur approximately once every five years (the last one, Pongsona, occurred in 2002). Typhoons destroy native vegetation by opening the canopy and modifying the availability of light, and create disturbed areas conducive to invasion by non-native pest species (Asner and Goldstein 1997, p. 148; Harrington et al. 1997, pp. 539-540). Typhoons also can cause defoliation (loss of leaves), uprooting of trees, and breakage of stems, branches, and trunks of trees depending on the severity and duration of the storm and its point of impact (Brokaw and Walker 1991, p.442). Super-typhoons fragment and decrease the suitability of existing habitat, and exacerbate the effects of introduced plants and ungulates (USFWS 2005a, p. 34). Climate models indicate that typhoons in the northwestern Pacific are expected to increase in intensity, frequency, and duration by 2200 (Emanuel et al. 2008, p. 360).

Loss of Pollinators, Seed Dispersers, and Frugivores

The loss of forest birds on Guam caused by BTS predation has caused a disruption in the ecosystem services provided by birds as pollinators, seed dispersers, and frugivores (Mortenson et al. 2008, p. 2146; Caves et al. 2013, p. 7). Seeds are dispersed significantly farther from parent trees on islands with birds compared to Guam, and seed ingestion by birds doubles to quadruples the chance of germination for plant species (Rogers 2011, p. 2). The combination of loss of seed dispersal and reduced germination can produce major changes in the spatial pattern, abundance, and diversity of Guam's forests (Rogers 2011, p. 2). In addition, seed set and seedling recruitment were significantly higher on Saipan (where BTS is absent) than Guam for bird pollinated trees (Mortensen et al. 2008, p. 2146). These studies concluded that the loss of ecosystem services provided by birds will result in the loss of species diversity, distribution, and abundance; slow regeneration of degraded forests; and a reduction of plant species recruitment (Mortensen et al. 2008, p. 2146 and 2153; Rogers 2011, p. 2; Caves et al. 2013, p. 5).

Human Disturbance

The listed species on Guam are also threatened by disturbance from human activities including, but not limited to, noise from military training (aircraft, munitions, firing ranges, vehicles, etc.), noise from recreational pursuits (hiking, and hunting), and construction noises. These disturbances not only negatively affect species, but reach into forested interiors and degrade the quality of habitat for listed species. The Mariana fruit bat is sensitive to human disturbance, and as development continues on Guam, disturbance-free forested habitats are increasingly rare on Guam.

Land Management on DoD Lands

The majority of remaining limestone forests on Guam occurs on DoD lands at AAFB and the NBG's NMS. As noted above, the primary limestone forest on AAFB is considered some of the best native limestone forest remaining that provides habitat for threatened and endangered species (Morton 1996, p. 69). The Service and the DoD (USAF, DON, and JRM) have worked together over the past 20 years to manage DoD lands for threatened and endangered species. In 1994, a Cooperative Agreement (Agreement) was established between the USAF, DON, and the Service for purposes of establishing and managing the GNWR Overlay on DoD lands (USFWS 1994). The GNWR includes approximately 376 ac (152 ha) of fee simple Service-owned land and 22,501 ac (9,106 ha) of Overlay Refuge areas on land owned by DoD. The Agreement, which is still in effect, affirms the signatory parties commitment for a "coordinated program centered on the protection of endangered and threatened species and other native flora and fauna, maintenance of native ecosystems, and the conservation of native biological diversity in cooperation with the Guam's DAWR, consistent with the national defense mission of the Navy." Notably, all signatory parties to agreed that DON lands included within the GNWR shall be managed and administered, consistent with the national defense mission of the DON and the requirements of section 7(a)(2) of the Act, and other laws as applicable.

Management of listed species habitat on DoD lands has occurred with some success. The approximately 180 ac (73 ha) Haputo ERA and the 30 ac (12 ha) Orote Point ERA, both on NBG are two examples. Both were established in 1984, prior to the Agreement, as mitigation for the Kilo Wharf project. The 133 ac (54 ha) Habitat Management Unit (HMU) on AAFB was developed as a conservation measure under the 2006, informal consultation on the Beddown of Training and Support Initiative at the NWF (USFWS 2006c, p. 2), and currently serves as an experimental site for BTS research and control.

Environmental Baseline for the Mariana Fruit Bat

Other than a few isolated periods of increase, Mariana fruit bats have been declining on Guam since the early 1900s (Wiles 1987b, p. 1; USFWS 2009d, pp. 6 & 7 and references cited therein). Although the decline of the Mariana fruit bat was likely initiated by the introduction of firearms and increased hunting efficiency in the early 1900s, predation by BTS has contributed to the continued decline (Wiles et al. 1987, p.148; Lemke 1992, p. 137; Wiles et al. 1995, p. 32; Janeke 2006, p. 3; Brooke 2008, p. 2; USFWS 2009d, p. 19, 30). By 1995, nearly all of Guam's remaining Mariana fruit bats were located on AAFB (Wiles et al. 1995, p. 39). In 2006, the only known maternity colony on Guam was located on AAFB at Pati Point and had less than 100 individuals (Janeke 2006, p. 4). By 2010 the Pati Point colony no longer existed, and no other colonies were known to exist on Guam (SWCA 2012, p. 20, DON 2014c, p. 2).

In December 2015, Mariana fruit bats were observed within the HMU at AAFB. Preliminary estimates were 30 to 50 Mariana fruit bats present within the HMU (D. Lujan, AAFB, pers. comm. 2016). Since that time, Mariana fruit bats have been regularly using the forest of the HMU for foraging and roosting. According to direct observation and indirect evidence of Mariana fruit bat presence (e.g., excrement, discarded fruits with bat-teeth markings), the Mariana fruit bats appear to be using most of the interior forested area in the HMU. Four different Mariana fruit bat roosting locations were identified during three perimeter and eight interior surveys of the HMU in 2016. The largest group of Mariana fruit bats counted in one area was 112 bats (Mildenstein 2016, p. 1). Mariana fruit bats were also observed flying from and to adjacent areas outside of the HMU (Mildenstein 2016, p. 2).

As described below, individual Mariana fruit bats have been detected at multiple locations on Guam in the past eight years.

Mariana fruit bat detections in northern Guam (GNWR, AAFB, Finegayan, and Haputo):

- In December 2015-February 2016, bats were observed within the HMU on AAFB. It is estimated that 112 bats were present within a colony at the HMU. This represents greater than a 200 percent increase in the estimated Mariana fruit bat population on Guam in early 2015. The increase in the Guam bat population is evidence of the periodic movement of bats between Guam and Rota.
- In July 2014, a large-scale survey throughout AAFB resulted in an estimate of 8-21 bats (DON 2014c, p. 2). Annual base-wide surveys on AAFB have been conducted in 2014, 2015, 2016 and 2017 (A. Brooke, DON, pers. comm 2017).
- Surveys on AAFB in 2012 recorded 50 detections of Mariana fruit bats at 84 stations, some of which could have been the same individuals. Mariana fruit bats were primarily

recorded along the cliff line extending from above the Combat Arms Training and Maintenance (CATM) Range east to Pati Point, in the MSA, and in the vicinity of the HMU (SWCA 2012, p. 58).

- In 2011, three Mariana fruit bats were observed flying west along the beach in front of the headquarters at GNWR (Schwagerl, pers. comm., 2015).
- Extensive surveys throughout AAFB from December 2010 to December 2011 resulted in a conservative estimate of approximately 25 Mariana fruit bats (DON 2014c, p. 48).
- From 2010-2013, a single Mariana fruit bat was observed flying across Route 3A on six occasions; four observations of a Mariana fruit bat flying into the HMU from Finegayan, and two observations of a Mariana fruit bat flying out of the HMU into Finegayan in the late afternoon (J. Schwagerl, USFWS, pers. comm. 2015). Mariana fruit bats from AAFB may use forested areas of Finegayan for foraging and roosting.
- During 10 observation days in 2008, one fruit bat was observed in the Haputo ERA and one in the northeastern portion of Finegayan (Brooke 2008, p. 1). The Haputo ERA contains some of the best remaining fruit bat habitat on the DON-managed lands (Brooke 2008, p. 2; DON 2010c).

Mariana fruit bat detections at Naval Magazine, Naval Base Guam, and in Southern Guam:

- In August 2014, two observations of a Mariana fruit bat in flight occurred at Fena Reservoir within the NMS (L. Takano, USFWS, pers. comm. 2014).
- In May and June of 2012 seven detections were recorded during surveys on six separate occasions at four locations on the NMS; it could not be determined whether observations were of a single individual or multiple individuals (DON 2014a, p. 48).
- In 2012, Mariana fruit bat surveys were conducted within the NMS and at a site on private land located in southern Guam (DON 2013b). Seven observations were recorded of a solitary Mariana fruit bat in flight at NMS, but it could not be determined if these observations represent one, or multiple individuals (DON 2013b, p. 11). These observations supplement Mariana fruit bat sightings previously documented in the vicinity of the NMS where foraging and roosting habitat is present (Brooke 2008, pp 1-2). No observations were recorded at the private lands site where suitable Mariana fruit bat roosting and foraging habitat is limited. However, known food plants of the Mariana fruit bat are present in the vicinity and this area may be used for roosting, foraging, and other activities (DON 2013b, p. 12).
- One Mariana fruit bat was sighted on NBG lands in 2008 during 90 hours of surveys at 14 survey locations on or near NBG lands. (DON 2014a, p. 48).

Threats to the Mariana Fruit Bat within the Action Area

In addition to the threats described in the General Environmental Baseline section, the following threats also affect Mariana fruit bat populations on Guam.

Hunting

Humans have been using Mariana fruit bats as a food source since human arrival in the Marianas. Consumption of Mariana fruit bats represents a significant Chamorro cultural tradition (Lemke 1992, p. 135; Sheeline 1991, p. 14). Demand for Mariana fruit bats for human

consumption is demonstrated by the large commercial trade in Mariana fruit bats that existed in the Marianas in the late 1960s until it became illegal through the Convention on International Trade of Endangered Species of Wild Fauna and Flora (CITES) (Wiles and Payne 1986, p. 143; Stinson et al. 1992, p. 63-66; Wiles et al. 1997, p. 204; CITES 2015). It is estimated that approximately 221,000 Mariana fruit bats were imported to Guam between 1975 and 1989 (Wiles 1992, p. 54). Illegal hunting appears to be the key reason for the Mariana fruit bat's dramatic decline on Guam (Wiles 1987b, p. 154; Wiles and Brooke 2009; USFWS 2009d, p. vii).

Even though Mariana fruit bats are protected by Guam and Federal law, they are likely still hunted opportunistically on private property when they transit the island and by hunters on AAFB (GNWR, unpublished data, 2005). For example, in 2007, reports were made of construction workers illegally hunting Mariana fruit bats at the Pati Point colony. The number of Mariana fruit bats at the colony declined from 55 (summer 2007) to 21 (December 4, 2008 survey) (PEER 2009). A recreational public ungulate hunting program has been in effect on AAFB since 1964 (D. Lujan 2015, pers. comm.), and is managed by a small group of hunters known as the Volunteer Conservation Officers (VCOs). The public is authorized to hunt on weekends in designated areas, and VCOs may hunt after regular working hours during the week. All hunting effort is documented by the VCOs. Currently, archery-only hunting is allowed in four areas (D. Lujan 2015, pers. comm.) and shotgun and muzzle loading hunting is prohibited. Elimination of shotgun and muzzle-loading hunting likely reduced the chance of illegal hunting of Mariana fruit bats on AAFB; however, it is possible that they are still hunted opportunistically on AAFB. SWCA (2012, p. 58) reported that roosting Mariana fruit bats were approached by observers as close as 16 ft (5 m), and suggested that hunters could, without difficulty, shoot and kill a roosting Mariana fruit bat.

Noise

Air traffic is the primary source of noise disturbance for Mariana fruit bats on Guam (SWCA 2008, p. 2-3; SWCA 2012, p. 23, 37). The first known study examining the effects of aircraft overflights on Mariana fruit bats on AAFB was conducted at Pati Point, where a colony of approximately 400 Mariana fruit bats roosted (Morton 1996). During this study, roosting Mariana fruit bats responded to some low-altitude aircraft overflights with distress and flushing, which increased time spent in alert, aggression, and maintenance behaviors. Four-engine carriers and bombers generally elicited a greater response from roosting Mariana fruit bats than fighter aircraft. Morton (1996, p. iii) suggested that higher levels of air-traffic volume would result in increased energy expenditure and perhaps roost abandonment by some or all of the Mariana fruit bats present at AAFB.

In 2006, the effects on Mariana fruit bats from noise resulting from increased jet aircraft and helicopter use at AAFB were analyzed in the ISR-Strike BO (USFWS 2006b). In that consultation, noise effects were expected to adversely affect the Mariana fruit bat to the extent that the nearby Pati Point colony would be abandoned, and Mariana fruit bats would relocate from Pati Point to other, less-protected areas on the island (USFWS 2006b, p. 49). In the ISR-Strike BO, we concluded that Mariana fruit bats on Guam would be taken as a result of the proposed action, but that action would not jeopardize the continued overall existence of the Mariana fruit bat (USFWS 2006b, pp. 49-52).

In 2007-2008, another study was conducted to document potential effects of aircraft noise on fruit bats at AAFB (SWCA 2008). During this period, the number of fruit bats at the Pati Point colony had decreased from 55 to 21 by the end of the surveys (PEER 2009). Aircraft noise affected the Mariana fruit bats by increasing alertness behaviors, preventing Mariana fruit bats from resting and sheltering in place, compared to surveys with no overflight occuring. However, the proportion of bats displaying alertness behaviors following an overflight was variable. Overflights did not appear to affect active thermoregulation. Six percent of overflights resulted in flushing events, and all flushing events were at noise levels exceeding 106 dBc, the highest reading being 122.6 dBc (SWCA 2008, pp. 2-3).

In 2010, another study was was funded to assess the effects of aircraft noise on Mariana fruit bats at AAFB (SWCA 2012); however, the colony at Pati Point no longer existed. Although up to eight individual Mariana fruit bats were observed roosting there at any one time, most departed the site by the end of each sampling period, indicating the site was no longer used as a colonial roost (SWCA 2012, p. 2). Increases in active thermoregulation (32 percent), maintenance (14 percent), locomotion (74 percent), and alertness (62 percent) were recorded during aircraft overflights. All flush events were at recorded peak noise levels above 90 dBA/101 dBc; the highest reading at 124.9 dBA/125.5 dBc (two F-15 aircraft). The observed flush events were associated with fighter, bomber, transport, and helicopter aircraft overflights (SWCA 2012, p. 23, 37).

Observations suggest that Mariana fruit bats may also be affected by small arms noise at the existing CATM Range at Tarague (J. Quitugua, DAWR, pers. comm. 2015). When the Mariana fruit bat colony was still roosting at Pati Point, a DAWR wildlife biologist observed Mariana fruit bats avoiding the firing range area as they left the roost to fly to their foraging grounds. Some flew away from land over the ocean, and returned to land by the Tarague beach area. Others flew up to the cliff line heading towards the ISR-Strike area. These observations occurred while the firing range was active on two different days. During the time period between the two observations, the number of Mariana fruit bats in the colony dropped from approximately 40 to less than 20 individuals. When the firing range was inactive, Mariana fruit bats were observed to fly along the cliff line near the range (J. Quitugua, DAWR, pers. comm. 2015).

Typhoons

Mariana fruit bats evolved in the presence of typhoons, the principal natural disturbance in the archipelago, but today these storms are a threat to the species because they can exacerbate the effects of the anthropogenic threats listed above (USFWS 2009d, p. 34). Evidence from Rota suggests that typhoons may not be a substantial source of direct mortality for Mariana fruit bats (Stinson et al. 1992, p. 65; Esselstyn et al. 2006, p. 536). However, the synergistic effect of illegal hunting and severe storms on Mariana fruit bats is documented on Rota (e.g., Stinson et al. 1992; Esselstyn et al. 2006). Severe storms can alter Mariana fruit bats foraging and roosting behavior by decimating food resources, removing protective foliage cover, temporarily modifying forest structure, and changing vegetation composition, especially by facilitating encroachment of non-native species. Loss of food resources can drive Mariana fruit bats to forage on the ground, during daylight hours, and closer to areas of human activity; thereby

increasing their vulnerability to illegal hunting (Stinson et al. 1992, p. 65; Esselstyn et al. 2006, p. 532).

Mariana Fruit Bat Survival and Recovery Habitat

Although Mariana fruit bats have been observed in a variety of habitat types, they are more likely to occur in native primary or secondary limestone forest (see Status of the Species above). Mariana fruit bat populations that have been subject to intense hunting pressure (e.g., populations on Saipan, Tinian, Rota, and Guam) are sensitive to human presence, and in recent history, maternity roosts are not known to occur in close proximity to areas inhabited by humans (Wiles 1987b, p. 151; J. Boland, unpublished data 2008-2014). However, Mariana fruit bats may forage on or near human-inhabited lands, in spite of hunting pressure (Wiles 2006, pers. comm. as cited in USFWS 2006b; Boland 2008-2015, pers. obs.). Therefore, for this BO, we assume that all areas identified as limestone and ravine forests on the 2006 Forest Service landcover maps (Liu and Fisher 2006a) are potential habitat for the fruit bat on Guam. We then updated the amount of available habitat on Guam by removing all forested areas cleared since the landcover map was completed using 2011 satellite imagery of Guam (Metevier 2014, unpubl. data). Although primary limestone forest is higher quality habitat that secondary limestone forest habitat, we did not account for habitat quality in these calculations due to our inability to differentiate between these forest categories using imagery alone. Similarly, we were unable to account for other aspects of habitat quality such as hunting and predation threats. As such, our estimate of available survival and recovery habitat (hereafter, referred to as habitat) on Guam is likely an oversetimate.

Using the methods above, the total area of Mariana fruit bat habitat on Guam was estimated to be 27,096 ac (10,965 ha) (**Figure 7**). Based on our estimate of 27,096 ac (10,965 ha) of existing survival and recovery habitat for the Mariana fruit bat (Metevier 2014, unpubl. data), the estimated carrying capacity for Mariana fruit bats on Guam is 19,847 bats (DON 2013d, p. 26, 45). In order for native limestone forest to serve as habitat for the Mariana fruit bat, it will need to be managed to reduce threats to the species, including the BTS, illegal hunting, invasive plant species, and feral ungulates (USFWS 2009a, pp. 42-43). Only 576 ac (233 ha) of this habitat is designated for the purposes of conservation. Most of the lands set aside for conservation are not currently managed to reduce threats. Therefore, it is important to protect and manage Guam's forest habitat to allow for recovery of the Mariana fruit bat. If habitat continues to be degraded, it may no longer provide the appropriate attributes necessary to support the Mariana fruit bat.

Environmental Baseline for the Mariana Eight Spot Butterfly

The Mariana eight spot butterfly relies on the limestone forest and thus is affected by the same stressors within the action area threatening Guam's limestone forest habitat, described above. The DoD lands affected by the proposed action encompass six of 10 host plant populations used by Mariana eight spot butterflies on Guam (Rubinoff 2016, p. 6). Within the action area, Mariana eight spot butterflies of all life stages were always found in close proximity to their two host plant species, *E. calcareum* and *P. pedunculata* (Rubinoff 2011, in litt.; Rubinoff 2013). Both of the host plant species are rare in their range and are susceptible to feral ungulate grazing, based upon observations that the plants occur only in the extremely rugged limestone karst that is

inaccessible by most feral ungulates (Rubinoff 2013, in litt.). The amount of total suitable habitat for the Mariana eight spot butterfly within the action area has not been quantified.

In northern Guam, the Ritidian and Haputo areas are important sites because they include the most current and consistent observations of Mariana eight spot butterfly adults and their other life stages. Extensive host plant patches and five occurrences with adult or larval butterflies were documented within the Ritidian Point, NWF area (DON 2016, p. 3). All adult and larva observations were near the cliff line in the area of the proposed MPMG Range. Host plant patches and observations of Mariana eight spot butterflies, caterpillars and eggs also occur within the Haputo ERA (Rubinoff 2016, attachment). It is likely that protection from feral ungulates and the presence of large stands of host plants support these important, larger populations and result in greater population persistence (Rubinoff 2016).

The host plants for the Mariana eight spot butterfly are also present at AAFB Golf Course, AAFB Pati Point, and AAFB Tarague (USFWS 2012a; Globteck and HDR 2012; Rubenoff 2013; Lindstrom and Benedict 2014, DON 2015; Rubinoff 2016). These three areas are situated west of Ritidian Point, along the northern plateau around to the south. Mariana eight spot butterflies, or their life stages, have been observed using these areas (USFWS 2012a; Globteck and HDR 2012; Rubenoff 2013; Lindstrom and Benedict 2014, DON 2015; Rubinoff 2016). A sixth area with host plants and butterflies, Spanish Steps/Orote, is within an ERA; this area is located the furthest south. The Mariana eight spot butterfly has likely been able to survive in this area because feral ungulate access is limited due to steep topography and is surrounded by cliff line and ocean. In total, surveys in the action area, while not comprehensive, have documented 2,310 individual host plants of *E. calcareum* and *P. pedunculata.*

Figure 9 shows all locations where Mariana eight spot butterflies were documented within the action area. An estimate of a 1-kilometer buffer is used to distinguish between subpopulations and represents maximum Mariana eight spot butterfly flight distance, based on similar species under similar conditions (Hill et al. 1996, p. 730). However, recent comprehensive surveys have not been conducted within the action area to verify persistence of these subpopulations.

Since reintiation of this consultation, in 2016, the GNWR and Guam Plant Extinction Prevention Program (GPEPP) began propagating host plants (*E. calcareum and P. pedunculata*) successfully in their nurseries, for future outplanting and forest restoration activities.

Environmental Baseline for the Partulid Snails: Humped Tree Snail, Guam Tree Snail, and Fragile Tree Snail

Tree snails rely on primary and secondary limestone forest habitat and thus are affected by the same stressors within the action area threatening Guam's limestone forests, described above. Tree snails prefer cool, dense, shaded native forest communities, with high humidity and reduced air movement to conserve moisture (USFWS 2012a, 2012b). The humped tree snail, Guam tree snail, and the fragile tree snail were all reported in 1989 within the Haputo ERA (Hopper and Smith, 1992). A 2008 survey found two colonies within the Haputo ERA, one known historically at Haputo Beach and another further north at Pugua Point, but still within Haputo ERA. The Pugua Point site contained fragile tree snails and Guam tree snails, while the Haputo Beach site

contained humped tree snails and Guam tree snails (Smith et al., 2008). During surveys conducted in 2011, one colony of Guam tree snails and fragile tree snails were observed in back strand and *Neisosperma* forest vegetation at the east end of Tarague basin (DON, 2013d), north of the project footprint on AAFB. In surveys conducted in 2011 and 2013, no tree snails were observed in the NWF area (DON, 2013d; UOG 2014). Although tree snails were not found within the project footprint of the LFTRC, potential tree snail habitat does occur within the areas subject to clearing for the LFTRC (DON 2017a, p. 44).

Surveys conducted in 2013 found approximately 245 individual Guam tree snails, 112 humped tree snails, and three fragile tree snails within the Haputo ERA (UOG 2014). There are no records of tree snails within the Finegayan impacted areas. No tree snails have been reported from the support areas on AAFB and adjacent lands.

On NBG, Lindstrom and Benedict (2014) reported three populations of Guam tree snails on one of the 47 transects. A colony of 10 individuals of Guam tree snails was detected near Apra (Lindstrom and Benedict 2014). Two other populations of Guam tree snails were also identified along the same transect (Lindstrom and Benedict 2014). The second population consisted of five individuals observed in a one person-hour search and individuals were found on leaves less than 16.4 ft (5 m) high on a large *Annona reticulata* tree, approximately 49 ft (15 m) tall. Both of the populations were found within 65.6 ft (20 m) of a small freshwater stream. The third population of Guam tree snails, 68 individuals in total, was observed on *Morinda citrifolia* trees in a one person-hour search and this population was no less than 164 ft (50 m) from a freshwater source. No other colonies of tree snail species were observed in NBG (Lindstrom and Benedict 2014).

Guam tree snails were sighted in August 2016 in the Anderson South area and again in November 2016. Confirmation that these sightings were Guam tree snails were provided by subject matter experts at the University of Guam (Megan Volsteadt and Dr. Curt Fiedler) (Gosnell, 2017, personal communication). Surveys in the same area by USDA Wildlife Services personnel reported three live snails in 2016, DON personnel returned to the locations where these snails were sighted and confirmed presence of 35 live snails (and 51 snail shells) in February 2017 (Olmsted, 2017, personal communication). A total of 38 live snails were documented in the Andersen South project location (**Figure 10**).

Below is a summary of Partulid snail detections on non-DoD properties within the action area (Lindstrom and Benedict 2014):

- Hagåtña Springs, Hagåtña River and Asan Beach Memorial Park were all visited to conduct targeted searches in July 2013. At Hagåtña Springs, 11 Guam tree snails were documented during a timed search, but many other individuals were observed subsequently in that location away from the area searched. At Hagåtña River, at least 17 Guam tree snails were documented. At Asan Beach Memorial Park, 119 Guam tree snails were documented during a one person-hour search, with many others observed in that general location outside of the timed search period.
- Pigo Cemetary, Namo River, and Sella Bay were visited in July 2013. Pigo Cemetery was found to have four Guam tree snails, Namo River had 10 Guam tree snails, and at Sella Bay, eight Guam tree snails were observed. Ritidian Point was the site of a targeted

search on July 17, 2013 and 20 Guam tree snails were documented (but many more observed).

- The Lost Pond area was visited on July 20, 2013, and 118 Guam tree snails were recorded.
- On July 23, 2013, at the Ylig River, 22 Guam tree snails were observed. At Fua Bay on July 25, 2013, 74 Guam tree snails were observed and on July 26, 2013, at Cetti Bay, 30 Guam tree snails were documented (Lindstrom and Benedict 2014). Fragile tree snails were recorded during the wet season at Pugua Point and Lost Pond (Hilaan) during targeted searches. It was thought that some snails from other locations were also fragile tree snails, DNA samples from these individuals indicated they were actually juvenile Guam tree snails. Tarague Basin was reported to have sightings of fragile tree snails; however, surveys by Lindstrom and Benedict observed only Guam tree snails. Since some Guam tree snails have very similar color patterns to fragile tree snails, particularly as juveniles (Hopper & Smith, 1992), the previous identifications may have resulted in juvenile Guam tree snails being misidentified as fragile tree snails. The humped tree snail is only found at one location, Haputo Beach (Lindstrom & Benedict 2014). As stated in the Status section, the humped tree snail is the least common of the three listed tree snail species on Guam.

Environmental Baseline for the Orchids (Orchidacea): *Bulbophyllum guamense*, *Dendrobium guamense*, and *Tuberolabium guamense*

Orchids are known for their specialized niches and often, specific pollinators (Williams 1973). *Bulbophyllum guamense*, *D. guamense*, and *T. guamense* are not exceptions to the need for specialized conditions, which include certain requirements for humidity, air circulation, and sunlight. However, more research is needed to delineate the specific abiotic and biotic factors that are needed for each of these orchids, to understand what is required to maintain viable populations of each, and to determine the amount of habitat available for recovery throughout their ranges. The number of individuals of each listed orchid species presented below is based on botanical surveys. The majority of surveys were conducted or funded by the DON on DoD administered lands and results are not comprehensive island-wide, thus the number of plants within the action area is considered a conservative value.

As noted above in the General Baseline section, habitat loss, fragmentation and degradation associated with urban development, ungulates, invasive species, and typhoons continue to negatively impact forests on Guam. *Bulbophyllum guamense*, *D. guamense*, and *T. guamense* are also at risk from herbivory by nonnative invertebrates such as slugs.

Environmental Baseline for *Bulbophyllum guamense*

Approximately 148 individuals of *B. guamense* are present within the action area (**Figure 11**) (DON 2017a). Of this amount, 127 occur within the NMS. *Bulbophyllum guamense* forms mat-like formations made of many bulbs on branches. We define an individual here as the entire mat-like formation because of the difficulty in delineating within the formation. The action area supports 36 percent of the range-wide population.

Environmental Baseline for *Dendrobium guamense*

Approximately 264 individuals of *D. guamense* are present within the action area. The greatest concentration of *D. guamense* occurs within the NMS (**Figure 12**). Approximately 17 individuals of *D. guamense* are present in the area proposed for the Main Cantonment at Finegayan and 41 individuals are present in the proposed LFTRC area (DON 2017a). *Dendrobium guamense* grows in large clumps on branches. However, we use individual to represent each unique orchid clump. The action area supports 31 percent of the range-wide population.

Environmental Baseline for *Tuberolabium guamense*

Tuberolabium guamense is present in the areas that include the proposed Main Cantonment at Finegayan, LFTRC, the HMU at NWF, and the NMS. During survey efforts, a total of 12,607 *T. guamense* individuals or occurences were identified within the action area (DON 2017a). Of these plants, 6,924 *T. guamense* were identified in Finegayan, 3,078 on NWF, and 2,314 on the main portion of AAFB (**Figure 13**). For some occurrences, over 100 individual *T. guamense* were found on a single tree. *Tuberolabium guamense* has been observed growing as a solitary individual and as a large cluster. When possible the survey counts represent an individual plant.

Surveys found *T. guamense* to occur within secondary limestone forests (82 percent of occurrences) and primary limestone forest (17 percent of occurrences). *T. guamense* is found in small numbers within other vegetation community types, such as ravine forests, coconut plantation, herbaceous-scrub, and savanna vegetation types (these vegetation community types accounted for one percent of occurrences.

The highest densities of *T. guamense* are seen in secondary forests (14.8 plants per ac, or 36.56 plants per ha) and primary limestone forests (5.9 plants per ac, or 14.49 plants per ha). Across all vegetation community types where this species is found, *T. guamense* occurs in an approximate density of 10.2 *T. guamense* per ac (25.2 *T. guamense* per ha). The action area supports 98 percent of the range-wide population.

Environmental Baseline for *Cycas micronesica*

Cycas micronesica relies on a healthy limestone forest and thus is affected by the same stressors within the action area threatening Guam's limestone forest habitat, described in the General Baseline section above. During surveys conducted on AAFB in 2012-2013, 12,770 living and 12,425 dead *C. micronesica* were tallied (Marler 2014, pp. 89). During 2014-2015, surveys were conducted at Ritidian Point and NWF, containing the proposed LFTRC footprint. *Cycas micronesica* was reported as occurring in high densities with few scale infestations (JRM 2014). JRM (2016) reported at least 3,561 mature *C. micronesica* are present within the proposed NWF Ungulate Control Area, and little scale infection was noted at Ritidian Point. Most cycads had dark leaves and many healthy fronds (JRM 2016, p. 6). Because of the high numbers documented throughout forest and edge areas of AAFB, it is highly likely that a large number of cycads, both infested and relatively healthy, are located within the proposed project footprint,

much of which is within AAFB. The proposed footprint for the Main Cantonment area in Finegayan is comprised of approximately 500 ac (202 ha) of similar limestone forest habitat (DON 2014, p. 96) which, based on numbers from nearby AAFB, likely contain high numbers of cycads. In addition, corridors for utilities and other development under this action are located throughout northern Guam with likely occurrences of *C. micronesica*. Updated surveys conducted in 2015 through 2017, reported a total of 19,852 *C. micronesica* plants (both mature and juvenile) within the action area (DON 2017a, p. 82). **Figure 14** shows all locations where *C. micronesica* were documented within the action area. The action area supports five percent of the range-wide population of *C. micronesica*.

Despite the relatively high numbers of *C. micronesica* within the action area, the health of *C. micronesica* subpopulations are poor and subpopulations are declining, due largely to invasive insect damage (Marler and Lawrence 2012, p. 240). Over a five-year survey period, Marler and Muniappan (2006) recorded 10 invasive insect species on Guam predating on *C. micronesica* plants, including four records of invasive insects new to Guam (**Table 8**).

The Cycad aulacaspis scale is among the most damaging threat to *C. micronesica* within the action area. This scale, native to Thailand and unintentionally introduced to Guam in 2003, attacks all age classes and major plant parts of *C. micronesica*. A six-year study that surveyed 687 *C. micronesica* plants in one area before and after Cycad aulacaspis scale infestation, found all *C. micronesica* seedlings were killed within 9 months and all juvenile *C. micronesica* plants were killed within 30 to 50 months after initial scale exposure (Marler and Lawrence 2012, p. 233). By the end of the study, Marler and Lawrence (2012) estimated a 92 percent mortality rate for *C. micronesica* once exposed to the Cycad aulacaspis scale (p. 233) and the loss of 75 percent of mature trees (p. 238), due to Cycad aulacaspis scale damage. Other invasive insects, such as the Cycad leaf miner and stem borer species (**Table 8**) compound effects of the Cycad aulacaspis scale, as the leaf miner further damages the naturally long-lived leaves of *C. micronesica* and the stem borers preferentially attack already stressed plants, contributing to their mortality (Marler and Lawrence 2012, p. 238).

A biological control agent, *Rhyzobius lophanthae* that naturally predates on the Cycad aulacaspis scale was introduced to Guam in 2004 with limited success. The *R. lophanthae* scale predator has extended the life of many mature *C. micronesica* plants, however the size differential between *R. lophanthae* and *A. yasumatsui* limits ongoing efficacy of biocontrol efforts, as the Cycad aulacaspis scale is able to find locations on *C. micronesica* plants that the predator cannot access (Marler and Lawrence 2012, p. 238). As a result of ongoing invasive insect damage, no new wild seedlings have been observed within the action area since 2008, and recruitment appears to be severely limited for the *C. micronesica* Guam subpopulation (Marler and Terry 2011, p. 778).

Table 8. Summary of invasive insect species on Guam and the type of damage caused to *C. micronesica* plants (Adapted from Marler and and Muniappan 2006, p. 3).

Common name	Scientific name	Order	Family	Damage to leaf	Stem	Cone
Cycad leaf miner	*Erechthias* sp. *	Lepidoptera	Tineidae	X		
Cycad aulacaspis scale	*Aulacaspis yasumatsui**	Hemiptera	Diaspididae	X	X	X
Armored scale	*Lepidosaphes* sp. near *rubrovittata*	Hemiptera	Diaspididae	X		
Indian wax scale	*Ceroplastes ceriferus*	Hemiptera	Coccidae	X		
Hemisperical scale	*Saissetia coffeae*	Hemiptera	Coccidae	X		
Stem borer	*Dihammus marianarum*	Coleoptera	Cerambycidae		X	X
Sap beetle	*Carpophilus mutilatus*	Coleoptera	Nitidulidae		X	X
Stem borer	*Dasyses rugosella**	Lepidoptera	Tieneidae		X	
Cycad male cone borer	*Anatrachyntis* sp.*	Lepidoptera	Cosmopterigidae			X
Oriental flower beetle	*Protaetia orientalis*	Coleoptera	Scarabaeidae			X

*New records for Guam

Environmental Baseline for *Heritiera longipetiolata*

Heritiera longipetiolata is found rooted in crevices in limestone slopes and plateaus within the action area (Costion and Lorence 2012, p. 79). Approximately 404 individuals of *H. longipetiolata* are present on Guam (DON 2017a, p. 110; GPEPP 2015). The 82 individuals in northern Guam represent over 20 percent of the known population on the island (**Figure 15**). The factors limiting the *H. longipetiolata* subpopulation within the action area include heavy predation on seeds by deer and the browsing of seedlings by deer and pigs (Wiles et al. 1995, p. 43). The action area supports 83 percent of the range-wide population of *H. longipetiolata*.

Environmental Baseline for *Tabernaemontana rotensis*

Tabernaemontana rotensis on Guam was once thought to be extremely rare, but recent surveys have found thousands of individuals along forest margins and open patches. It should be noted that some of the clusters of *T. rotensis* included one adult plant and numerous seedlings. **Figure 16** shows the known locations for all *T. rotensis* within the action area. The factors limiting the *T. rotensis* subpopulation within the action area include lack of frugivores and natural seed dispersers, and browsing of seedlings by feral ungulates (UOG 2007). Approximately 22,413 *T. rotensis* plants occur within the action area (DON 2017a, p. 110; GPEPP 2015), which supports approximately 99 percent of the range-wide *T. rotensis* population.

Previous Consultations in the Action Area

The following section 7 consultations have been conducted within the action area of this BO.

- In October 2006, the Service issued a non-jeopardy BO on the ISR-Strike Project on AAFB, Guam (ISR BO; USFWS 2006) and effects to the Mariana Crow and the Mariana fruit bat. The incidental take statement accompanying the ISR-Strike BO authorized the take of up to one Mariana fruit bat foraging territory in the form of harm as result of clearing and construction of the Aircraft Staging Area Facility. In addition, the take of two Mariana fruit bat colonies and 21 Mariana fruit bats on Guam and 36 Mariana fruit bats from Rota (or six premature migrations to Rota) in the form of harassment and death as a result of aircraft disturbance associated with overflights and subsequent illegal hunting impacts was authorized throughout the duration of the proposed action. The conclusion relied on provisions in the proposed action to monitor the status of Mariana fruit bats observed to ensure no additional take occurred due to construction activities, as well as minimizing, avoiding and/or offsetting the impacts of increased aircraft operations on the species. The measures would offset the impacts of incidental take and provide a net conservation benefit to the species as a whole.
- In September 2010, the Service issued a non-jeopardy BO on the Joint Guam Program Office (JGPO) Relocation of the USMC from Okinawa to Guam and Associated Activities on Guam and Tinian (JGPO BO; Service File #2010-F-0122) and effects to the Mariana fruit bat, Guam Micronesian kingfisher, Guam rail, Mariana common moorhen, Mariana crow, Mariana swiftlet, Micronesian megapode, Green sea turtle and Hawksbill sea turtle. The incidental take statement accompanying the JGPO BO authorized up to 10 of the remaining Mariana fruit bats at the Pati Point natural area colony to be taken in the form of harassment due to loud aircraft noise resulting from the proposed action. To minimize impacts of incidental take of the Mariana fruit bat, DON would minimize the level of incidental take occurring as a result of aircraft operations on Guam by developing measures to control BTS, restore or enhance Mariana fruit bat habitat, reduce ungulates, restore forest habitat, manage four ecological reserve areas, reduce poaching by adding conservation law enforcement officers and fund research to fill knowledge gaps of Mariana fruit bat demography, movements, and phylogeography. DON would also monitor and report the number of Mariana fruit bats occupying all known roost sites on AAFB from one year prior to and one year after the proposed overflight increases were fully implemented.
- In February 2015, the Service issued a non-jeopardy BO on the MITT Program (MITT BO; USFWS 2010) and effects to the Mariana fruit bat and Micronesian megapode. The MITT BO included an incidental take statement which authorized one fruit bat to be killed every five years on Farallon de Medinilla (FDM) as a result of bombing, gunnery and missile exercises conducted under the program. The non-jeopardy conclusion included measures to monitor the impacts of take of Mariana fruit bat caused by the MITT program.
- In July 2015, the Service issued a non-jeopardy BO on the DON's Relocation of the USMC from Okinawa to Guam and Associated Activities on Guam (2015 BO; USFWS 2015) and effects to the Mariana fruit bat, Mariana crow, Guam Micronesian kingfisher, as well as designated critical habitat for these three species. The 2015 BO allowed up to 30 Mariana fruit bats at AAFB and Finegayan (the current population size at the time) to be repeatedly taken in the form of harassment leading to injury from loud aircraft noise, operation of the LFTRC, construction noise, and other human disturbance resulting from the proposed action. Mortality was not anticipated from the proposed action. The non-

jeopardy conclusion relied on the following conservation measures: postpone construction activities if a Mariana fruit bat was present within 492 ft (150 m) of the site, use hooded lighting, provide education materials and survey for maternity colonies. On February 14, 2016, the DON informed the Service that up to 112 Mariana fruit bats were found within the HMU on AAFB during surveys, and that based on this finding, the DON requested an increase in the amount of take authorized in the form of harassment. DON's request for an increase in Mariana fruit bat take is addressed in this BO.

The remaining 10 species addressed in this BO are newly listed and therefore no previous consultations have been conducted on those species.

EFFECTS OF THE ACTION

Exposure Analysis Approach

The Service has developed an analysis framework for section 7 consultations that incorporates the general structure, primary concepts, and nomenclature of the U.S. Environmental Protection Agency's ecological risk assessment framework (USFWS 2005c). Factors causing adverse effects are called "stressors" and beneficial effects are called "benefits." Under this approach, the Service determines the effects of the action on listed species and critical habitat by evaluating the location, timing, duration, frequency, and intensity of listed species or critical habitat exposure to each stressor and benefit, and the likely effects of such exposure on the reproduction, numbers, and distribution of the listed species and on the recovery support function of critical habitat. The only species addressed in this BO with designated critical habitat is the Mariana fruit bat. The analysis of effects on Mariana fruit bat critical habitat was conducted on the proposed Federal action in the 2015 BO (USFWS 2015a, pp. 103-104 and pp. 144-145). This analysis and the information used in the analysis remain unchanged and are therefore not included in this consultation.

The proposed action's stressors include and are limited to:

- Habitat modification due to vegetation clearing and grubbing;
- Topsoil excavation and loss of karst substrate;
- Cut and fill earthmoving;
- Water well boring/drilling;
- Trenching and grading;
- Stockpiling of green waste;
- Disturbance from lighting systems;
- Aircraft traffic, including DoD aircraft;
- Vehicle traffic, including both civilian and military;
- Military training, including all ground maneuvers, munitions and firearm use; and
- Aviation training, including low-level terrain flights and external load training.

The proposed action's benefits include and are limited to:

- Enhancement and protection of limestone forest habitat;
- Control and eradication of ungulates in the Forest Enhancment Sites and the LFTRC;
- Creation of BTS exclosures and suppression of the BTS within the exclosures; and

- Landscape scale invasive species planning and prevention.

For purposes of this analysis, the term of effects of the proposed action associated with the permanent destruction of listed species habitat caused by earthmoving and vegetation clearing activities and degradation of listed species habitat associated with the operation of the training areas are considered to be indefinite.

General Effects of the Action

Habitat Loss and Fragmentation (All Affected Listed Species)

The proposed action is likely to cause forest habitat loss and fragmentation as a result of vegetation clearing and earthmoving activities. Definitions and descriptions of habitat fragmentation are described above in the Environmental Baseline section. The further loss, degradation, and fragmentation of forest habitat, is likely to decrease the amount of suitable habitat for recovery of all terrestrial listed species on Guam. Habitat suitable for the survival and recovery of the Mariana fruit bat has been delineated on Guam (Amidon in litt., 2015). Because *C. micronesica* has been considered one of the dominant trees within the forests on Guam and occurs within all Mariana fruit bat foraging habitat, we used the number of Mariana fruit bat habitat acres affected by the proposed action to estimate the amount of habitat loss for *C. micronesica*. Based on known species ranges and survey reports, the remaining nine species (the Mariana eight spot butterfly, Guam tree snail, fragile tree snail, humped tree snail, *B. guamense*, *D. guamense*, *T. guamense*, *H. longipetiolata*, and *T. rotensis*) co-occur or prefer similar habitat conditions, such as primary and secondary limestone forests; therefore the loss of those habitat types are used to represent the loss of habitat for the nine species affected by the proposed action. Habitat is defined as both occupied and unoccupied suitable habitat. The amount of habitat relied upon by the 11 listed species, which will be lost as a result of the proposed action is shown in **Table 9**.

Table 9. Anticipated loss of habitat relied upon by the affected listed species, resulting from implementation of the proposed action.

Project	**Habitat Cleared** acres (hectares)	
	Mariana fruit bat & *C. micronesica*	Mariana eight spot butterfly, Guam tree snail, fragile tree snail, humped tree snail, *B. guamense*, *D. guamense*, *T. guamense*, *H. longipetiolata*, and *T. rotensis*
Finegayan, Main Cantonment	449 ac (182 ha)	683 ac (276 ha)
AAFB Main, Family Housing	180 ac (73 ha)	12 ac (5 ha)
LFTRC	168 ac (68 ha)	79 ac (32 ha)
AAFB South	2 ac (1 ha)	212 ac (86 ha)
Naval Base Guam	5 ac (2 ha)	86 ac (35 ha)
Water Wells and Sanitary Sewer Systems	77 ac (31 ha)	51 ac (21 ha)
Utilities & Site	38 ac (15 ha)	30 ac (12 ha)

Improvements		
TOTAL	919 ac (372 ha)	1,153 ac (467 ha)

The largest effects on listed species habitat in terms of habitat fragmentation will be on AAFB near Ritidian Point from construction of the LFTRC. This area currently contains a large expanse (over 350 ac {142 ha}) of high-quality primary limestone forest that serves as occupied habitat for the Mariana fruit bat, Mariana eight spot butterfly, *B. guamense*, *D. guamense, Tuberolabium guamense*, *C. micronesica*, *H. longipetiolata*, and *T. rotensis*, and unoccupied habitat for the Guam tree snail, fragile tree snail, and humped tree snail (DON 2017a, p. 44). This primary limestone forest is also contiguous with GNWR, providing an even larger forested area serving as habitat for the above eleven listed species. In total, approximately 78 ac (32 ha) of primary limestone forest and 109 ac (44 ha) of secondary limestone forest would be permanently cleared for construction of the LFTRC.

In addition to LFTRC clearing activities, the proposed action will create a Surface Danger Zone (SDZ) over approximately 68 percent of the GNWR at Ritidian Point during operation of the LFTRC. The SDZ will cover the GNWR access road, visitor center, offices, and other facilities and thereby limit access to the GNWR while firing occurs at the LFTRC. Any entry into GNWR will require scheduling with and approval by LFTRC Range Control personnel. The limited access that GNWR staff will have to the refuge property during the estimated 39 weeks per year the LFTRC is active will limit the amount of habitat management that can occur at the GNWR. This could have an adverse effect on listed species by: 1) limiting maintenance of the predator exclusion fence at the GNWR, 2) limiting maintenance of native out-plantings, 3) limiting invasive plant control, and 4) limiting effective ungulate control. Per Section 2822 (Establishment of surface danger zone, Ritidian Unit, GNWR) in the 2015 National Defense Authorization Act, the Service and the DON may enter into an agreement to establish and operate a SDZ over the GNWR. The agreement may include relocation and reconstruction of GNWR facilities, mitigation for impacts to wildlife species, and use of DoD personnel to complete GNWR conservation actions; however, this agreement is not yet in place. Therefore, in this analysis we assume that the operation of the LFTRC will have an adverse effect on listed species by preventing the management, research, and monitoring that would have otherwise occurred at GNWR.

In summary, a total of 1,219 ac (493 ha) of limestone forest habitat will be cleared and permanently lost as a result of the proposed action. The loss of Guam's limestone forests and habitat for listed species furthers the long-term trajectory of loss of native forested habitat on Guam, and without the full implementation of conservation measures, may affect recovery of listed species on Guam. Given the small amount of habitat left on Guam, off-setting measures are provided to restore or protect the remaining limestone forest and listed species habitats. Such measures are important in terms of the conservation needs of affected listed species and the recovery support function of affected critical habitat. The effects of habitat loss are further discussed in the species-specific sections below.

Edge Effects (All Affected Listed Species)

Based on the approximately 187 ac (76 ha) of listed species habitat (primary and secondary limestone forest) that will be cleared for the LFTRC, approximately 6.2 mi (10 km) of new edge will be created. As discussed in the Environmental Baseline section above, edge effects can cause adverse effects to wildlife populations and ecological processes (Murcia 1995, p. 58; Laurance 2000, p. 134) not adapted to habitat edge conditions. Abiotic edge effects may include changes in microclimate, soil conditions, and wind. Biotic edge effects include increased predation, competition, disease, and parasitism (Ewers and Didham, 2006; Harper, et al., 2005). Microclimate effects include changes in light, temperature, and relative humidity (Kapos 1989; Kapos et al. 1993; Carmago and Kapos 1995). Soil changes due to edge effects may include changes in temperature, moisture, and nutrient cycling (Kapos 1989; Carmago and Kapos 1995; Grilli et al. 2011). Edge effects also tend to increase in severity with larger areas of disturbance. For example, large clearings, such as those proposed for the LFTRC and Main Cantonment provide a larger area to accumulate heat from the sun or a longer fetch in which wind speed can accelerate (Laurance et al. 2002; Laurance and Curran 2008; Laurance et al. 2011).

Edge effect responses by listed plant species may include mortality, reduced seedling recruitment, and reduced or stunted growth rates (Harper et al. 2005). The Mariana fruit bat and Mariana eight spot butterfly are also vulnerable to edge effect due to the alteration of available foraging and breeding habitat.

Fire Effects (All Affected Listed Species)

The proposed action may result in wildfires burning listed species habitat. Fires could start from live-fire training (including use of tracers), bivouacking with campfires, arson, barbeques, debris burning, cigarette smoking, aircraft mishaps, and vehicular malfunctions. Between 1991 and 2002, an average of 28 fires per year burned on DON lands on Guam (DON 2013e, p. 4-8), with 429 ac (174 ha) burned on average per year. Most of the area burned was savanna grasslands (DON 2013e, p. 4-8). This is approximately double the average annual number of fires on DON lands from 1979 to 1989, though the burned acreage on DON lands was similar (425 ac per year or 172 ha per year). Arson and debris burning account for approximately 70 percent of fires, and 87 percent of area burned, on DON lands from 1979 to 2002. Smoking (eight percent), unknown (three percent), and miscellaneous causes (including children, campfires, and equipment) account for approximately four percent of fires on DON lands on Guam (Nelson 2009, Ch. 3 p. 4).

Fires can lead to a variety of direct and indirect affects to wildlife and their habitats. Fire can burn habitat resulting in habitat loss, fragmentation, and degradation, and loss of foraging and breeding habitat. Fires could expose Mariana fruit bats to smoke, resulting in respiratory distress or abandonment of habitat.

Range Fire Management Plan

To minimize adverse effects to listed species resulting from fires, the DON proposes to develop and implement a Range Fire Management Plan (RFMP) for the LFTRC. The RFMP will be prepared, among other purposes, to minimize fire threat to surrounding habitat and listed species, specifically *B. guamense, D. guamense, T. guamense, C. micronesica, H. longipetiolata, T.*

rotensis, and habitat and host plant species for the Mariana fruit bat, Mariana eight spot butterfly, Guam tree snail, humped tree snail, and the fragile tree snail. The RFMP will be developed and implemented to ensure that any fire sparked during training will not spread beyond the firing range and into forested habitat. Because the LFTRC is surrounded by listed species habitats, the development and implementation of the RFMP will be critical to insure that the listed species and their habitat near firing ranges are not lost due to training activities.

Because a comprehensive RFMP will be reviewed by the Service and conservation measures implemented, as described above, we anticipate that no additional habitat will be lost due to wildfires igniting as a result of the proposed action. Although the DON's comprehensive RFMP may also minimize fire impacts on non-DoD lands on Guam by instituting fire prevention, detection, and suppression programs as well as implementing landscape-level fuel modifications in the NMS, the beneficial effects of this DON action to threatened and endangered species are difficult to assess because the RFMP has not been completed at this time.

Invasive Species (All Affected Listed Species)

Implementation of the proposed project is likely to increase the risk of introducing or spreading non-native terrestrial and aquatic invasive species including plants, animals, and microbes. Pathways associated with anthropogenic activities have a relative risk of introducing and dispersing non-native or invasive species. Hulme et al. (2008) described three broad mechanisms for non-native species introductions: importation as a commodity (e.g., purposeful importation as biocontrol, pet trade), arrival via transport vector, and natural dispersal. Of these mechanisms, Hulme et al. (2008) further described a framework for introductions that is supported by six principal pathways, of which two could potentially occur via the implementation of the DON's proposed action: contaminantion of a specific commodity and stowaway (independent of a commodity, like ballast water or airfreight). The pathways of contaminants and stowaways include, but are not limited to species transported via: construction equipment, personal protective equipment, and delivery of supplies, materials, goods, foot traffic, vehicles or vessel traffic. Invasive species introduced as contaminants and stowaways could occur as a result of inadequate sanitation and inspection during and prior to the movement of equipment, supplies, personnel, or vehicles. The repeated or routine movement of equipment and people increases the risk of introduction and establishment of a non-native and/or invasive species.

It is important to understand that the "risk" of introduction and establishment of invasive species is highly variable across taxa and habitats. Identifying and analyzing risk for all the species that could be moved via DON-related activities is not practicable. Instead, a more efficient approach is to identify pathways where numerous species from different taxa may be inadvertently introduced and implement prescriptive measures to control risks from those pathways. A pathway risk assessment will provide a structure for assessing where the greatest "risk" for a non-native species introduction occurs and locations where managing ingress or egress of these species is most efficient for control. Pathways must be controlled because repetition of an action has a direct effect on propagule pressure which as stated above increases the likelihood of a species to become established.

To address pathways and encourage a more holistic approach to managing invasive species, the DON funded the development of the Regional Biosecurity Plan (RBP) for Micronesia and Hawaii (formerly referred to as the Micronesia Biosecurity Plan). Individual activities for various species will continue, but the DON and others agree it is more efficient to manage pathways and prescribe corrective measures for a suite of species that will be monitored at discrete control points over time. The RBP will provide stakeholders in Micronesia and Hawaii with a platform for coordination and integration of inter-agency invasive species management efforts such as control, interdiction, eradication, and research. Several of the recommendations of the RBP are incorporated into the proposed action and are detailed in the Conservation Measures section. For example, to control points along potential invasive species pathways, the DON's HACCP program has been established for construction which includes control measures as well as baseline and follow on surveys to evaluate the effectiveness of the program (e.g., inspection of all DON related equipment or materials entering or leaving the action area, implementation of vehicle wash down procedures).

The DON is also committed to a comprehensive BTS interdiction program, also detailed in the Conservation Measures section, to ensure that military activities, including the transport of civilian and military personnel and equipment to and from Guam, do not contribute to the spread of the BTS (DON 2014a, p. 38). Brown tree snake interdiction requirements (e.g., trapping and inspections at ports, cargo facilities; and aircraft inspections of household goods, and biosecurity plans for training events) are specified in DoD instructions (i.e., 36 Wing Instruction 32-7004, BTS Control Plan and COMNAVMAR Instruction 5090.10A, BTS Control and Interdiction Plan) as well as the annual Work Financial Plan that is developed in cooperation with USDA Wildlife Services (DON 2014a, pp. 38-39).

In addition, the DON will fund any increase of current federally funded BTS interdiction measures (in Guam, CNMI, and Hawaii) where the need for the increase is to address direct or indirect effects related to the proposed action. The fiscal year (FY) 2010 level of funding for the Federal interagency BTS interdiction effort on Guam, CNMI, and Hawaii and 2010 transportation levels associated with outbound cargo from Guam to the U.S. or U.S. territories will be used as the baseline. The Service agrees that it is not DON's responsibility to fund increased interdiction measures that are identified more than one year after the end of the fiscal year in which the USMC relocation construction activities have ended and permanent non-transient USMC military units have completed their relocation to Guam. However, the Service understands the DON will continue to provide a baseline level of interdiction funding related to the direct, indirect, and induced-growth effects of its proposed action beyond one year.

Because of the DON's commitment to the RBP and BTS interdiction and with full implementation of the biosecurity measures described above, we anticipate that the proposed action will reduce the introduction and spread of invasive species both within the action area and beyond the borders of Guam.

Beneficial Effects of the Proposed Action (All Affected Listed Species)

In addition to the above measures that will minimize the risk of fire and spread of invasive species, the proposed action also includes other measures which will provide beneficial effects to all affected listed species.

- Enhancement and protection of two Forest Enhancement Sites in Finegayan totaling 1,108 ac (448 ha) of limestone forest habitat. In 2016, the DON conducted a vegetation survey (MCAG 2016) to determine the vegetation composition baseline prior to the commencement of forest enhancement activities (**Figure 17**). A majority of the current vegetation in the Forest Enhancement Sites consists of non-native *Vitex parviflora* (476 ac, 192.6 ha) or is comprised of grassland and disturbed limestone forest gaps (354 ac, 143.3 ha) (**Table 10**).
- Enhancement and protection of approximately 218 ac (88.2 ha), 66.7 ac (27.0 ha), and 97.1 ac (39.3 ha) of primary limestone forest, secondary limestone forest, and herbaceous scrub, respectively, by constructing an ungulate fence, creating an Ungulate Control Area in the Northwest Field, and eradicating ungulates within this area surrounding the LFTRC.
- Fencing of the Haputo Ecological Reserve Area (ERA) and providing signage and educational materials along the access trail to minimize human disturbance in the area and assist in maintaining the characteristics and integrity of the ERA. The fencing will prevent overuse by military and civilian personnel and potential damage to terrestrial biological resources.

Table 90. Vegetation-type totals within the North Finegayan Forest Enhancement Site and the South Unit BTS Exclusion Fence (MCAG 2016). General field classifications were used and overlap may exist.

	Total	
Dominant Vegetation	**Acres**	**Hectares**
Vitex, Gaps, Disturbed Limestone Forest	314	127.1
Disturbed Limestone Forest, Gaps	197	79.7
Barren, Grassland, Shrub	87	35.2
Vitex, Gaps	76	30.7
Vitex	48	19.4
Gaps, Disturbed Limestone Forest, Vitex-minimal	36	14.6
Disturbed Limestone Forest, Vitex, Cocos	27	10.9
Vitex, Disturbed Limestone Forest	19	7.7
Vitex, Gaps, Cocos	12	4.9
Cocos, Vitex	7	2.8
Disturbed Limestone Forest	7	2.8
Total Area Surveyed	830	335.8

Conservation measures with specific effects are described in species specific sections below.

Direct and Indirect Effects of the Action on the Mariana Fruit Bat

In addition to the general and beneficial effects of the action discussed above, a species-specific effects analysis for the Mariana fruit bat is provided below.

The Service's draft recovery criteria for the Mariana fruit bat proposes that recovery of the Mariana fruit bat will require subpopulations on each island where they are currently extant, and those subpopulations must be of sufficient size to avoid genetic and demographic risks associated with small populations (USFWS 2009a, p. 9). The Mariana fruit bat subpopulation within the action area fluctuates due to periodic movements between Rota and Guam. For example, in February 2016, 112 Mariana fruit bats were documented within the AAFB HMU area on Guam. This connectivity between Rota and Guam is important to allow access to available food resources and ensure genetic flow between islands. Resilience of the Mariana fruit bat population on Guam is expected to be low given the critically small starting population, the species' slow reproductive rate (USFWS 2009a, p. 17 and references therein), infrequent and unpredictable immigration from other islands (DON 2013d, p. 78), and abundant, widespread, and uncontrolled threats (USFWS 2009a, p. 19-33 and references therein). Based on our estimate of 27,096 ac (10,965 ha) of existing survival and recovery habitat for the Mariana fruit bat (Amidon in litt., 2015), the estimated carrying capacity for Mariana fruit bats on Guam is 19,847 bats (DON 2013d, p. 26, 45).

Given the small population of Mariana fruit bats remaining on Guam, recovery will likely depend on immigration or translocation of Mariana fruit bats from Rota (Esselstyn et al. 2006, p. 531) and long-term conservation and maintenance of Mariana fruit bat habitat on Guam. The Mariana fruit bat has high energetic demands associated with flight and year-round breeding, and as such depends on a steady and ample supply of fruiting and flowering plants that are distributed patchily through space and time (Wiles and Fujita 1992, pp. 26-31; USFWS 2009d, p. vi; Amitai et al. 2010, p. 2693; Downs et al. 2012, p. 344). To meet requirements for breeding, feeding, and sheltering, a self-sustaining population of Mariana fruit bats will rely on threat-managed, native limestone forest habitat containing diverse food resources that are available throughout the year.

Noise Effects

The proposed action will generate noise from the use of a variety of vehicles and machinery (construction and engineering equipment, fixed-wing aircraft, helicopters, and other convoy vehicles) and munitions (small arm firing and projectile detonations). Noise resulting from weapons training and construction on Guam will affect areas occupied by the Mariana fruit bat and reduce the quality of Mariana fruit bat habitat within disturbance range of the noise. Increased jet and helicopter aircraft traffic throughout Guam and especially at AAFB will regularly expose the Mariana fruit bat to high levels of noise.

Upon operation of the LFTRC, live-fire operations would occur between 7:00 am and 7:00 pm for up to 39 weeks per year, plus night operations (two nights per week over 39 weeks per year) would occur between 7:00 pm to 10:00 pm or 6:00 am to 7:00 am. The noise disturbance from the training will be impulse noise with very intense sounds of short duration (e.g., the discharge of a weapon). Firing noise from single shots merged in bursts, machine gun burst, and concurrent firing of multiple weapons would result in short periods of intense firing followed by periods of silence. Live-fire operations may occur for hours at a time, for five days a week, or not occur for multiple weeks in a row.

Peak noise level measures sound from a single event (e.g., grenade detonation or firing of a small arms weapon) received at a defined location, and is often referred to as sound pressure level (SPL). The average daily noise level (ADNL) sound metric accounts for not only the maximum SPL, but also the duration and temporal variation of the sound exposure (US Army 2008, p. 3-61). The DON provided the Service with estimated ADNL noise levels for all activities of the proposed action, including operation of the LFTRC, aircraft overflights within the action area, and operation of the hand-grenade training range at AAFB South **(Figure 18)**. The DON conducted a noise study at AAFB at three sampling sites near the LFTRC and found that ambient noise was never below 50 dB, and on some days was above 65 dB almost 100 percent of the time (DON 2014a, p. 66). The DON provided ADNL levels for areas surrounding the LFTRC (DON 2014a, p. 68). In the areas closest to the training ranges in operation the estimated ADNL would increase approximately 20 to 25 dB over baseline conditions, with average daily sound levels rising above 85 dB.

Hall and Richards (2000, p. 38) reported that flying foxes had peak sensitivity at 11 kHz but could hear between 2-40 kHz. Given the sensitivity of Mariana fruit bats to noise and human disturbance on Guam, and because of the reaction of Mariana fruit bats to hunting disturbance (i.e. gunshots), we anticipate that Mariana fruit bats will avoid the LFTRC and surrounding areas while it is in operation. For this reason, we have conservatively chosen a 65 dB threshold for noise disturbance of Mariana fruit bats that would preclude them from using habitat for breeding, foraging, or sheltering. The 65 dB threshold is based on the high-end of current ambient noise levels; we can reasonably expect that all habitats with noise louder than 65 dB would be avoided by Mariana fruit bats given the level and type of noise (i.e., gunshots). Therefore based on GIS mapping of areas where noise levels above 65 dB are expected to occur, we anticipate that approximately 1,817 ac (735 ha) of Mariana fruit bat habitat will be lost or degraded in northern Guam (AAFB and LFTRC) due to noise effects from military training and aircraft flights (**Figure 19**).

The proposed construction of the Main Cantonment at Finegayan will increase human presence and noise in the area. The cantonment is near the Haputo ERA, which contains high-quality Mariana fruit bat habitat, where fruit bats have been observed in the past. Increased use of the Haputo ERA by humans could deter Mariana fruit bats from using these areas for foraging or roosting.

Training will also occur at the NMS in southern Guam, where Mariana fruit bats are routinely observed. Training will include air-ground operations on five to seven consecutive days, 12 weeks per year, day and night, for a total annual throughput at the NMS of 1,440 Marines. Training at the NMS will also include terrain flight, ground threat reaction, defensive maneuvering, confined area landing, and external load training. These training activities will result in an increase in temporary noise and other human disturbance at the NMS. Solitary Mariana fruit bats flushed as a result of project noise may travel to another area where the likelihood of poaching or harassment is greater overall than it is on DoD lands. Flight restrictions will limit low-level flights over much of the NMS and this will minimize, but not completely avoid, adverse noise impacts to the Mariana fruit bat in this area. Therefore, we anticipate that approximately 319 ac (129 ha) of Mariana fruit bat habitat will be degraded in Southern Guam due to noise effects from military aircraft training flights (**Figure 20**).

Species Response

Stress reactions caused by human disturbance can have an adverse effect on Mariana fruit bats by increasing energetic demands, disrupting hormonal balance, and forcing relocation to lower quality habitat (Klose et al. 2006, p. 347, and references therein; CNMI 2010, p. 7). All of these factors can lead to reduced time foraging, sheltering, or breeding and adversely affect survival. When a disturbance is experienced by a Mariana fruit bat colony, individuals may disperse on their own or in smaller groups (CNMI 2010, p.6). In some cases, the degree of colony dispersal (i.e., how many individuals leave the main colony) may be related to the degree and/or type of human disturbance. When Mariana fruit bats are forced to disperse from colonies as a result of human disturbance, infant mortality may increase because dependent, non-volant pups that are too big for the mother to carry are likely abandoned. Forced dispersal may also negatively affect the reproductive potential of the population because access to mates is compromised (CNMI 2010, p. 7). Even without dispersal, high levels of stress from any disturbance can disrupt reproductive cycles and/or lead to miscarriage (Wingfield et al. 1998, p. 192-193, Heideman 2000, pp. 169-199, Klose et al. 2006, p. 347).

The following reactions to aircraft noise have been reported:

- Mariana fruit bats have been reported to flush at noise levels exceeding 106 dBC (SWCA 2008, pp. 2-3) and at peak noise levels above 90 dBA/101 dBc (SWCA 2012, p. 23, 37).
- Mariana fruit bats at a maternity colony on Rota flushed when a helicopter was within 656 ft (200 m) and a military jet aircraft (type unknown) flew overhead within 984 ft (300 m) (J. Boland, pers. obs., 2009 and 2010).
- Successive launches of F-14 aircraft repeatedly flushed 50 Mariana fruit bats from a roost site and F-14s (95 dBA to 106 dBA) also caused agitated Mariana fruit bat vocalization and flushing (Grout 1993 in Morton 1996, p. 67).
- Increases in active thermoregulation (32 percent), maintenance (14 percent), locomotion (74 percent), and alertness (62 percent) of Mariana fruit bats were recorded after aircraft overflights (SWCA 2012, p. 23, 37).

Mariana fruit bats in the vicinity of construction could be disturbed or harassed by noise and human presence. In order to avoid disturbance to Mariana fruit bats in the vicinity of construction, the DON will conduct surveys for Mariana fruit bats one week prior to onset of construction in areas within or in the vicinity of Mariana fruit bat habitat. If a Mariana fruit bat is present within 492 ft (150 m) of the project site, the work will be postponed until the bat has left the area (DON 2014a, p. 33). The DON clarified that this conservation measure does not mean that work will halt if a Mariana fruit bat enters the vicinity of a construction site while construction is on-going (C. Cobb, DON, 2015, pers. comm.). In general, Mariana fruit bats are likely to avoid construction sites due to human presence and noise disturbance, and seek other locations to roost and forage. If a fruit bat is present near a construction site and not seen (for example, roosting below a cliff line) then it will likely be harassed or harmed by the proposed action.

Noise from construction of the proposed action would be temporary and intermittent. Construction noise reaching fruit bat habitat may rise above the disturbance threshold for the

Mariana fruit bat; however, this noise will be short-term in duration and will not lead to a permanent reduction in the capability of the habitat to serve as suitable habitat for Mariana fruit bats.

Most Mariana fruit bats will depart from roost sites to foraging areas from one hour before to one hour after sunset (J. Boland unpublished data, 2008-2011). Therefore the range will be operational when bats can be expected to be commuting to foraging areas. We expect that any Mariana fruit bats that are able to hear the LFTRC in operation will avoid the area and seek out a less disturbed area. While bats are capable of flying outside the disturbance zone, bats seeking alternate commuting corridors and/or foraging areas may be forced into lower quality habitat or exposed to increased risks of poaching and harassment. In addition, bats in the vicinity of the LFTRC when firing begins will likely flush and leave the area. As mentioned above, if reproductive females are exposed to stressors that cause flushing and dispersal, it can disrupt reproductive cycles, cause miscarriage, or cause abandonment of non-volant young (Wingfield et al. 1998, p. 192-193, Heideman 2000, pp. 169-199, Klose et al. 2006, p. 347).

A colony of bats may periodically roost within the HMU on AAFB. These bats forage within AAFB and are likely to be further harassed from the increase in aircraft overflights associated with the proposed action.

Mariana fruit bats are suspected to migrate from Rota to Guam periodically following typhoons, and the migrants are suspected to return to Rota when the effects of the storm have subsided (Wiles and Glass 1990, p. 3; Esselstyn et al. 2006, p. 536). Migrants from Rota are thought to have occupied the Pati Point roost site on Guam in the past (Esselstyn et al. 2006, pp. 535-536; Wiles and Glass 1990, p. 2-3). We suspect that if Rota migrants are subjected to high levels of noise disturbance from increased air traffic at AAFB, it may cause them to return to Rota prematurely. A premature return to Rota under post-typhoon conditions may expose Mariana fruit bats to high levels of hunting and decreased food and habitat availability.

It is also possible that the increased noise near Pati Point, and on AAFB in general, will limit the establishment and growth of the Mariana fruit bat colony in northern Guam. If the Mariana fruit bat population on Guam were to increase, individuals and colonies are not likely to establish roost sites in areas with high levels of human foot, vehicular, or aircraft traffic, due to hunting-induced sensitivities to human-presence (i.e., humans are predators), and sensitivity to loud noise and vibration from aircraft (see data presented above and in the Species Status section).

Habitat Conservation and Protection

The DON's protection and management of 5,234 ac (2,118 ha) of Guam Micronesian kingfisher habitat in northern Guam, in accordance with the GMK MOA (**Figure 21**), will have a beneficial effect on the survival and recovery of the Mariana fruit bat on Guam because these two species use similar habitat.

As part of the proposed action, the DON proposes to create two Forest Enhancement Sites at Finegayan, in low-quality secondary limestone forest, to benefit listed species, including the Mariana fruit bat. The DON has proposed the enhancement of the sites to include installation of

ungulate exclusion fences protecting a minimum of 1,000 ac (405 ha) and the creation of two BTS-free enclosures totaling 460 ac (186 ha), according to the schedule described in the Conservation Measures section, with the goal of ungulate eradication within the fenced areas; invasive plant removal; and the propagation, planting, and establishment of dominant and rare species characteristic of native limestone forest habitats. Although this site would not fully compensate for the loss of primary limestone forest in northern Guam, the enhancement of forest and protection of the site is expected to provide benefits to the Mariana fruit bat.

Summary

The proposed action is likely to adversely affect the Mariana fruit bat on Guam. Noise from, aircraft, operation of the LFTRC, and other military training activities will harm and harass Mariana fruit bats in the vicinity of the project activities. In total, 2,136 ac (864 ha) of Mariana fruit bat habitat will be lost, or degraded at least 75 percent of the time, due to noise effects of the proposed action (**Figure 13 & 14**). This loss or degradation of Mariana fruit bat habitat represents 8 percent of the existing Mariana fruit bat habitat on Guam.

While the maximum number of Mariana fruit bats seen at one time within the action area was estimated at 112 individuals, the number of Mariana fruit bats in Guam is unknown, but is believed to flunctuate as a result of migrations between Guam and Rota. The Guam population of Mariana fruit bats may forage throughout the action area in search of food resources and suitable roosting sites. Mariana fruit bats will avoid or be flushed from habitat areas with excessive noise above the ambient level, such as weapon fire or aircraft flights, as evidenced by documented observations. This disturbance, combined with existing threats to the Mariana fruit bats in the action area (as described in the Environmental Baseline), will make reestablishment of a Mariana fruit bat colony at Pati Point in northern Guam, unlikely. Increased human disturbance in northern Guam and in the NMS area may alter Mariana fruit bat behavior, increase stress reactions, or preclude use of high-quality foraging areas. Based on the increased disturbance throughout AAFB, where Mariana fruit bats have been historically detected, it is likely that individual bats may be harassed by the proposed action. Mortality to Mariana fruit bats as a result of the proposed action is unlikely. As part of the proposed action, the DON protect and management of 5,234 ac (2,118 ha) of Mariana fruit bat habitat in northern Guam, including 3,271 ac (1,324 ha) of occupied or suitable Mariana fruit bat habitat away from noise effects (**Figure 13**).

The areas of Mariana fruit bat habitat that will be permanently cleared are areas which, in the absence of the project and in the foreseeable future, would have remained intact to provide habitat for the species. Although this loss will not preclude the survival or recovery of the Mariana fruit bat, it will reduce the total number of bats the island can support. The proposed action will reduce the current estimate for the carrying capacity of Mariana fruit bats on Guam (see Environmental Baseline above) by approximately 1,559 bats.

Effects to Mariana Fruit Bat Critical Habitat

The proposed action may affect Mariana fruit bat critical habitat and its primary constituent elements (USFWS 2004). Although the current population of Mariana fruit bats on Guam is

small, the foraging behavior and diverse diet of the fruit bats cause them to use most of the island for foraging, as documented by Wiles et al. (1995). Thus, all of the designated critical habitat for this species is used for foraging and/or roosting and is considered occupied. Recent sightings of Mariana fruit bats at the GNWR within the critical habitat unit confirm this. Actions that affect the ability of the critical habitat unit to provide the conservation function for which it was designated (serving as habitat for roosting and foraging bats) may adversely affect critical habitat, regardless of whether the habitat features are actually physically altered.

The proposed project will not clear any designated critical habitat for the Mariana fruit bat. However, the proposed action will create disturbance that may affect the PCE (described above) requiring remote locations on clifflines with limited exposure to human disturbance. As described below, this primary constituent element will be adversely affected by the proposed action.

Construction

Construction of the MPMG range will take place over approximately three years beginning in 2021. Construction equipment will include standard heavy equipment including bulldozers, graders, haulers, large trucks. No blasting or use of dynamite will occur as part of the proposed project. The use of heavy equipment can reach noise levels of 96 dB (USFWS 2006a, p. 15). Noise levels within critical habitat, at the base of the cliff below the MPMG firing range, are anticipated to be 5 to 15 dB less than that above the cliff line (personal communication, M. Downing, Blue Ridge Research and Consulting, February 2014 in DON 2014b, p. 5-230). Therefore, we anticipate that noise from construction of the LFTRC would range between 81-91 dB within the critical habitat unit (without accounting for noise attenuation due to vegetation, humidity or other factors). Ambient noise within the critical habitat unit will depend on wind and surf conditions, and distance from the ocean. Based on ambient noise studies conducted above the cliff line at AAFB (DON 2014a, p. 66), we expect that ambient noise within the critical habitat unit is at least 60 to 65 dB. Therefore, noise from the construction of the MPMG firing range on AAFB may reach between 16 to 26 dB above ambient conditions in the critical habitat unit.

Noise from construction will not be heard within the entire critical habitat unit. While it is difficult to estimate what portions of the critical habitat unit will be affected, we assume that the noise above ambient levels would be heard in the portions of critical habitat immediately below the MPMG cliff line. In a conservative scenario, construction noise may be heard in a 100 ac (41 ha) portion of the 376 ac (152 ha) critical habitat unit (or 27 percent of the critical habitat unit). Noise from construction of the MPMG would be temporary and intermittent. Noise reaching the critical habitat unit would likely only come from construction activities at the MPMG range, which might occur for a few years of the total construction time.

Construction noise within the critical habitat (81-91 dB) will rise above the disturbance threshold for Mariana fruit bats (described in the Effects of the Action – Mariana Fruit Bat section). This noise will be short-term in duration and will not lead to a permanent reduction in the capability of the critical habitat unit to support recovery of the Mariana fruit bat. However, during construction, the critical habitat unit will not serve as a remote location with limited exposure to

human disturbance and this will limit the fruit bat's use of the clifflines for roosting or reproductive activity. Construction noise at this time, and for a period of time after while fruit bats still avoid the area, may have an adverse effect on the critical habitat unit serving as a remote location.

Operation of the LFTRC and aircraft overflights

Noise disturbance from the LFTRC and aircraft overflights could expose the critical habitat unit to increased human disturbance and preclude Mariana fruit bat roosting and reproductive activity. Based on the noise data shown in **Figure 17**, approximately two acres of fruit bat critical habitat, along a cliffline, will be exposed to noise levels above 65 dB. This includes approximately 150 linear meters (492 linear ft) of cliffline. There are approximately 2,500 m (6,652 feet) of cliffline within the critical habitat unit. Therefore, the amount of cliffline critical habitat precluded from use by the Mariana fruit bat is small.

In addition, based on the map of noise contours for aircraft at AAFB from the 2010 DON EIS (DON 2010b, Vol. 2, p. 6-25), we do not expect aircraft noise over the critical habitat unit to rise above ambient conditions.

Direct and Indirect Effects of the Action on the Mariana Eight Spot Butterfly

In addition to the general effects of the action discussed above, a species-specific effects analysis for the Mariana eight spot butterfly is provided below.

NOTE: In light of limited available empirical information on the biology and ecology of the Mariana eight spot butterfly, in the following analysis we have relied on information for other well-studied butterfly species in the same family (Nymphalidae). The Mariana eight spot butterfly appears to exhibit much of the same behavior, life history, and patchy distribution as other well-studied species in the family Nymphalidae. The Nymphalidae are the largest family of butterflies with about 6,000 species distributed throughout most of the world. These are usually medium-sized to large butterflies. Most species have a reduced pair of forelegs and many hold their colorful wings flat when resting. Many butterflies in this family exhibit a similar patchy distributional pattern because they exist as metapopulations [i.e., at any given point in time, butterflies may be using some areas and not others (Hanski and Gilpin 1991)]. Suitable habitat within the range of a species that exists as a metapopulation can play a pivotal role in maintaining natural metapopulations, especially for butterflies like the Mariana eight spot butterfly that may have limited dispersal abilities.

Habitat Loss

One of the most important factors likely influencing the status of butterfly species' populations in general and the Mariana eight spot butterfly population in particular is the distribution and abundance of nutritional resources, primarily food plants for larvae and nectar for adults. In many cases, the plant species providing nectar and those providing larval food are different, but grow together in the same habitat patches (Ehrlich 1984). The host plants for the Mariana eight spot butterfly are distributed in patches, and there is a strong association between the occurrence

of the species and its host plants. Schreiner and Nafus (1996) reported that at all locations where host plants were present, at least one of the life stages of the Mariana eight spot butterfly occurred. Recent surveys have shown that the Mariana eight spot butterflies are rarely observed except in close proximity to host plants.

Under the proposed action, 350 ac (142 ha) of high quality limestone forest habitat containing nectar and host plants known to be used by foraging Mariana eight spot butterflies and larvae within and surrounding the proposed LFTRC at Ritidian Point will be removed or degraded as a result of the construction and operation of this facility. The proposed action will directly and permanently remove 140 individual host plants (*E. calcareum* and *P. pedunculata*) for the Mariana eight spot butterfly on 187 ac (76 ha) within the proposed MPMG and Non-Standard Small Arms (NSSA) ranges at the LFTRC.

The Ritidian Point area is an important site for the Mariana eight spot butterfly due to interconnected patches of host plants within primary and secondary limestone forest habitat. Mariana eight spot butterflies have consistently been observed occupying this area. For example, during surveys, seven of the 140 individual host plants within the proposed project footprint were found to be occupied by Mariana eight spot butterfly larvae or chrysalis (DON 2017a, pp. 121-122). Permanent removal of host plants would decrease the number of suitable egg-laying sites by female Mariana eight spot butterflies. In addition, larvae of the Mariana eight spot butterfly will have a reduced amount of available food resources. The permanent removal of 350 ac (142 ha) of limestone forest habitat in this portion of the butterfly's range is likely to decrease the carrying capacity of the Ritidian Point area for the butterfly and cause a temporal decrease in the use of the area by Mariana eight spot butterflies.

However, this loss of habitat will be partially offset by the permanent fencing and removal of ungulates within an area of 284.7 ac (115.2 ha) of existing primary limestone and secondary limestone forest adjacent to the LFTRC in the Ritidian Point area. It is likely that with the installation of fencing and removal of ungulates, the host plants for the Mariana eight spot butterfly will be able to establish and thrive and Mariana eight spot butterflies will expand into this protected area.

Habitat Fragmentation

Many butterfly species exhibit metapopulation structure in which populations colonize new patches as previously occupied patches are vacated, leading to an on-off temporal patchwork of localized occupation and extirpation during certain times of the year or over several years (Rubinoff 2016, pp. 4-5). Connectivity of host plants and patch sizes are expected to influence the suitability of habitat for the Mariana eight spot butterfly. Given what we know about butterflies in this family, we suspect that on Guam, as habitat has been lost, the remaining patches have become smaller and more isolated. As habitat patches have become more isolated, the amount of intervening unsuitable areas between the suitable habitat patches have likely exceeded an individual's movement or dispersal capability and heighten vulnerability to the overall metapopulation.

Based on vegetation and butterfly surveys, our current understanding of the distribution and connectivity of suitable butterfly habitat on Guam, while not optimum, has allowed the Mariana eight spot butterfly metapopulation to persist within the action area. We believe the current distribution of butterfly habitat is a result, in part, of ungulates not being able to reach butterfly host plants due to the rugged terrain along cliff faces and the loss of habitat from other sources (e.g., development). As such, controlling existing threats such as ungulates is necessary in order to preserve existing locations of and expand habitat for Mariana eight spot butterfly host plant species.

The construction of the LFTRC will convert a portion of the limestone forest where Mariana eight spot butterflies occur from contiguous primary limestone karst forest to fragmented habitat. Habitat fragmentation may be one of the most challenging ecological issues to address (Dobson et al 1999). For example, Warren (1993) found that key butterfly species have been disappearing even from protected areas and concluded that, if site protection alone is not enough to maintain butterfly populations in the long-term, more emphasis should be placed on creating and maintaining habitat links at a landscape scale. In the absence of functioning habitat links, habitat fragmentation leads to isolation of populations, loss of genetic heterozygosity within populations, disruption of metapopulation, and local extinctions (Wilson et al. 2009, p. 1421). The long-term conservation of most butterfly species requires the protection of its metapopulation in a closely linked network of high quality habitat patches (Thomas et al. 2001, p. 1791).

Under the proposed action, conservation measures involving ungulate-proof fencing and ungulate removal as well as development of a focused fire management plan to minimize the frequency and size of fires caused by live-fire exercises are likely to provide for butterfly habitat in the Ritidian Point area that is better quality than is currently available.

Maintenance of the suitable habitat in a particular landscape is the most fundamental factor determining the presence of a species in a particular area (Thomas et al. 2001). In this context, stepping-stone habitat patches are important for butterflies. Maintaining habitat patches can help ensure and speed up the re-colonization of unoccupied sites that contain suitable habitat. The more isolated a habitat patch is, the less likely it is to be occupied, similarly the greater the gap between habitat patches the longer it takes for the vacant patch to be colonized. In general, the smaller the gap between habitat patches the quicker the vacant patch can be colonized (Thomas et al. 1992).

The network of host plant habitat patches at Ritidian Point is not currently contiguous and is situated between two occupied Mariana eight spot butterfly areas at Haputo and Tarague. As a result of the proposed action, areas of butterfly habitat will be permanently removed, potentially fragmenting habitat by creating gaps that could limit butterfly movement or dispersal between habitat patches within the Ritidian Point area and potentially between the two neighboring areas. Furthermore, because host plants for the Mariana eight spot butterfly are restricted in distribution, occurring in tower karst (Rubinoff 2016, 9 pp), populations of the Mariana eight spot butterfly could easily become isolated, since many tropical forest butterflies are unlikely to fly through open terrain (Laurance et al. 2002).

However, the permanent protection and maintenance of the proposed ungulate-proof fenced area discussed above is likely to provide the Mariana eight spot butterfly with a large block of suitable habitat that when restored, will provide better quality habitat than is currently available in the area. We also note, that while the firing range will not have a durable conservation easement per se, there would be no development or construction in adjacent areas of suitable butterfly habitat due to safety concerns (e.g., live fire exercises). Additionally, the mandatory development of a fire management plan (i.e., implementation of fire prevention measures) will minimize the impact of fires that may ignite within the areas adjacent to the firing range from the use of live munitions. This land use configuration will ensure that the areas of suitable butterfly habitat adjacent to the LFTRC are permanently protected from direct (development) and indirect (fire) loss of habitat, which would effectively benefit the Mariana eight spot butterfly.

Human Disturbance

Although we did not find any studies that evaluated the specific effects of construction activity and the operation of an active firing range on butterflies, a study on the effects of human recreational activities on butterflies found that oviposition events were concentrated on host plants furthest from the trail, suggesting that breeding habitat was constrained by recreational activities (Bennett et al. 2013, pp. 1783-1798). Minimum breeding areas or habitat patches for various butterflies have been calculated and range from 1.2 ac (0.5 ha) to over 123 ac (50 ha), but these areas should be considered within the metapopulation structure (Spalding 2005, p. 4). It is unknown what the minimum breeding area is for the Mariana eight spot butterfly.

Construction activity and firing range operation would disturb Mariana eight spot butterflies using host plants that remain on the edge of the clearing of the MPMG range, and in the absence of adequate buffers, may no longer provide suitable habitat for egg-laying female butterflies. While we do not know the extent of disturbance caused by the proposed action on the Mariana eight spot butterfly, we estimate the exposure of some, small areas adjacent to the LFTRC to human disturbance would be tempered by the beneficial effect of permanently protecting suitable butterfly habitat adjacent to the LFTRC from development or other land use activities due to firing range safety concerns.

In addition to the Ritidian Point area, the proposed action will also affect two subpopulations of Mariana eight spot butterflies located in the Finegayan-Haputo ERA and NMS. The Haputo ERA is an important site for Mariana eight spot butterflies because of the amount of high-quality host plants available. The proposed action includes construction and operation of a 1,213 ac (492 ha) Main Cantonment on the upper plateau above the Haputo ERA. The DON has addressed the potential for increased military and civilian access to the shoreline and into Haputo ERA by fencing the Haputo ERA and providing for educational signage and materials, as part of the proposed action. The NMS, Southern Land Navigation Area contains a single site where the Mariana eight spot butterfly was observed over multiple occasions in the last 10 years in primary limestone forest habitat. Ground maneuvers planned for the Southern Land Navigation Area may disturb this subpopulation of Mariana eight spot butterflies. The NMS, Northern Land Navigation Area also contains eight butterfly-unoccupied locations of individual host plants (*E. calcareum* and *P. pendunculata*).

Habitat Conservation and Minimization Measures

The adverse effects of the proposed action discussed above to the Mariana eight spot butterfly would be minimized, in part, by the DON's proposed conservation measures. The following is a summary of those conservation measures that may affect the Mariana eight spot butterfly:

- Implementation of fire prevention measures will decrease the risk of wildfire and destruction of habitat for the Mariana eight spot butterfly located adjacent to the LFTRC and within the Naval Munitions Site.
- Pre-construction surveys within a project footprint will be conducted to identify all stages of the Mariana eight spot butterfly, prior to construction. If any life stage of the Mariana eight spot butterfly (e.g., eggs, caterpillar, and chrysalis) is located within a project footprint during pre-construction surveys, it will be relocated onto an appropriate host plant (e.g., relocate pre-diapause larvae to *Procris pedunculata* or *Elatostema calcareum*) in similar sites away from the project footprint. This can be conducted by clipping the host plant and grafting the plant to another plant outside the project footprint (Cook and Delisle 2010), but within an occupied area of Mariana eight spot butterflies. The translocation of butterflies using the host plant grafting method in not likely to be 100 percent successful; however, if translocation is done in accordance with accepted protocols (Cook and Delisle 2010) and harm resulting from the relocation would be exempted from take prohibitions. The objective of this conservation measure is to minimize the amount of impact to the species by re-locating individuals out of harm's way and into existing suitable habitat. Movement of the individuals is better for the species than leaving them in habitat that will be destroyed by construction actions as long as actions are sensitive enough to protect the various different life stages.
- The DON will out-plant a minimum of 140 individual host plants of either *P. pedunculata* or *E. calcareum*, commensurate with the amount of each plant species that is removed as a result of construction activities associated with the proposed action. Out-planted host plants will be located in protected areas, including the two Forest Enhancement Sites at Finegayan and within the new ungulate exclusion fence surrounding the LFTRC.
- In addition to the 140 host plants to be out-planted in protected areas, the DON will out-plant host plants of either *P. pedunculata* or *E. calcareum* on the backside of LFTRC range berms that have no likelihood of encountering munitions. This conservation measure will enhance the suspected habitat corridor along the cliff face to ensure connectivity of nearby locations of Mariana eight spot butterflies. When feasible, but no less than annually, the DON will document the status of Mariana eight spot butterfly host plants on the backside of the earthen berms and any presence of the Mariana eight spot butterfly, in order to evaluate the efficacy of this conservation measure.
- The DON will construct an ungulate exclusion fence and remove ungulates within the NWF Ungulate Control Area, surrounding the LFTRC. This conservation measure will protect and enhance 284.7 ac (115.2 ha) of existing primary limestone and secondary limestone forest habitat that is occupied by the Mariana eight spot butterfly.

The planting of butterfly host plants at the Finegayan Forest Enhancement Sites will increase the number of host plants available for the Mariana eight spot butterfly. However, it is unknown

whether this site would be naturally colonized by Mariana eight spot butterflies or whether there would be suitable conditions to allow breeding at this site. The Finegayan Forest Enhancement Sites include mostly *Vitex* sparse canopy and mixed limestone plateau/secondary limestone forest which is a different vegetation community than the vegetation community found in the Haputo ERA and Ritidian Point area where Mariana eight spot butterflies have been observed. Though rearing of Mariana eight spot butterflies in captivity has been successful, successful full-scale propagation or breeding the species in captivity and subsequent reintroduction into previously unoccupied areas, requires additional research and refinement (C. Cobb, DON, pers. Comm 2017). The DAWR has funded a captive breeding project at the University of Guam, with planning underway (D. Vice, DAWR, pers. Comm. 2016).

Although butterfly habitat is limited within the NWF Ungulate Control Area, fencing and removal of ungulates will protect and enhance 284.7 ac (115.2 ha) of existing primary limestone and secondary limestone forest habitat for the Mariana eight spot butterfly. Once ungulates are removed, this permanent protection will greatly assist in improving butterfly habitat and connectivity. Habitat connectivity and patch sizes influence the suitability of habitat. When habitat is lost, the remaining patches become smaller and more isolated. As habitat patches become more isolated, the amount of intervening unsuitable areas between the suitable habitat patches can exceed an individual's movement or dispersal capability and heighten its vulnerability. Therefore, connectivity between patches of suitable habitat is necessary to facilitate daily and seasonal movements, and dispersal to increase the likelihood of long-term viability of Mariana eight spot butterfly populations. Because of long-term commitments to habitat protection through fencing and removal of ungulates, this conservation measure is likely to effectively expand the amount of suitable butterfly habitat beyond its current distribution along the cliff faces. As a result of the proposed fencing and removal of ungulates, host plants and other associated forest plants are expected to develop and be maintained within the 284.7 ac (115.2 ha) area for the foreseeable future.

Summary

The known distribution of Mariana eight spot butterfly populations is disjunct. This suggests that, historically, butterfly habitat was likely less fragmented and provided much greater connectivity to facilitate butterfly movement and dispersal. The proposed action will remove 350 ac (142 ha) of butterfly habitat, including approximately 140 host plants of *P. pedunculata* or *E. calcareum*, which represents 6.1 percent of all currently known host plants range-wide. However, the conservation measures proposed as part of the action (e.g., out-planting of 140 host plants, installation of ungulate-proof fencing, ungulate removal, fire management, and translocation of individual butterflies) in conjunction with natural expansion of host plants within the fenced area will not only minimize impacts of the action, but also restore additional butterfly habitat within areas that are currently unsuitable.

The Ritidian Point area includes occupied habitat and other suitable habitat that is important for sheltering, breeding, and foraging Mariana eight spot butterflies. The restoration of habitat under the proposed action is likely to allow for butterfly population expansion and provide additional habitat connectivity above what is currently available. In addition, this area includes a network of host plant patches with consistent observations of Mariana eight spot butterfly occupancy that

will be retained with implementation of the proposed action. The area is situated between two other Mariana eight spot butterfly habitat areas, and is therefore likely important in maintaining the connectivity of populations for this species.

Implementation of the proposed action, inclusive of the conservation measures, is likely to result in a net loss of limestone forest habitat and adverse impacts to the Mariana eight spot butterfly and its habitat, but will ultimately assist in the restoration of butterfly food plants that will benefit the metapopulation by increasing habitat connectivity. When the fencing in the Ritidian Point area is complete and ungulates are removed, we anticipate these actions will be effective in facilitating the establishment and maintenance of butterfly host plants and other associated forest vegetation within the 284.7 ac (115.2 ha) fenced area for the foreseeable future. Collectively, these conservation actions are likely to temper the loss and fragmentation of limestone forest and butterfly habitat caused by the proposed action to an extent that does not deepen the current degraded baseline for the Mariana eight spot butterfly on Guam.

Direct and Indirect Effects of the Action on the Partulid Snails: Humped Tree Snail, Guam tree snail, and Fragile tree snail

In addition to the general effects of the action discussed above, a species-specific effects analysis for the Partulid snails is provided below.

For partulid snails, the analysis considers the number of known snails within project footprints, existing vegetation cover, historical records of partulid snails within the action area, and mark-recapture survey data from long-surveyed populations of endemic tree snails elsewhere in the Pacific. The most severe impact to listed partulid snails is expected to occur within Anderson South, where up to 212 ac (86 ha) of disturbed secondary limestone forest snail habitat is expected to be permanently removed. In 2016, the DON opportunistically found a site of Guam tree snails within this 212 ac (86 ha) area at Anderson South that had not been known previously. In 2016 and 2017, the DON conducted transect surveys to count the number of listed partulid snails within the project site. The DON focused survey efforts on the most suitable and likely habitat to be occupied by partulid snails and expanded survey efforts outwards from that area. Due to the vegetation and substrate, not all vegetation within the 212 ac (86 ha) area at AAFB South could be surveyed. Based on the survey method we estimated a conservative transect buffer area of 9.8 ft (3 m), to represent the area searched along a transect. Based on the transect buffer area, a total of 153 ac (62 ha) were surveyed within the area of suitable snail habitat in AAFB South. Within the area surveyed, the DON found 38 live Guam tree snails, along with 51 dead Guam tree snail shells (DON 2017a, p. 45).

No other species of listed partulid snails were found at Anderson South. At the time of listing in 2015, the humped tree snail on Guam declined to approximately 100 individuals and was only found at one location, Haputo Beach, alongside the Guam tree snail and fragile tree snail (Smith et al. 2008). The DON will construct an ungulate fence and limit military and civilian recreational activities within the Haputo Beach ERA in order to minimize effects to listed partulid snails, as part of the proposed action. The entire Haputo ERA ungulate fence will be approximately 2.8 mi (4.6 km) in length, tying into steep cliffs on each end. Since 1989, the fragile tree snail was found only in the presence of the Guam tree snail (Hopper & Smith 1992),

and adult fragile tree snails are often mistaken for juvenile Guam tree snails. Based on the co-occuring nature of these species and the inability to accurately differentiate fragile tree snails from Guam tree snails, the effects analyses for the listed partulid snails are evaluated collectively.

While suitable habitat exists within the Main Cantonment and LFTRC areas proposed for clearing, the DON surveys have resulted in no sightings of listed partulid snails in these areas. No historical sites of listed partulid snails are known within the Main Cantonment and LFTRC areas proposed for clearing.

Partulid snails are found on the tops and undersides of various types of vegetation and do not exhibit a preference for a particular host plant species, rather they can be found in beach back strand vegetation and primary and seconday limestone forest habitat. Their cryptic nature can make detection challenging. Based on a 5-year dataset surveying listed Hawaiian tree snails of similar shape and size in a forested habitat enclosure where a known number of snails were translocated into the enclosure, timed-count monitoring efforts found that during subsequent surveys for tree snails on average only 30 percent of the actual number of tree snails present, are detected by human observers (U.S. Army 2015, Appendix 3-1; US Army 2016, p. 167; Hall et al. 2010, pp. 67-80).

Based on listed partulid surveys conducted within the action area, with consistent one-person hour searches in over 15 different sites, oberservers were able to detect and count 433 Guam tree snails or fragile tree snails (DON 2017a, p. 45; Lindstrom and Benedict 2014). Due to similar color patterns, surveyors were unable to reliably distinguish fragile tree snails from juvenile Guam tree snails (DON 2017a, p. 45; Lindstrom and Benedict 2014). Based on an average detection rate of 30 percent, the Guam tree snail and fragile tree snail population within the action area is approximately 1,400 snails. Approximately 100 humped tree snails were detected in the Haputo ERA, which is the only location in which they are known to occur. However, all three listed partulid snail species co-occur in similar habitat.

However, because the tree snails are located in terrain that is difficult to survey and the individuals are small and cryptic and can easily be missed during a survey, the Service is using the amount of impacted habitat (212 ac {86 ha}) as a surrogate to evaluate the effects to the Guam, fragile, and humped tree snails.

Habitat Conservation and Minimization Measures

In order to reduce effects to partulid snails, the DON has committed to conduct pre-construction surveys to locate partulid snails within the project footprint, prior to construction or any vegetation clearing activities. The pre-construction surveys will be conducted with the objective of locating, removing, and translocating listed snails out of the project footprint and into suitable protected habitat. Snails would be moved to similar suitable, protected habitat (i.e., habitat not subject to further anthropogenic effects or ungulate damage) and alongside other conspecifics.

In addition, the DON has committed to protect and enhance a total of 1,393 ac (564 ha) of suitable partulid snail habitat in primary and seconday limestone forest in the Finegayan and Ritidian areas.

Summary

The proposed action will adversely affect the Guam tree snail and possibly the fragile tree snail. While the humped tree snail and fragile tree snail are not known to occur within the project footprint, all three species co-occur and are found within the Haputo ERA. The DON will fence the Haputo ERA to reduce civilian and military access and minimize degradation to sensitive snail habitat. Historically, all three species shared similar habitat throughout the action area. Therefore, the likelihood that DON pre-construction surveys may detect individuals of the humped or fragile tree snail in the future cannot be discounted.

The proposed action will result in harm or harass of all Guam tree snails, fragile tree snails or humped tree snails in the 212 ac (86 ha) of limestone forest habitat to be impacted at Anderson South. The DON will conduct pre-construction surveys within the 212 ac (86 ha) of habitat and move all tree snails found to host plants in suitable tree snail habitat outside of the construction footprint. Pacific tree snail translocation techniques have been successful when conducted on similar species (U.S. Army 2015, Appendix 3-1). As long as the DON follows these translocation techniques, any effects to individual snails that occur as a result of translocation from the project footprint to protected habitat will be exempt from take prohibitions. In addition, the DON has committed to protect and enhance a total of 1,393 ac (564 ha) of suitable partulid snail habitat in primary and seconday limestone forest in the Finegayan and Ritidian areas. Therefore, the effect of the DON's action is qualitative, where the relocation of tree snails is considered in context of the amount of habitat impacted within the project footprint and the importance of this habitat to overall snail recovery. Based on the full implementation of the DON's proposed conservation measures, we expect the populations of Guam tree snail, humped tree snail and fragile tree snail to be maintained within the action area.

Direct and Indirect Effects of the Action on the Orchids (Orchidacea): *Bulbophyllum guamense*, *Dendrobium guamense*, and *Tuberolabium guamense*

In addition to the general effects of the action discussed above, a species-specific effects analysis for the affected listed orchids is provided below.

Direct and Indirect Effects on *Bulbophyllum guamense*

The proposed project will result in the removal of three individuals of *B. guamense* in order to clear forests to construct utilities, buildings, structures, and the LFTRC. The DON has proposed to conduct pre-construction surveys for *B. guamense* within the project construction footprint. After pre-construction surveys are completed and if individuals of *B. guamense* are present within the construction footprint and cannot be avoided, the DON has proposed to salvage healthy individuals of *B. guamense* and relocate individuals to other protected areas away from the project footprint or temporarily house the *B. guamense* individuals at the DON Nursery until a suitable translocation site can be found. Individuals would be relocated by a qualified biologist

and into protected forest habitat or the forest enhancement sites at Finegayan. Please refer to the conservation measures section for more detail.

The DON's conservation measures, to salvage and relocate orchids, are intended to prevent the mortality of individuals of *B. guamense* as a result of the proposed construction activities. However, removing orchids from the wild may result in injuries to the plants. Salvaged individuals may sustain injury from the uprooting, bruising, broken bulbs and leaves (William 1894, p. 15). The DON's measure to hire a qualified biologist would minimize this effect.

Translocation programs, which include moving orchids into new sites (assisted migration) or augmenting wild populations, have been used as tools for orchid conservation (Zettler and McInnis 1992). However, in devising conservation strategies, particularly assisted migration to new safe sites, it is important to consider the orchid's life history traits that may have an impact on long-term survival (Dixon et al. 2003, p. 4). In addition, effective conservation of orchids includes understanding natural migration routes and the functionality of biotic partners (mycorrhizas and pollinators). Orchids are also acutely susceptible to changes in ecosystem equilibria involving organic content, light availability, hydrology and competition that can affect both adult survival and the ability of seedlings to germinate and survive to maturity. We expect the DON will consider these factors in choosing adequate recipient sites for *B. guamense*.

Genetic differences between and among populations also should be considered in the relocation of orchids (Swarts and Sinclair 2008, Duffy et al. 2009). Because little is known about the life history traits of *B. guamense*, the success of relocating individuals of *B. guamense* back into the wild is unknown. However the DON is committed to ensure that a minimum of two *B. guamense* individuals survive and exhibit new root growth at a new protected site. If the DON is unable to successfully salvage all three *B. guamense* individuals then the DON will seek sources outside the project footprint for tissue culture and propagation of *B. guamense*. Since orchids are relatively slow-growing plants, it will require anywhere from several months to more than a year for a newly planted specimen on the tree to become securely attached. The DON has committed to monitoring the success of *B. guamense* translocations that will allow for appropriate adaptive management measures to be implemented in order to reach success targets, defined in **Table 6**.

In addition to the three *B. guamense* individuals known to occur within the project footprint, if any other *B. guamense* individuals are found during pre-construction surveys the DON will seek to translocate all healthy *B. guamense* individuals found.

Habitat Conservation and Minimization Measures

The largest concentration of *B. guamense* occurs within the NMS, which contains at least 127 *B. guamense* individuals within primary and secondary limestone forest habitat. The DON will implement avoidance measures including signage restricting access into sensitive areas of orchid habitat and minimization measures to reduce the risk of fire from training activities that would severely impact *B. guamense* habitat. By adhering to all conservation measures, effects to *B. guamense* will be minimized significantly.

The DON will also protect and enhance a minimum of 1,000 ac (405 ha) of occupied suitable *B. guamense* habitat, according to the schedule described in the Conservation Measures section, with the goal of ungulate eradication within the fenced areas; invasive plant removal; and the propagation, planting, and establishment of dominant and rare species characteristic of native limestone forest habitats. In addition, the DON will protect 285 ac (115 ha) of existing primary limestone and secondary limestone forest habitat surrounding the LFTRC in northern Guam.

Summary

The proposed action will adversely affect *B. guamense*. The proposed action will result in harm, injury, or mortality to three *B. guamense* individuals that occur in the Finegayan and Ritidian areas. In consideration of the DON's commitment to insure that of the three individuals of *B. guamense* removed, at least two *B. guamense* will survive; the proposed action will result in the loss of 0.2 percent (1 of 407) of the known range-wide population of *B. guamense* and 0.6 percent (1 of 148) of the known population within the action area. Although surveys within the construction footprint have been conducted, surveys may have missed *B. guamense*. The DON has proposed pre-construction surveys. Because *B. guamense* are confined to limited areas and their distribution is not uniform across the landscape, we expect a few additional *B. guamense* to be located near the individuals found in the Finegayan area and the seven occurrences within and surrounding the LFTRC. In addition, as detailed above and in the General Effects section, the proposed action will result in the fragmentation of habitat and will cause ecological degradation that extends beyond the proposed vegetation clearing due to edge effects.

We estimate that that the proposed action would negatively impact less than one percent of the known *B. guamense* population range-wide. Although edge effects, and most notably fragmentation, of forest habitat would occur within the action area in northern Guam, the majority of the population of *B. guamense* occurs at the NMS in southern Guam and these individuals and habitat would be avoided. In addition, if orchids are salvaged, kept in captivity and relocated back into the wild successfully, these methods coupled with the current research being conducted to propagate *B. guamense*, potentially could be used for augmenting existing populations in efforts to recover the species. Based on the full implementation of the DON's conservation measures, we expect the population of *B. guamense* to be maintained within the action area.

Direct and Indirect Effects on *Dendrobium guamense*

In addition to the general effects of the action discussed above, a species-specific effects analysis for *D. guamense* is provided below.

The proposed project will result in the removal of 18 individuals of *D. guamense* in order to clear areas of vegetation to construct utilities, buildings, structures, and the LFTRC. The DON has proposed to conduct pre-construction surveys for *D. guamense* within the project construction footprint. After pre-construction surveys are completed and if individuals of *D. guamense* are present within the construction footprint and cannot be avoided, the DON has proposed to salvage all healthy individuals of *D. guamense* that are feasible to relocate to other protected areas away from the project footprint or temporarily house the *D. guamense* individuals at the

DON Nursery until a suitable translocation site can be found. Individuals would be relocated by a qualified biologist and into protected forest habitat or the forest enhancement sites at Finegayan. Please refer to the conservation measures section for more detail.

The DON's conservation measures, to salvage and relocate orchids, are intended to prevent the mortality of individuals of *D. guamense* as a result of the proposed construction activities. However, removing orchids from the wild may result in injuries to the plants. Salvaged individuals may sustain injury from the uprooting, bruising, broken bulbs and leaves (William 1894, p. 15). The DON's measure to hire a qualified authorized biologist would minimize this effect. As stated in the Effects of the Action for *B. guamense*, translocation programs have been used as tools for orchid conservation (Zettler and McInnis 1992). However, in devising conservation strategies, it is important for biologist and conservation planners to be fully aware of the orchid's life history traits that may have an impact on long-term survival (Dixon et al. 2003, p. 4). In addition, effective conservation of orchids includes understanding natural migration routes and the functionality of biotic partners (mycorrhizas and pollinators). Orchids are also acutely susceptible to changes in microclimate; including humidity, temperature and moisture, as well as organic content, and the presence of other competitors that can affect both adult survival and the ability of seedlings to germinate and survive to maturity. We expect the DON will consider these factors in choosing adequate recipient sites for *D. guamense*. Genetic differences between and among populations also should be considered in the relocation of orchids (Swarts and Sinclair 2008, Duffy et al. 2009).

Because little is known about the life history of *D. guamense*, the likelihood of success of relocating individuals of *D. guamense* back into the wild is unknown. However, the DON is committed to ensure that at a minimum nine *D. guamense* individuals survive and exhibit new root growth at a new protected site. If the DON is unable to successfully salvage all nine *D. guamense* individuals then the DON will seek sources outside the project footprint for tissue culture and propagation of *D. guamense*. The DON has committed to monitoring the success of *D. guamense* translocations that will allow for appropriate adaptive management measures to be implemented in order to reach success targets, defined in **Table 6**.

In addition, to the 18 *D. guamense* individuals known to occur within the project footprint, if any other *D. guamense* individuals are found during pre-construction surveys the DON will seek to translocate all healthy *D. guamense* individuals found.

Habitat Conservation and Minimization Measures

The largest concentration of *D. guamense* occurs within the Naval Munitions Site (NMS), which contains at least 201 *D. guamense* individuals within primary and secondary limestone forest habitat. The DON will implement avoidance measures including signage restricting access into sensitive areas of orchid habitat and minimization measures to reduce the risk of fire from training activities that would severely impact *D. guamense* habitat in the NMS. By adhering to all conservation measures, effects to *D. guamense* will be minimized significantly.

The DON will also protect and enhance a minimum of 1,000 ac (405 ha) of occupied suitable *D. guamense* habitat, according to the schedule described in the Conservation Measures section,

with the goal of ungulate eradication within the fenced areas; invasive plant removal; and the propagation, planting, and establishment of dominant and rare species characteristic of native limestone forest habitats. In addition, the DON will protect 285 ac (115 ha) of occupied primary limestone and secondary limestone forest habitat surrounding the LFTRC in northern Guam.

Summary

The proposed action will adversely affect *D. guamense*. The proposed action will result in impacts to 18 *D. guamense* individuals that occur in the Finegayan, LFTRC, and Anderson South areas. In consideration of the DON's commitment to insure that nine of the 18 individuals of the relocated *D. guamense* will survive; the proposed action will result in the loss of one percent (9 of 837) of the known range-wide population of *D. guamense* and 3.4 percent (9 of 264) of the known population within the action area. Because *D. guamense* are confined to limited areas and their distribution is not uniform across the landscape, we expect a few additional *D. guamense* to be located near the individuals found in the Finegayan area and the 41 occurrences within and surrounding the LFTRC.

We estimate that that the proposed action would negatively impact less than three percent of the known *D. guamense* population range-wide. Although edge effects, and most notably fragmentation, of forest habitat would occur within the action area in northern Guam, the majority of the population of *D. guamense* occurs at the NMS in southern Guam and these individuals and habitat would be avoided. In addition, if orchids are salvaged, kept in captivity and relocated back into the wild successfully, these methods coupled with the current research being conducted to propagate *D. guamense*, potentially could be used for augmenting existing populations in efforts to recover the species. Based on the full implementation of the DON's conservation measures, we expect the population of *D. guamense* to be maintained within the action area.

Direct and Indirect Effects on *Tuberolabium guamense*

In addition to the general effects of the action discussed above, a species-specific effects analysis for *T. guamense* is provided below.

The proposed action will result in adverse effects to *T. guamense* as a result of the removal of 4,922 individuals of *T. guamense* in order to clear areas of forest for the construction of buildings, structures, utilities and roads in the Finegayan and Ritidian areas. The 4,922 individuals of *T. guamense* represent 39 percent (4,922 of 12,607) of the known population on Guam, and 38.3 percent (4,922 of 12,846) of the total known population of *T. guamense* range-wide.

The DON has proposed to conduct pre-construction surveys for *T. guamense* within the project construction footprint. After pre-construction surveys are completed and if individuals of *T. guamense* are present within the construction footprint and cannot be avoided, the DON has proposed to salvage healthy individuals of *T. guamense* and relocate individuals to other protected areas away from the project footprint or temporarily house the *T. guamense* individuals at the DON Nursery until a suitable translocation site can be found. Individuals would be

relocated by a qualified biologist and into protected forest habitat or the forest enhancement sites at Finegayan. Please refer to the conservation measures for more detail.

The DON's conservation measures, to salvage and relocate orchids, are intended to prevent the mortality of individuals of *T. guamense* as a result of the proposed construction activities. However, removing orchids from the wild may result in injuries to the plants. Salvaged individuals may sustain injury from the uprooting, bruising, broken bulbs and leaves (William 1894, p. 15). The DON's measure to hire a qualified authorized biologist would minimize this effect.

As stated in the Status of the Species section of this BO, *T. guamense* does not occur uniformly within the forest; but instead grows in more humid areas where moss is present on trees and other epiphytic growth including ferns and other native orchids occur. Local site conditions may have a large impact on population dynamics of orchid species, and differences in populations may be due to variables relating to seed germination, such as availability of suitable fungi to promote seed germination, or suitable organic content, moisture, and temperature levels (Perkins 1995, Jersakova and Malinova 2007, Jacquemyn 2010). Therefore, it is important to conserve habitats in which remaining large populations of rare orchids occur, in order to save such species from extirpation (Cozzolino et al. 2003).

The Finegayan area contains the largest and most robust known population of *T. guamense*; the majority or 56 percent of the known range-wide population occurs within the proposed Main Cantonment at Finegayan. The proposed action would negatively impact the Finegayan population by reducing it by at least 70 percent (from 6,924 to 2,070 orchids) and by removing the largest known cluster of this orchid species in the wild. However, this reduced population is not expected to be more vulnerable to extirpation because nearly all remaining *T. guamense* orchids would be contained within the two Forest Enhancement Sites. The DON will enclose these areas with ungulate-proof fences and eradicate ungulates within these enclosures, as well as conduct common native and listed species out-planting efforts to enhance these areas for protection of limestone forest habitat. These measures taken together are expected to protect and allow natural augmentation of the remaining Finegayan population of *T. guamense*.

The area within and adjacent to the proposed LFTRC at Ritidian represents the best remaining primary limestone forest habitat on Guam. Approximately 3,078 individuals of *T. guamense* are present within the Ritidian area. Based on current surveys, the proposed action will result in the removal of 68 *T. guamense* individuals as a result of construction of the LFTRC. The proposed action is also expected to result in fragmentation of *T. guamense* habitat within the Ritidian area.

Habitat Conservation and Minimization Measures

As a conservation measure to minimize the above adverse effects, the DON will salvage all healthy *T. guamense* found during pre-construction surveys where feasible, with the objective of translocating the *T. guamense* individuals to protected areas or temporarily house the specimens at the DON's Nursery until a suitable site can be found. The DON has committed to ensure that a minimum of 1,000 *T. guamense* individuals are translocated or outplanted successfully into protected areas. Because little is known about the life history of *T. guamense*, the likelihood of

success of relocating individuals of *T. guamense* back into the wild is unknown. If the DON is unable to successfully salvage at least 1,000 *T. guamense* individuals from within the project footprint, then the DON will seek sources outside the project footprint for tissue culture and propagation of *T. guamense*. The DON has committed to monitoring the success of *T. guamense* translocations that will allow for appropriate adaptive management measures to be implemented in order to reach success targets, defined in **Table 6**.

The salvaging and relocation of *T. guamense* are intended to prevent the mortality of *T. guamense*. However, in devising conservation strategies, it is important for biologist and conservation planners to be fully aware of the orchid's life history traits that may have an impact on long-term survival (Dixon et al. 2003, p. 4). In addition, effective conservation of orchids includes understanding natural colonization routes and the functionality of biotic partners (mycorrhizas and pollinators). Orchids are also acutely susceptible to changes in microclimate; including humidity, temperature and moisture, as well as organic content, and the presence of other competitors that can affect both adult survival and the ability of seedlings to germinate and survive to maturity. We expect the DON will consider these factors in choosing adequate recipient sites for *T. guamense*. Genetic differences between and among populations also should be considered in the relocation of orchids (Swarts and Sinclair 2008, Duffy et al. 2009).

The DON will also protect and enhance a minimum of 1,000 ac (405 ha) of occupied suitable *T. guamense* habitat, according to the schedule described in the Conservation Measures section, with the goal of ungulate eradication within the fenced areas; invasive plant removal; and the propagation, planting, and establishment of dominant and rare species characteristic of native limestone forest habitats. In addition, the DON will protect 285 ac (115 ha) of occupied primary limestone and secondary limestone forest habitat surrounding the LFTRC in northern Guam.

Summary

The proposed action will adversely affect *T. guamense*. The proposed action will result in adverse affects to at least 4,922 individuals of *T. guamense* that occur in the Finegayan and LFTRC areas. In consideration of the DON's commitment to insure that of the amount removed, at least 1,000 *T. guamense* will survive; the proposed action will result in the loss of 30.5 percent (3,922 of 12,846) of the known range-wide population of *T. guamense* and 31.1 percent (3,922 of 12,607) of the known population within the action area. In view of the fact that comprehensive *T. guamense* surveys were focused only within and adjacent to the proposed project footprints, the proposed project's impact to the range-wide population of *T. guamense* is a conservative estimate. Based on the status of Guam's remaining forest habitat and current botanical surveys, it is likely that the Finegayan and Ritidian areas constitute the best habitat for *T. guamense* range-wide.

The proposed action will negatively impact the Finegayan subpopulation by reducing it by at least 70 percent (from 6,924 to 2,070 orchids) and by removing the largest known cluster of this orchid species in the wild. However, this reduced population is not expected to be more vulnerable to extirpation because nearly all remaining known *T. guamense* orchids would be contained within the two Forest Enhancement Sites. The DON will enclose these areas with ungulate-proof fences and eradicate ungulates within these enclosures, as well as conduct

common native and listed species out-planting efforts to restore these areas for protection of limestone forest habitat. These measures taken together are expected to provide 1,000 ac (405 ha) of protected occupied *T. guamense* habitat and allow natural augmentation of the remaining Finegayan population of *T. guamense*. In addition, the DON will also control and eradicate ungulates within the Ungulate Control Area in the NWF, surrounding the LFTRC. The Ungulate Control Area will provide 285 ac (115 ha) of occupied primary limestone forest habitat for *T. guamense*. Overall restoration efforts are likely to offset the loss of 30 percent of the *T. guamense* population range-wide. With conservation measures in place, we expect the *T. guamense* population to increase within the Finegayan Forest Enhancement Sites and within the Ungulate Control Area at Ritidian within 10 years.

Direct and Indirect Effects of the Action on *Cycas micronesica*

In addition to the general effects of the action discussed above, a species-specific effects analysis for *C. micronesica* is provided below.

The proposed project will result in the removal of 3,191 individuals of *C. micronesica* in order to clear forest to construct the LFTRC ranges at Ritidian Point and the Main Cantonment at Finegayan. The remaining 3,177 individuals within the Ritidian Point area will be subject to edge effects, habitat fragmentation, and increased susceptibility to the introduced cycad scale insect, *A. yasumatsui*. Once infected with the cycad scale insect, *C. micronesica* plants monitored have had a 90 percent mortality rate over several years, especially in heavily degraded habitat (JRM 2016).

The largest concentration of *C. micronesica* (18,620 in total) occurs within primary limestone forest habitat within the Ritidian area. *Cycas micronesica* relies on a healthy limestone forest; therefore the loss of 1,219 ac (493 ha) of limestone forest habitat will adversely affect the population of *C. micronesica* on Guam.

Habitat Conservation and Minimization Measures

The DON has proposed to conduct pre-construction surveys for *C. micronesica* within the project construction footprint. After pre-construction surveys are completed and if individuals of *C. micronesica* are present within the construction footprint and cannot be avoided, the DON attempt to translocate any healthy mature individuals and basal suckers (i.e., cycad pups) found. Healthy basal suckers of *C. micronesica* found during pre-construction surveys would be temporarily housed at the DON Nursery until a suitable translocation site can be found. Any cycad pups salvaged may need to be hardened and grown to a suitable size prior to translocation. Individuals of *C. micronesica* would be relocated by an authorized biologist into protected forest habitat (e.g., NWF Ungulate Control Area or lands within the MOA). Refer to the conservation measures section for more detail.

The DON's conservation measures are intended to reduce effects to *C. micronesica* as a result of the proposed construction activities. The relocation of basal suckers of *C. micronesica* has been successful (USFWS 2016, in litt.). Of the 3,191 known *C. micronesica* individuals within the construction footprint, the DON has committed to insuring that 1,596 *C. micronesica* individuals

are maintained and survive into maturity. However, due to predation by invasive insect species, detailed in the Environmental Baseline section, the number of extant individuals that can successfully reproduce is unknown. These 1,596 *C. micronesica* individuals that the DON commits to manage will either be translocated as a whole plant, a basal sucker from the impacted mature plant, or sourced from stock outside the project footprint and propagated in the DON Nursery. The priority is to salvage the maximum amount of genetic stock from the impacted mature *C. micronesica* plants in the Ritidian area. Prior to out-planting into a protected area, the DON will ensure that the *C. micronesica* individual is of sufficient size and durability to withstand the change in environment and will likely need to be hardened off in a temporary location close to the out-planting site. The DON understands the time commitment involved in the growth of cycad plants from basal suckers.

Although the remaining 3,177 mature *C. micronesica* indivduals in the vicinity of the LFTRC would be subject to habitat fragmentation, 34 of these mature trees would be enclosed within the Ungulate Control Area surrounding the LFTRC, and as a result these plants and their offspring would be protected from ungulate damage.

Summary

The proposed action will adversely affect *C. micronesica*. The proposed action will result in harm, injury, or mortality to 3,191 *C. micronesica* individuals that occur in the Finegayan and LFTRC areas. In consideration of the DON's commitment to insure that of the 3,191 individuals of *C. micronesica* removed, at least 1,596 *C. micronesica* will survive; the proposed action will result in the loss of 0.4 percent (1,595 of 421,802) of the minimum known range-wide population of *C. micronesica* and 0.8 percent (1,595 of 19,852) of the known population within the action area.

We estimate that the proposed action would negatively impact less than one percent of the known *C. micronesica* population range-wide. At Ritidian, the loss and fragmentation of high quality limestone forest habitat will have immediate adverse impacts to *C. micronesica*, as well as other native and listed species that rely on *C. micronesica*. However, based on the full implementation of the DON's conservation measures, including translocation and propagation efforts of *C. micronesica* beginning concurrently or prior to forest clearing activities, we expect the population of *C. micronesica* to be temporarily reduced within the action area.

Direct and Indirect Effects of the Action on *Heritiera longipetiolata*

In addition to the general effects of the action discussed above, a species-specific effects analysis for *H. longipetiolata* is provided below.

The proposed project will result in the removal of seven individuals of *H. longipetiolata* in order to clear forest to construct the Multi-Purpose Machine Gun (MPMG) and Non-Standard Small Arms (NSSA) ranges for the LFTRC at Ritidian. The remaining 21 mature trees in the vicinity of the LFTRC will be subject to edge effects and habitat fragmentation. In addition, in the event of a severe wind storm, with the removal of forest vegetation that would otherwise have acted as a buffer from strong winds or typhoons, structural damage or injury to the remaining *H.*

longipetiolata mature trees are likely, especially since *H. longipetiolata* trees are the tallest canopy trees in the area (JRM 2016, pp. 5-6).

The largest concentration of *H. longipetiolata* (223 in total) occurs within remnant coastal plateau secondary limestone forest habitat at Naval Base Guam and AAFB. These areas are outside the construction project footprints and are not expected to be impacted.

Habitat Conservation and Minimization Measures

The DON has proposed to conduct pre-construction surveys for *H. longipetiolata* within the project construction footprint. After pre-construction surveys are completed and if individuals of *H. longipetiolata* are present within the construction footprint and cannot be avoided, the DON would record any mature trees. If any mature trees within the project footprint are found to be seeding, the DON would make every attempt to collect viable seeds from a mature *H. longipetiolata* tree prior to removal. Please refer to the conservation measures section for more detail.

The DON's conservation measures are intended to reduce effects to *H. longipetiolata* as a result of the proposed construction activities. Of the seven known *H. longipetiolata* trees within the construction footprint, the DON has committed to insuring that four *H. longipetiolata* plants are maintained and survive into maturity. These four *H. longipetiolata* individuals will be propagated from seed collected from the seven impacted mature trees, or sourced from seed outside the project footprint and propagated from seed. The priority is to salvage the genetic stock from the impacted mature trees. Prior to out-planting into a protected area, the DON will ensure that the *H. longipetiolata* individual is of sufficient size and durability to withstand the change in environment and will likely need to be hardened off in a temporary location close to the out-planting site. The DON understands the time commitment involved in the growth of hardwood trees from seed. The DON will construct an ungulate fence enclosing 285 ac (115 ha) of occupied primary limestone and secondary limestone forest habitat surrounding the LFTRC in northern Guam. This area and other areas on GMK MOA designated land will be used as *H. longipetiolata* outplanting sites.

Although the remaining 21 mature trees outside the LFTRC footprint at Ritidian would be subject to habitat fragmentation, 18 of these mature trees would also be enclosed within the Ungulate Control Area surrounding the LFTRC, and as a result these trees and their saplings would be protected from ungulate damage.

Summary

The proposed action will adversely affect *H. longipetiolata*. The proposed action will result in harm, injury, or mortality to 7 *H. longipetiolata* mature trees that occur in the LFTRC area. In consideration of the DON's commitment to insure that of the 7 individuals of *H. longipetiolata* removed, at least four *H. longipetiolata* individuals will be propagated from seed and maintained to maturity; the proposed action will result in the loss of 0.6 percent (3 of 488) of the minimum known range-wide population of *H. longipetiolata* and 0.7 percent (3 of 404) of the known population within the action area.

Considering the temporal delay, resulting from the DON's proposal to collect only *H. longipetiolata* seed and propagate to maturity, we estimate that that the proposed action will negatively impact 1.4 percent of the known *H. longipetiolata* population range-wide. The largest concentration of *H. longipetiolata* (223 in total) occuring within remnant coastal plateau secondary limestone forest habitat at Naval Base Guam will not be affected by the proposed action. Based on the full implementation of the DON's conservation measures, we expect the population of *H. longipetiolata* to be maintained within the action area.

Direct and Indirect Effects of the Action on *Tabernaemontana rotensis*

In addition to the General effects of the action discussed above, a species-specific effects analysis for *T. rotensis* is provided below.

The proposed project will result in the removal of 217 individuals of *T. rotensis* in order to clear forest to construct utilities, buildings, and structures, within AAFB Main and AAFB South, including the LFTRC at Ritidian. The remaining 189 mature trees in the vicinity of the LFTRC area will be subject to edge effects and habitat fragmentation. In addition, in the event of a severe wind storm, with the removal of forest vegetation that would otherwise have acted as a buffer from strong winds or typhoons, structural damage or injury to the remaining *T. rotensis* trees is likely.

The largest concentration of *T. rotensis* (16,366 in total) occurs within limestone forest habitat at AAFB in northeast Guam. The majority of these trees are outside the construction project footprints, however these trees occur adjacent to areas proposed for roads or utility infrastructure and therefore are expected to be indirectly impacted by project effects in the form of edge effects and habitat fragmentation.

Habitat Conservation and Minimization Measures

The DON has proposed to conduct pre-construction surveys for *T. rotensis* within the project construction footprint. After pre-construction surveys are completed and if individuals of *T. rotensis* are present within the construction footprint and cannot be avoided, the DON would record any mature trees. If any mature trees within the project footprint are found to be seeding, the DON would make every attempt to collect viable seeds from a mature *T. rotensis* tree prior to removal. Refer to the conservation measures section for more detail.

The DON's conservation measures are intended to reduce effects to *T. rotensis* as a result of the proposed construction activities. Of the 217 known *T. rotensis* trees within the construction footprint, the DON has committed to insuring that 109 *T. rotensis* trees are maintained and survive into maturity. These 109 *T. rotensis* trees that the DON commits to manage will be propagated from seed collected from the impacted mature tree, or sourced from seed outside the project footprint and propagated from seed. The priority is to salvage the genetic stock from the impacted mature tree. Prior to out-planting into a protected area, the DON will ensure that the *T. rotensis* individual is of sufficient size and durability to withstand the change in environment and will likely need to be hardened off in a temporary location close to the out-planting site. The

DON understands the time commitment involved in the growth of hardwood trees from saplings or seed. The DON has committed to monitoring the success of *T. rotensis* outplanted individuals to allow for appropriate adaptive management measures to be implemented in order to reach success targets, defined in **Table 6**. The DON will construct an ungulate fence enclosing 285 ac (115 ha) of occupied primary limestone and secondary limestone forest habitat surrounding the LFTRC in northern Guam and protect and enhance two Forest Enhancement Sites in Finegayan totaling 1,108 ac (448 ha) of occupied limestone forest habitat. This area and other areas on GMK MOA designated land will be used as *T. rotensis* outplanting sites.

Although the remaining 189 mature trees outside the LFTRC footprint at Ritidian would be subject to habitat fragmentation, 34 of these mature trees would be enclosed within the Ungulate Control Area surrounding the LFTRC, and as a result these trees and their saplings would be protected from ungulate damage.

Summary

The proposed action will adversely affect *T. rotensis*. The proposed action will result in harm, injury, or mortality to 217 *T. rotensis* individuals that occur in the LFTRC and AAFB South areas. In consideration of the DON's commitment to insure that of the 217 individuals of *T. rotensis* removed, 109 *T. rotensis* individuals will be propagated from seed and maintained to maturity; the proposed action will result in the loss of 0.5 percent (108 of 22,422) of the known range-wide population of *T. rotensis* and 0.5 percent (108 of 22,413) of the known population within the action area.

Considering the temporal delay, resulting from the DON's proposal to collect only *T. rotensis* seed and propagate to maturity, we estimate that that the proposed action will negatively impact one percent of the known *T. rotensis* population range-wide. The largest concentration of *T. rotensis* trees (19,319 in total) occur in secondary limestone and primary limestone forest habitat suounding Andersen Air Force Base, and will not be affected by the proposed action. Based on the full implementation of the DON's conservation measures, we expect the population of *T. rotensis* to be maintained within the action area.

CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, tribal, local or private actions that are reasonably certain to occur in the action area considered in this BO. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

The extent to which future development is addressed as a cumulative effect in the following analysis excludes any such future development that will have a federal nexus, such as federally-funded roads, or is likely to be caused by other Federal actions. Such actions will be addressed in future section 7 consultations.

Future state, local, or private actions that are reasonably certain to occur in the action area are listed below.

- A private developer has initiated steps to build the Pago Bay Ocean Resort, residential condominiums. The planned footprint of the resort is three ac (1.2 ha) on the southern side of Pago Bay. Surveys for listed partulid tree snails have not been conducted within the project footprint; however, one ac (0.4 ha) of the project footprint may be suitable habitat for any of the federally listed tree snail species.
- Guam Waterworks Authority will be upgrading the Northern District Wastewater Treatment Plant in Dededo. The upgrade will consist of increasing the capacity of the current plant and provide for secondary treatment of wastewater. The upgrade will impact approximately 10 ac (4 ha). Surveys for listed partulid tree snails have not been conducted on this land, however based on tree snail habitat preferences, the species may be present.
- The Guam International Raceway Park in Yigo will be completing site improvements and a raceway expansion. The current footprint of the raceway is 253 ac (102 ha) and the improvements and expansion are anticipated to impact an additional 70 ac (28 ha). There is a potential to impact the following listed species that may be present in the area based on habitat suitability: Mariana eight spot butterfly, *C. micronesica*, and *H. longipetiolata*.

Natural Resource Management Projects

Most natural resource management projects that would benefit the listed species covered in this BO will be federally funded. However, small scale projects may occur funded by the territorial or local governments. These projects may benefit listed species; however, their scale is likely to be insignificant compared to the loss of habitat from the proposed action.

Species-Specific Cumulative Effects

In northern Guam, habitat for these species may be lost as a result of cumulative effects from civilian development. Because we are still learning about the life histories and habitat requirements of the newly listed species addressed in this consultation, we are unable to estimate the specific number of acres that would be lost as a result of cumulate effects from civilian development. However, many of the newly listed species addressed in this consultation occur in limestone forest habitat. We anticipate at least a few hundred acres would be developed in the absence of the proposed action by 2035.

In southern Guam, habitat for the listed orchids at issue in this consultation may be lost as a result of cumulative effects from wildfire. However, since the trend in annual area burned has been declining, and we anticipate it will continue to decline as a result of ongoing and future Federal support of the development of local fire suppression resources, the amount of habitat lost to wildfire should decline. In addition, the listed orchids are present in ravine forests in southern Guam and the threat of wildfire may not be as high for ravine forests, which are located closer or adjacent to rivers.

CONCLUSION

After reviewing the current status of the listed species addressed in this BO, the environmental baseline, the effects of the proposed action and the cumulative effects, it is the Service's biological opinion that the action, as proposed is not likely to jeopardize the continued existence of the Mariana fruit bat, Mariana eight spot butterfly, the humped tree snail, Guam tree snail, fragile tree snail, *B. guamense*, *D. guamense*, *T. guamense*, *C. micronesica*, *H. longipetiolata*, and *T. rotensis*; and is not likely to destroy or adversely modify Mariana fruit bat critical habitat. The Service reached these conclusions based on the findings for each species presented below.

Mariana Fruit Bat

The proposed action will adversely affect the Mariana fruit bat on Guam due to increased noise and human disturbance. Approximately 1,817 ac (735 ha) in the LFTRC and AAFB in northern Guam and 319 ac (129 ha) at the NMS in southern Guam will be affected by increased disturbance to the level that would result take in the form of harm or harass that may preclude successful breeding, foraging and sheltering by the Mariana fruit bat. About 7.8 percent of the Mariana fruit bat habitat on the island will be degraded as a result of the proposed action, and although this impact will not preclude the recovery of the Mariana fruit bat, it may reduce the total number of bats that the island can support. The noise and disturbance to the Mariana fruit bats from construction and operation of project facilities will generally be intermittent and of short duration.

The DON's protection and management of 5,234 ac (2,118 ha) of Mariana fruit bat habitat in northern Guam, including the protection and enhancement of 3,271 ac (1,324 ha) of occupied and suitable Mariana fruit bat habitat away from noise effects will help off-set the disturbance of Mariana fruit bat habitat from the proposed action, and will help insure that Mariana fruit bat habitat in the near term, will be available for survival and recovery of the species on Guam. In addition, the DON's biosecurity conservation measures including landscape-level BTS eradication/control, recommendations from the Regional Biosecurity Plan, HACCP planning, and BTS interdiction program, will be beneficial to the Mariana fruit bat because it will reduce the snake population on Guam and also help prevent spread of the BTS to Rota and other Mariana islands. Based on the full implementation of the DON's proposed conservation measures, including pre-construction surveys, protection and enhancement of 3,271 ac (1,324 ha) of occupied and suitable Mariana fruit bat habitat, and BTS control, we expect the population of Mariana fruit bats to be maintained in the action area. In addition, the DON's two Forest Enhancement Sites at Finegayan, including the creation of 460 ac (162 ha) of BTS-free habitat will facilitate future recolonization or reintroduction of the Mariana fruit bat into Finegayan. Furthermore, the DON's BTS interdiction and control work will help prevent the spread of BTS to other Mariana Islands that support the Mariana fruit bat.

On the basis of these findings, the Service concludes that the effects of the subject action, taken together with cumulative effects, is not likely to appreciably reduce the likelihood of both the survival and recovery of the Mariana fruit bat in the wild because sufficient habitat and populations are likely to persist throughout its range at levels that retain the potential for recovery of this species.

<u>Mariana fruit bat critical habitat</u>

The Guam critical habitat unit for the Mariana fruit bat consists of approximately 376 ac (152) ha of land in the fee simple portion of the GNWR. The critical habitat unit is currently occupied, and is located at the base of the cliff below the LFTRC. Upon operation of the LFTRC, noise from gunshots will reach a small portion (approximately two acres) of the critical habitat unit. This noise may preclude the Mariana fruit bat from using this area for roosting as a remote place free of human disturbance. However, because only two acres will be affected, this noise is unlikely to diminish the value of the critical habitat for the conservation of the species in the long-term. Therefore, we determine that the proposed action will not result in the destruction or adverse modification of the Guam critical habitat unit for the Mariana fruit bat.

Mariana Eight Spot Butterfly

The range-wide population of the Mariana eight spot butterfly is comprised of at least 10 known local populations. All of these local populations are small, geographically restricted, and subject to further decline due to loss of their native host plants, habitat degradation, and mortality caused by two genera of parasitic wasps (*Ooencyrtus* spp. and *Telenomus* spp.), which predate on Mariana eight spot butterfly eggs. The likelihood of this species surviving and recovering is dependent on restoring a functional metapopulation of Mariana eight spot butterfly. Given the current status of this species, avoiding or effectively offsetting adverse effects to butterfly-occupied habitat is critical to maintaining the resiliency of the Mariana eight spot butterfly metapopulation in the action area.

The proposed action will result in the removal of 350 ac (142 ha) of butterfly habitat, including 140 host plants of *P. pedunculata* or *E. calcareum*, which represents 6.1 percent of all known host plants range-wide. The proposed action will also result in habitat fragmentation and edge effects to limestone forest habitat within the action area, which may reduce its potential to be used by the Mariana eight spot butterfly in the future.

The DON has proposed conservation measures to minimize, the adverse effects of the proposed action on the butterfly in the form of forest habitat restoration, propagation and out-planting efforts to augment existing habitat of *P. pedunculata* and *E. calcareum* host plants, and the commitment to conduct pre-construction surveys to identify all stages of the Mariana eight spot butterfly, prior to construction. If any life stage of the Mariana eight spot butterfly (e.g., eggs, caterpillar, and chrysalis) is located within a project footprint during pre-construction surveys, it will be relocated onto an appropriate host plant (e.g., relocate pre-diapause larvae to *P. pedunculata* or *E. calcareum*) in similar sites away from the project footprint. This has been successfully carried out by clipping the host plant and grafting the plant to another plant outside the project footprint (Cook and Delisle 2010) but within an occupied area of butterfly habitat. These conservation measures will not preclude effects to the species but will minimize effects as a result of vegetation clearing activities. Overall, implementation of the proposed action is likely to temporarily degrade the quality of habitat for the survival of the Mariana eight spot butterfly. In order to prevent permanent degradation of Mariana eight spot butterfly habitat, the DON will place a high priority on creating and protecting quality butterfly habitat in the Haputo ERA and remaining locations within the Ritidian Point area, but outside LFTRC range operations. The

creation and protection of this high quality Mariana eight spot butterfly habitat should occur without delay.

On the basis of these findings, the Service concludes that the effects of the proposed action, taken together with cumulative effects, is not likely to appreciably reduce the likelihood of both the survival and recovery of the Mariana eight spot butterfly in the wild because effects of the action will be minimized significantly and sufficient habitat and populations are likely to persist throughout its range at levels that retain the potential for recovery of this species.

Partulid Snails: Guam tree snail, humped tree snail, and the fragile tree snail

The proposed action will adversely affect Guam tree snail and possibly the fragile tree snail. While humped tree snail and fragile tree snail are not known to occur within the project footprint, all three species occur within the Haputo ERA. The DON will fence the Haputo ERA to reduce civilian and military access and minimize degradation to sensitive snail habitat. Historically, all three species co-occurred and shared similar habitat throughout Guam. Therefore, the likelihood that DON pre-construction surveys will detect individuals of humped tree snail and fragile tree snail cannot be discounted.

The proposed action will result in harm or harass to all Guam, fragile, or humped tree snails located in the 212 ac (86 ha) of occupied Partulid snail habitat in Anderson South that will be permanently removed. Not all vegetation within the 212 acres has been surveyed. The area that will be cleared is disturbed secondary limestone forest habitat. The DON will conduct a biological survey of a minimum of two-person hours (e.g., 4-persons at 30 minutes each or 2-persons at one hour) at least three days prior to construction at Anderson South for the purpose of locating and removing listed snails within the project footprint that would be impacted by construction activities. The DON will work with the Service and experienced malacologists for appropriate refinement of translocation methods and selection of receiving sites. All detected Partulid snails will be translocated into a protected area with suitable habitat which would allow the translocated Partulid snails to thrive. In addition, the DON will protect and enhance 1,393 ac (564 ha) of suitable Partulid snail habitat in primary and seconday limestone forest in the Finegayan and Ritidian areas. The DON will also fence the Haputo ERA to reduce civilian and military access and minimize degradation to sensitive snail habitat.

On the basis of these findings, the Service concludes that the effects of the subject action, taken together with cumulative effects, is not likely to appreciably reduce the likelihood of both the survival and recovery of Guam tree snail, humped tree snail and fragile tree snail in the wild because effects of the action will be minimized significantly and sufficient habitat and populations are likely to persist throughout its range at levels that retain the potential for recovery of this species.

Orchids*: Bulbophyllum guamense, Dendrobium guamense,* and *Tuberolabium guamense*

The proposed action will adversely affect three *B. guamense* individuals that occur in the Finegayan and Ritidian areas. In consideration of the DON's commitment to insure that of the three individuals of *B. guamense* relocated, at least two *B. guamense* will survive; the proposed

action will result in the loss of 0.5 percent of the known range-wide population of *B. guamense*. The majority of the population of *B. guamense* occurs at the NMS in southern Guam and these individuals and habitat would be avoided.

The proposed action will result in relocation of 18 individuals of *D. guamense* that occur in the Finegayan, LFTRC, and Anderson South areas. Translocation efforts will require at least nine *D. guamense* to survive and exhibit new root growth at a new protected site. Therefore, the proposed action will result in the impacts to 2.2 percent of the known range-wide population of *D. guamense*.

The population of *T. guamense* on Guam comprises 98 percent of its known range-wide population. The loss of 4,922 individuals of *T. guamense* as a result of the proposed action would represent a decrease of the Guam population by 39 percent (4,922/12,607) and in the range-wide population by 38.3 percent, and reduce the largest known subpopulation of this species on Guam. In consideration of the DON's commitment to insure that of the amount removed, at least 1,000 *T. guamense* will survive and exhibit new root growth at a new protected site; the proposed action will result in the loss of 30 percent of the known range-wide population of *T. guamense*.

With the listed orchids being salvaged, kept in captivity and relocated back into the wild, instead of being destroyed, these methods coupled with the current research being conducted to propagate *B. guamense*, *D. guamense,* and *T. guamense* could potentially be used for augmenting existing populations in efforts to recover the species. The DON will protect and enhance a minimum of 1,000 ac (405 ha) of suitable limestone forest habitat in the Forest Enhancement Sites, with the goal of ungulate eradication within the fenced areas; invasive plant removal; and the propagation, planting, and establishment of dominant and rare species characteristic of native limestone forest habitats. These protected areas will provide suitable habitat for translocation efforts and future recovery efforts for *B. guamense, D. guamense,* and *T. guamense*. In addition, the DON will protect 285 ac (115 ha) of existing primary limestone and secondary limestone forest habitat surrounding the LFTRC in northern Guam.

On the basis of these findings, the Service concludes that the effects of the subject action, taken together with cumulative effects, is not likely to appreciably reduce the likelihood of both the survival and recovery of *B. guamense, D. guamense,* and *T. guamense* in the wild because effects of the action will be minimized significantly and sufficient habitat and populations are likely to persist throughout its range at levels that retain the potential for recovery of this species.

Cycas micronesica

The proposed action would result in adverse effects to *C. micronesica* and loss of over 1,000 acres of occupied habitat for this species. The proposed action will result in adverse effects to at least 3,191 individuals of *C. micronesica* that occur in the Ritidian and Finegayan areas.

Range-wide, the total population of *C. micronesica* is approximately 420,000 individuals and the 3,191 individuals represent 0.8 percent of the known population. Of the total individuals affected, the DON will insure that at least 50 percent, or 1,596 *C. micronesica* will survive relocation efforts, initially as basal suckers and then be out-planted into protected areas to allow

survival into maturity. Based on this conservation measure, the proposed action will result in the loss of 0.4 percent of the known range-wide population of *C. micronesica*. The largest concentration of *C. micronesica* (18,620 in total) occurs within primary limestone forest habitat throughout northern Guam.

Considering the status and environmental baseline of *C. micronesica*, and the effects of the action, taken together with cumulative effects, the proposed action is not likely to reduce appreciably the likelihood of the survival and recovery of *C. micronesica* in the wild.

Heritiera longipetiolata

The proposed action would result in adverse effects to at least seven individuals of *H. longipetiolata* and loss of over 1,000 acres of unoccupied habitat that occurs in the Ritidian Point area. The range-wide population of *H. longipetiolata* is approximately 339 individuals and the seven individuals at Ritidian represent two percent of the known population. In consideration of the DON's commitment to insure that at least four *H. longipetiolata* will survive to maturity; the proposed action will result in the loss of one percent of the known range-wide population of *H. longipetiolata*.

On the basis of these findings, the Service concludes that the effects of the subject action, taken together with cumulative effects, is not likely to appreciably reduce the likelihood of both the survival and recovery of *H. longipetiolata* in the wild because effects of the action will be minimized significantly and sufficient habitat and populations are likely to persist throughout its range at levels that retain the potential for recovery of this species.

Tabernaemontana rotensis

The proposed action would result in adverse effects to at least 217 individuals of *T. rotensis* and loss of over 1,000 acres of occupied habitat for this species in the Ritidian Point area. The range-wide population of *T. rotensis* is approximately 21,000 individuals and the 217 individuals to be impacted at AAFB and Anderson South represent one percent of the known population. In consideration of the DON's commitment to insure that at least 109 *T. rotensis* will survive to maturity; the proposed action will result in the loss of 0.5 percent of the known range-wide population of *T. rotensis*.

On the basis of these findings, the Service concludes that the effects of the subject action, taken together with cumulative effects, is not likely to appreciably reduce the likelihood of both the survival and recovery of *T. rotensis* in the wild because effects of the action will be minimized significantly and sufficient habitat and populations are likely to persist throughout its range at levels that retain the potential for recovery of this species.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act and Federal regulations pursuant to section 4(d) of the Act prohibit the take of endangered or threatened species, respectively, without special exemption. Take is defined as harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in

any such conduct. Harm is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including, breeding, feeding, or sheltering. Harass is defined by the Service as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering.

Incidental take is defined as take that is incidental to, and not the purpose of, carrying out an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered a prohibited taking under the Act provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The measures described below are non-discretionary, and must be undertaken by DON for the exemption in section 7(o)(2) to apply. The DON has a continuing duty to regulate the activity covered by this incidental take statement. If DON (1) fails to assume and implement the terms and conditions or (2) fails to require contractors to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to contract documents, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, DON must report the progress of the action and its impact on the species to the Service as specified in this incidental take statement [50 CFR 402.14(i)(3)].

Take of listed plants are not covered under this incidental take statement because sections 7(b)(4) and 7(o)(2) of the Act do not apply to listed plant species. The Act provides protection for endangered plants by prohibiting removal and reduction to possession or the malicious damage of such plants on areas under Federal jurisdiction, or the destruction of endangered plants on non-Federal areas in violation of State law or regulation or in the course of any violation of a State criminal trespass law. Exceptions to these prohibitions are described in 50 C.F.R. 17.61, 17.62, 17.71, and 17.72.

Amount or Extent of Take Anticipated

Determining with accuracy the anticipated incidental take for a specific number of individuals of the Mariana fruit bat, Mariana eight spot butterfly, Guam tree snail, humped tree snail, and fragile tree snail is difficult because the subject species are small, cryptic in nature (butterfly and snails), two species are similar in appearance in their juvenile forms (Guam and fragile tree snail), definitive population estimates are lacking (all species), and the natural population fluctuations of these species remain undescribed (all species).

Under these circumstances, monitoring of take impacts in terms of individuals of the affected listed species is problematic. As a consequence of these compounded uncertainties, the Service finds that a habitat surrogate is a practical alternative to expressing and monitoring the anticipated extent of take of these five species because (1) the causal link between the surrogate and take is described above in the *Effects of the Action* section of this BO; (2) we have also explained above why it is not practical to express the amount or extent of take or monitor take impacts in terms of individuals; and (3) below we provide a clear standard for determining when the level of anticipated take has been exceeded. The habitat surrogate represents the area of habitat in which

the listed species is known occur, or where suitable habitat exists but has not been surveyed, within the construction and operation footprint of the proposed action and where the biological impacts of the action on the species are likely to conform to the statutory and regulatory definition of take.

Based on the analysis presented in this BO, the Service anticipates the following take is likely to occur as a result of the proposed action:

1. Over the term of the proposed action, all Mariana fruit bats using 2,136 ac (864 ha) of suitable roosting and foraging habitat surrounding the construction and operation footprint of the proposed action (**Figure 13**) are likely to be taken in the form of harm or harass due to exposure to loud aircraft noise, and to noise, light, and human disturbance associated with construction and operation of the LFTRC. This includes approximately 1,817 ac (735 ha) in northern Guam and approximately 319 ac (129 ha) in southern Guam due to noise effects from military aircraft flights and training exercises. The biological impact of the taking on the fruit bat is likely to cause a significant disruption of their breeding, feeding, and sheltering behavior to an extent that creates the likelihood of injury, but not death, of the affected bats. This take level is based on the analyses presented in the *Effects of the Action* section above, which included consideration of the following factors:
    a. The population of the Mariana fruit bat on Guam fluctuates due to periodic migrations of Mariana fruit bats between Guam and Rota;
    b. The Mariana fruit bat population within the action area has been concentrated in northern Guam within AAFB and Finegayan;
    c. Mariana fruit bats have also been noted using the NMS in southern Guam;
    d. In the last 17 years, Mariana fruit bat breeding colony survey counts have reported an average of 113.75 Mariana fruit bats in total on Guam (119 and 179 Mariana fruit bats reported from two separate island-wide efforts in 2000; 40 Mariana fruit bats in 2008; and 112 Mariana fruit bats in 2016);
    e. When Mariana fruit bats are forced to disperse from colonies as a result of human disturbance, infant mortality may increase because dependent, non-volant pups that are too big for the mother to carry are likely abandoned. Forced dispersal may also negatively affect the reproductive potential of the population because access to mates is compromised (CNMI 2010, p. 7). Even without dispersal, high levels of stress from any disturbance can disrupt reproductive cycles and/or lead to miscarriage;
    f. The action area contains approximately 27,096 ac (10,965 ha) of suitable Mariana fruit bat habitat. The proposed action will result in the loss or degradation of 7.9 percent of Mariana fruit bat habitat due to noise disturbance; and,
    g. Mariana fruit bats traverse large areas in search of food and shelter and therefore are likely to be exposed to stressors caused by the proposed action (aircraft noise, construction and operation of the proposed action) multiple times during their life-span;
2. The Service anticipates that, over the term of the proposed action, all life stages of the Mariana eight spot butterfly (i.e., egg cluster, caterpillar, chrysalis, and butterfly) found on identified host plants within 350 ac (142 ha) of occupied habitat within the

LFTRC construction footprint are likely to be subject to take in the form of capture and re-location out of "harm's" way. In addition, all Mariana eight spot butterfly life stages that remain within the 350 ac (142 ha) after host plant translocation occurs are likely to be taken in the form of harm or harass caused by vegetation clearing activities during construction of the LFTRC. The biological impact of the taking on the Mariana eight spot butterfly is likely to be negligible due to the relocation of all identified host plants. Any hram occurring to any Mariana eight spot butterfly life stage during the relocation process would be exempted from take prohibitions as long as translocation protocols are being followed. This take level is based on the analyses presented in the *Effects of the Action* section above, which included consideration of the following factors:

a. The locations of Mariana eight spot butterflies (of all life stages) are closely associated with the occurrence of their host plants, *E. calcareum* or *P. pedunculata*. Both of these plant species are rare within the action area;
b. Due to the cryptic nature of Mariana eight spot butterfly larvae, eggs, and chrysalides and their dependence on these host plants, it is reasonable to use Mariana eight spot butterfly host plants as a surrogate for Mariana eight spot butterfly presence; and
c. The DON has identified 140 individual host plants for the Mariana eight spot butterfly on 187 ac (76 ha) within the LFTRC construction footprint. Of these host plant locations, 11 were documented to contain Mariana eight spot butterfly larvae.

3. The Service anticipates that, based on the pre-development estimate of 176 listed tree snails occurring within the 212 acres of occupied, or potentially occupied, habitat in the Anserson South area, that about 53 Guam tree snail are likely to be detected, based on a 30 percent searcher efficiency, and subject to take in the form of capture and relocation out of harm's way. Although not found within the 212 acres on previous surveys, take in the form of capture and relocation out of harm's way may also occur to any individuals of the humped tree snail or fragile tree snail. Any hram occurring to tree snails during the relocation process would be exempted from take prohibitions as long as translocation protocols are being followed. In addition, all individuals of the Guam tree snail, humped tree snail, or the fragile tree snail remaining on the 212 ac of suitable habitat after removal and relocation efforts are completed may be taken in the form of harm or harass as a result of vegetation clearing activities during construction, operation, and military training activities at AAFB South. This take level is based on the analyses presented in the *Effects of the Action* section above, which included consideration of the following factors:

a. Guam's listed partulid snails are found on the tops and undersides of various types of vegetation and do not exhibit a preference for a particular host plant species, rather they can be found in coastal strand vegetation and primary and secondary limestone forest habitat;
b. Due to their habitat and behavior, listed partulid snails are difficult to detect. Based on a 5-year dataset surveying listed Hawaiian tree snails of similar shape and size in a forested habitat enclosure where a known number of snails were translocated into the enclosure, timed-count monitoring efforts found that during subsequent surveys for tree snails, on average only 30 percent of the

actual number of tree snails present, are detected by human observers (U.S. Army 2015, Appendix 3-1);

c. While the DON has documented only the Guam tree snail within the construction footprint at Anderson South, all three federally listed species (the Guam tree snail, humped tree snail, and the fragile tree snail) co-occur, share similar habitat, and have similar appearances in their juvenile stages; and
d. The DON has detected 38 Guam tree snail individuals within the AAFB South construction footprint; this number reflects 0.83 snails per acre. Based on this information, we expect that up to a total of 127 listed partulid snails are likely present within the 153 ac (62 ha; 0.83 snails per ac x 153 ac = 127 snails) surveyed area. A total of approximately 59 ac (24 ha) of suitable snail habitat at AAFB South was not surveyed. Based on the density of 0.83 snails per acre, calculated from the surrounding surveyed area at AAFB South, we expect that up to 49 snails occur within the unsurveyed 59 ac (24 ha) area of disturbed secondary limestone forest habitat. Therefore, we estimate a total of 176 snails (127 snails + 49 snails) occur within the AAFB South area proposed for construction and operation. While we expect that listed partulid snail density is not uniform in a habitat area, incorporating the highest density estimate to calculate the number of snails likely to be impacted provides a conservative estimate to describe the maximum amount of impact to these species as a result of construction and operation activities at AAFB South.

Effect of the Take

As described in the accompanying BO,the Service determined that this level of anticipated take is not likely to result in jeopardy to the Mariana fruit bat, Mariana eight spot butterfly, Guam tree snail, humped tree snail, or the fragile tree snail.

Reasonable and Prudent Measures

Reasonable and Prudent Measures serve to minimize the impacts of anticipated take on listed species, and to establish (through terms and conditions) the requirements for the monitoring of take levels to ensure timely reinitiation of consultation if anticipated take levels are exceeded. The Service believes the following Reasonable and Prudent Measures are necessary and appropriate to minimize and monitor the impacts of incidental take on the Mariana fruit bat, Mariana eight spot butterfly, Guam tree snail, humped tree snail, and the fragile tree snail:

1) The DON shall monitor the level of incidental take of the Mariana fruit bat, Mariana eight spot butterfly, Guam tree snail, fragile tree snail, and the humped tree snail using a habitat-based surrogate because it is not practical to detect or monitor the take of individuals that are: (1) exposed to excessive noise levels or other human disturbance; and (2) small and cryptic. The amount of habitat subject to excessive noise levels and to clearing for project construction can be monitored to ensure that these amounts are not exceeded as the proposed action is implemented. The causal link between the habitat surrogate and take of listed species was established for each of these species in the *Effects of the Action* section of the biological opinion.
2) The DON shall prioritize the enhancement and protection of high quality Mariana eight spot butterfly habitat (e.g., forest enhancement areas, Haputo ERA trail and

NWF Ungulate Control Area), including outplanting of *P. pedunculata* and *E. calcareum* host plants into these protected areas prior to or commensurate with vegetation clearing activities that remove butterfly habitat.

Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the Act, the DON must comply with the following Terms and Conditions, which implement the Reasonable and Prudent Measures, described above and specify reporting requirements. These terms and conditions are non-discretionary.

In order to implement the reasonable and prudent measures above, the following terms and conditions apply:

1) The DON shall implement the Conservation Measures in the Project Description of this BO. We reiterate this requirement here for convenience and clarity.
2) To minimize the level of incidental take of the Mariana fruit bat, Mariana eight spot butterfly, Guam tree snail, humped tree snail, and the fragile tree snail, the DON shall:
    a. Halt construction if a Mariana fruit bat is present within 492 ft (150 m) of a construction site, at any point during the construction cycle, until the bat leaves the area of its own accord.
    b. Use hooded lighting within 482 ft (150 m) of all potential Mariana fruit bat roost habitat.
    c. Provide educational materials regarding Mariana fruit bat appearance, behavior, and biology to all pertinent DON personnel so that they can correctly identify any Mariana fruit bats near or within the proposed action. If a Mariana fruit bat is sighted down range, in the line of fire, during operation of the LFTRC, all use of the range shall cease until the Mariana fruit bat has left the area of its own accord.
    d. Implement systematic searches for Mariana fruit bat maternity colonies, on a semi-annual basis, in all areas of suitable habitat within AAFB that could be affected by the proposed action including; 1) all Mariana fruit bat habitat within the 65 dB noise contour surrounding the LFTRC and AAFB shown on **Figure 13**; and 2) all Mariana fruit bat habitat that will be subject to increased noise levels from aircraft overflights. Searches shall begin one year prior to the operation of the LFTRC and one year prior to the proposed overflight increases. Surveys shall proceed on a semi-annual bases for the first five years, then conducted annually for the length of the project. If a Mariana fruit bat maternity colony is found the Service shall be notified within one week of the finding.
    e. Monitor all known Mariana fruit bat roost sites, in all areas of AAFB that could be affected by the proposed action including; 1) all Mariana fruit bat habitat within the 65 dB noise contour surrounding the LFTRC and AAFB shown on **Figure 13**; and 2) all Mariana fruit bat habitat that will be subject to increased noise levels from aircraft overflights at a minimum of once a quarter, from one year prior to and one year after the proposed overflight increases are fully

implemented and during all years in which operation of the LFTRC is active. The monitoring methodology shall, at a minimum, include direct counts of Mariana fruit bats using a spotting scope at an appropriate distance to avoid disturbance impacts to the bats.

f. Conduct a noise study at the GNWR and at Ritidian Point upon operation of the MPMG range at the LFTRC. The noise study shall occur during the first year of operation of the LFTRC. Multiple stations shall record noise levels during operation of the MPMG at the GNWR and at Ritidian Point. The monitoring stations shall be approved by the Service in coordination with the DON. Noise monitoring shall occur during day and night activities over multiple days (minimum of 10 days) at least once a quarter to address seasonal and climatic changes. Weather conditions during monitoring shall be closely recorded including temperature, humidity, and wind direction. Results of the after-action noise study, combined with Mariana fruit bat survey data, will continue to inform analyses of noise effects on Mariana fruit bats and assist in refinement of minimization measures, if needed.

g. Conduct a biological survey, involving a minimum of one-person hour, at least three days prior to construction at AAFB South, for the purpose of locating and removing listed partulid snails (Guam tree snail, humped tree snail, and fragile tree snail) within the project footprint or that would be impacted by construction activities, and translocate any listed snails to protected, suitable habitat. The DON shall work with the Service for appropriate refinement of translocation methods and selection of receiving sites.

h. Conduct a biological survey, no less than annually, for the purpose of evaluating the use of sites where host plants with life stages of the Mariana eight spot butterfly (e.g., eggs, caterpillar, and chrysalis) were relocated onto an appropriate host plant (e.g., relocate pre-diapause larvae to *Procris pedunculata* or *Elatostema calcareum*) away from the project footprint.

3) DON shall complete the NWF Ungulate Control Fence within two years of awarding the contract for construction of the portion of LFTRC that removes the existing Ritidian Ungulate Fence.
4) DON shall remove all ungulates from the NWF Ungulate Control Area within six months after completing the NWF Ungulate Fence.
5) In order to monitor the impact of incidental take, the DON shall annually report the progress of the action and its impact on the species, to the Service. A Take Monitoring Plan (Plan) for the Mariana fruit bat, Mariana eight spot butterfly, Guam tree snail, humped tree snail, and the fragile tree snail shall be prepared by the DON in close coordination with and the approval of the Service within 60 days of the date of issuance of the BO accompanying this incidental take statement. The Plan shall include a schedule for the submittal of reports detailing the extent of listed species habitat subject to excessive noise levels or clearing for construction and operation activities to ensure the limits of take exemption have not been exceeded during implementation of the proposed action.

If, during the course of the action, the extent of incidental take is exceeded or occurs for reasons other than described in the BO (above) or the project description or timing changes, such

incidental take represents new information requiring reinitiation of consultation and a new determination(s) of compliance with section 7(a)(2) of the Act. The DON must immediately provide an explanation of the causes of the taking and review with the Service the need for reinitiation of formal consultation.

In summary, the Service anticipates that, over the term of the proposed action, all Mariana fruit bats using 2,136 ac (864 ha) of suitable roosting and foraging habitat surrounding the construction and operation footprint within the action area (**Figure 13**) are likely to be subject to take in the form of harass due to their exposure to noise levels above 65 decibels caused by the proposed action. The Service anticipates that, over the construction phase of the proposed action, all Mariana eight spot butterflies of different life stages (i.e., egg cluster, caterpillar, chrysalis, and butterfly) found on identified host plants in 350 ac (142 ha) of occupied habitat within the LFTRC construction footprint are likely to be subject to take in the form of capture and re-location. The Service anticipates that, over the construction phase of the proposed action, all individuals of the Guam tree snail, humped tree snail, or the fragile tree snail on 212 ac (86 ha) of occupied or potentially occupied habitat (187 ac sureveyd + 59 ac that has not been surveyed), are likely to be subject to take in the form of capture due to capture and relocation and harm due to project clearing and construction.

The incidental take exempted under this incidental take statement will be exceeded if:

1) Effects of the action cause take of the Mariana fruit bat in the form of harm (involving actual death or injury) due to habitat modification (i.e., excessive noise levels) within the 2,136 (864 ha) acres of bat roosting and foraging habitat; or any effects of the action are likely to cause take of the bat in the form of harm or harass outside of the 2,136 ac (864 ha) acres of roosting and foraging habitat discussed above; and/or
2) Mariana eight spot butterfly host plants are found in areas outside of the 350 ac (142 ha) discussed above, and these additional areas would be impacted by the project construction to an extent likely to cause take of the butterfly; and/or
3) Listed tree snails are found in habitat outside of the 212 ac (86 ha) discussed above and subject to project construction impacts causing take in the form of harm.

Conservation Recommendations

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species, to help implement recovery plans, or to develop information. The recommendations provided relate only to the proposed action and do not necessarily represent complete fulfillment of the DON's section 7(a)(1) responsibilities for the species. In order for the Service to be kept informed of actions minimizing or avoiding adverse effects or benefiting listed species or their habitats, the Service requests notification of the implementation of any conservation recommendations.

Conservation Recommendations for the Mariana fruit bat

Our conservation recommendations for the Mariana fruit bat include (adapted from USFWS 2014, pp. 5-6):

- Ungulate monitoring and control:
    - Decrease habitat loss by eradicating feral ungulates on islands where ungulates exist, and prevent their introduction on other islands where Mariana fruit bat recovery is desired.
    - Decrease habitat loss by controlling feral deer in areas of high-quality Mariana fruit bat habitat.
- Habitat and natural process management and restoration:
    - Improve habitat through support of native forest restoration, especially on Guam, Saipan, and Tinian.
    - Set aside enough high-quality habitat areas, including in-perpetuity protection of conservation areas that support the recovery of Mariana fruit bat populations on three of the five southern islands.
- Human interaction monitoring and management:
    - Limit military training in areas occupied by Mariana fruit bats to activities that will not disturb Mariana fruit bats or their habitat.
    - Limit urban development in areas occupied by or potentially used for roosting and foraging by Mariana fruit bats.
- Continue and increase efforts to prevent introduction of BTS on other Mariana Islands.
- Predator / herbivore monitoring and control:
    - Develop and implement large-scale, long-term methods for BTS control that will reduce the BTS population on a landscape level on Guam.

Conservation Recommendations for the Mariana eight spot butterfly

Future conservation actions needed for the Mariana eight spot butterfly are listed below. The following actions reflect findings presented in Lindstrom and Benedict (2014, pp. 34-35), Moore (2014, pp. B21-21), and Rubinoff (2016, p.4):

- Develop and implement standardized surveys for the Mariana eight spot butterfly within suitable habitat across Guam.
    - Survey results and location information should be kept current and compiled (i.e., stored in an electronic database) and available to our conservation partners.
- Eradicate or control feral ungulates to allow Mariana eight spot butterfly host plants to expand their range onto less rugged karst, consequently increasing their availability to the butterfly.
- Determine seasonal habitat use, movement, and population dynamics of the butterfly.
    - Identify nectar plants for adult Mariana eight spot butterflies.
- Research the basis for host plant use and possible oviposition preferences of female Mariana eight spot butterflies.
- Augment existing subpopulations or populations of the Mariana eight spot butterfly, provided that studies or data indicate such augmentation is likely to be effective. Augmentation should be conducted under a plan that fully considers the principles of metapopulation and conservation biology principles.

- Reintroduce captive-reared Mariana eight spot butterflies within suitable, but currently unoccupied, habitat to bolster the function and viability of the metapopulation. Female Mariana eight spot butterflies would be collected from an existing local population(s) and allowed to oviposition in captivity. The larvae would then be reared in captivity, and larvae or pupae would be returned back into the wild at new, protected sites.
- Designate Mariana eight spot butterfly reserves or conservation areas that provide host and nectar plants within contiguous habitat at spatial scales that reflect the metapopulation behavior of the overall Mariana eight spot butterfly population.
- Propagate host plants in a nursery and out-plant host plants in protected areas.
    - Conduct research to determine optimal conditions for out-planted host plants and to determine ideal location of out-plantings that increases the likelihood of butterfly use and occupancy.
- Remove invasive vines that are encroaching on Mariana eight spot butterfly host plants.
- Develop standard operating procedures for the proper collection and relocation of eggs and larvae that may be at risk due to projects, including potential future development.
- Develop and initiate an effective public education and outreach focused on the conservation of the Mariana eight spot butterfly.

Conservation Recommendations for B. guamense, D. guamense, and T. guamense

Future management actions which would benefit *B. guamense D. guamense, and T. guamense* include:

- Ungulate control throughout *B. guamense, D. guamense, and T. guamense* range would contribute to the protection of the species and habitat.
- Monitoring the status of *B. guamense, D. guamense, and T. guamense* to determine rate of population change and determine population threshold that triggers additional conservation action
- Determine life history and habitat preferences, including conditions that support healthier and more reproductively viable individuals.
- Identify areas that if protected, could provide additional habitat for the conservation of *B. guamense, D. guamense, and T. guamense*.
- Determine the best methods in augmenting populations and relocating and/or reintroducing *B. guamense, D. guamense, and T. guamense* into protected areas within its historic range.

Conservation Recommendations for Cycas micronesica

Recommended management actions to help recover the species include:

- Conduct bio-control trials to control damage by insect pests such as the native beetle *D. marianarum* and the invasive *A. yasumatsui*
- Protection from predation and damage by invasive ungulates by use of fencing and population control measures
- Prevention of new invasive pest species which may further threaten the status of *C. micronesica*
- Protection of existing habitat, primarily existing limestone forest

Conservation Recommendations for Heritiera longipetiolata

The following recommendations (adapted from DAWR 2006, p. 120) include future management actions to help recover *H. longipetiolata*. This includes:

- Collect seeds from fruiting trees and develop a nursery of seedlings for outplanting in protected areas throughout its range.
- Outplant or relocate wild seedlings/saplings to increase the species distribution.
- The eradication of ungulates from current and potential habitat will serve both to enhance conditions for populations already present, and contribute to promoting additional habitat that may become occupied naturally or via outplanting.
- Install enclosures around trees to protect seeds and seedlings from ungulate.

Conservation Recommendations for Tabernaemontana rotensis

The following are recommended conservation actions that would assist in reaching recovery of *T. rotensis*:

- Continue monitoring and survey efforts for *T. rotensis*. Information about the health and reproductive status of individuals will create a more complete understanding of the species on these islands and will inform conservation actions to protect the species.
- Collect seeds from fruiting trees and develop a nursery of seedlings for outplanting in protected areas throughout its range.
    - *Tabernaemontana rotensis* responds to typhoons with a synchronized flowering pulse (UOG 2007, p. 6). Conservation efforts should ensure harvest of the mast seeding that occurs about four months after the passage of a typhoon (UOG 2007, pp. 22, 29).
- Outplant or relocate wild seedlings to increase their distribution.
    - *Tabernaemontana rotensis* seedlings typically occur in a cluster near the parent tree. The seedlings compete with one another for light and other resources, and not all seedlings survive. Resource managers would benefit from transplanting some of these seedlings prior to their death (UOG 2007, p. 22). This approach also would thin out crowded seedlings and possibly ensure more of them remain alive (UOG 2007, p. 23).
- The eradication of ungulates from current and potential habitat will serve both to enhance conditions for populations already present, and contribute to promoting additional habitat that may become occupied naturally or via outplanting.
- Prevent establishment of introduced invasive species (*e.g.*, insect pests).
- Install enclosures around trees to protect seeds and seedlings from ungulate.

Reinitiation – Closing Statement

This concludes the Service's formal consultation on the action outlined in the DON's formal consultation request. As provided in 50 CFR § 402.16, reinitiation of formal consultation is required and shall be requested by the Federal agency or by the Service, where discretionary Federal involvement or control over the action has been retained or is authorized by law and: (1) If the amount or extent of incidental take is exceeded; (2) If new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered; (4) If the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in the biological

opinion; or (5) If a new species is listed or critical habitat designated that may be affected by the identified action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease immediately pending reinitiation.

Thank you for your ongoing efforts to conserve listed species. If you have questions, please contact Jacqueline Flores, Mariana Islands Team Manager, at (671) 989-6744 or via email at jacqueline_flores@fws.gov or Darren LeBlanc, Planning and Consultation Team Manager, at (808) 792-9403 or via email at darren_leblanc@fws.gov . In future communications with us regarding this project, please refer to this project by these reference numbers, 01EPIF00-2015-F-0025 and 01EPIF00-2016-F-0185.

Sincerely,

Mary Abrams
Field Supervisor
Pacific Islands Fish and Wildlife Office

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Appendix A - List of Acronyms

AAFB	Andersen Air Force Base
ac	acre
ACE	Air Combat Element
ADNL	Average Daily Noise Level
APHIS	Animal Plant Health Inspection Service
BA	Biological Assessment
BEQ	Bachelor Enlisted Quarters
BMPs	Best Management Practices
BO	Biological Opinion
BOQ	Bachelor Officer Quarters
BTS	Brown Tree Snake
CATM	Combat Arms Training and Maintenance
CM	Conservation Measures
cm	centimeters
CNMI	Commonwealth of the Northern Marianas
DAWR	Division of Aquatic and Wildlife Resources
dB	decibel
dBc	decibels relative to the carrier
DFW	Division of Fish and Wildlife
DNL	Day-Night Average Sound Level
DoD	Department of Defense
DON	Department of the Navy
EI&E	Energy, Installations and Environment
ERA	Ecological Reserve Area
ESS	Explosive Safety Standard
FDM	Farallon de Medinilla
ft	foot
GEPA	Guam Environmental Protection Agency
GMK	Guam Micronesian Kingfisher
GNWR	Guam National Wildlife Refuge
GPEPP	Guam Plant Extinction Prevention Program
GPS	Global Positioning System
GRN	Guam Road Network
GWA	Guam Waterworks Authority
ha	hectare
HACCP	Hazard Analysis Critical Control Point
HG	Hand Grenade
HMU	Habitat Management Unit
HVT	High Value Trees

INRMP	Integrated Natural Resources Management Plan
ISR Strike	Intelligence Surveillance Reconnaissance Stirke
IUCN	International Union for the Conservation of Nature
JGPO	Joint Guam Program Office
JRM	Joint Region Marianas
KD	Known Distance
kHz	Kilohertz
km	kilometer
kV	kilovolt
LFTRC	Live Fire Training Range Complex
m	meter
m^3	cubic meter
MA,NLAA	May affect, not likely to adversely affect
MCAG	Marine Corps Activity Guam
MCB Hawaii	Marine Corps Base
MEC	Munitions and Explosives of Concern
MGd	million gallons per day
mi	mile
MITT	Mariana Islands Training and Testing
mm	millimeter
MOA	Memorandum of Agreement
MPMG	Multipurpose Machine Gun
MRF	Modified Record of Fire
MSA	Munitions Storage Area
MW	Megawatt
NCN	No Common Name
NAVFAC	Naval Facilities
NBG	Naval Base Guam
NGLA	Northern Guam Lens Aquifer
NMS	Naval Munitions Site
NSSA	Non-Standard Small Arms
NWD	No Wildlife Disturbance
NWF	Northwest Field
OASN	Office of the Assistant Secretary of the Navy
PBF	Physical or biological features
PCE	Primary Constituent Elements
PIFWO	Pacific Islands Fish and Wildlife Office
PSS	Public School Systems
RBP	Regional Biosecurity Plan
RFMP	Range Fire Management Plan

RSS	Range Safety Specialist
SDZ	Surface Danger Zone
SOP	Standard Operating Procedure
U&SI	Utilities and Site Improvements
UN	United Nations
UOG	University of Guam
USAF	United States Air Force
USCG	United States Coast Guard
USDA	United States Department of Agriculture
USFWS	United States Fish and Wildlife Service
USMC	United States Marine Corps
UXO	Unexploded Ordnance
VCO	Volunteer Conservation Officer
WWTP	Wastewater Treatment Plant
yd	Yard
yd^3	Cubic yard

Appendix B – Informal consultation for the Department of the Navy's Marine Corps Relocation from Okinawato Guam Affects to *Maesa walkeri*, *Nervilia jacksoniae*, and *Eugenia bryanii*.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Pacific Islands Fish and Wildlife Office
300 Ala Moana Boulevard, Room 3-122
Honolulu, Hawaii 96850

In Reply Refer To:
01EPIF00-2015-F-0025
01EPIF00-2016-F-0185

Commander Jeffrey S. Powell
Director, Pacific Programs Office
Office of the Assistant Secretary of the Navy (OASN)
Energy, Installations and Environment (EI&E)
1000 Navy Pentagon
Washington, DC 20350-1000

Dear Commander Powell:

The U.S. Fish and Wildlife Service (Service) received your request on May 18, 2017, requesting our concurrence with your determination that the Marine Corps relocation from Okinawa to Guam, including the construction of the Live Fire Training Range Complex (LFTRC), the Marine Cantonment, and use of lands within the Naval Munitions Site (collectively known as Project) may affect, but is not likely to adversely affect three newly listed plant species pursuant to section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C 1531 et seq.). This consultation addresses the impact of the project on the federally threatened plants *Maesa walkeri* and *Eugenia bryanii*, and the federally endangered plant *Nervilia jacksoniae*.

The DON's proposed Project includes the relocation of 5,000 USMC personnel and 1,300 dependents from Okinawa to Guam. To support this relocation effort, the DON plans to construct and operate a main cantonment area, including family housing; construct and operate an LFTRC; and conduct training activities on Guam. Project activities will occur on land administered by the Department of Defense and the Government of Guam (for road and bridge work). This consultation addresses actions that will take place within the Northwest Field (NW Field) for the construction of the LFTRC and within the Naval Munitions Site (NMS), in both the Northern Land Navigation Area and the Southern Land Navigation Areas. For a complete description of the Project, along with maps of the action area, please see the Description of the Proposed Action section of the accompanying 2017 USMC Relocation BO.

Maesa walkeri (no common name) is a shrub in the primrose family (Primulaceae) found only in the Mariana Islands within the forest ecosystem (USFWS, 2015). At the time of listing, *M.*

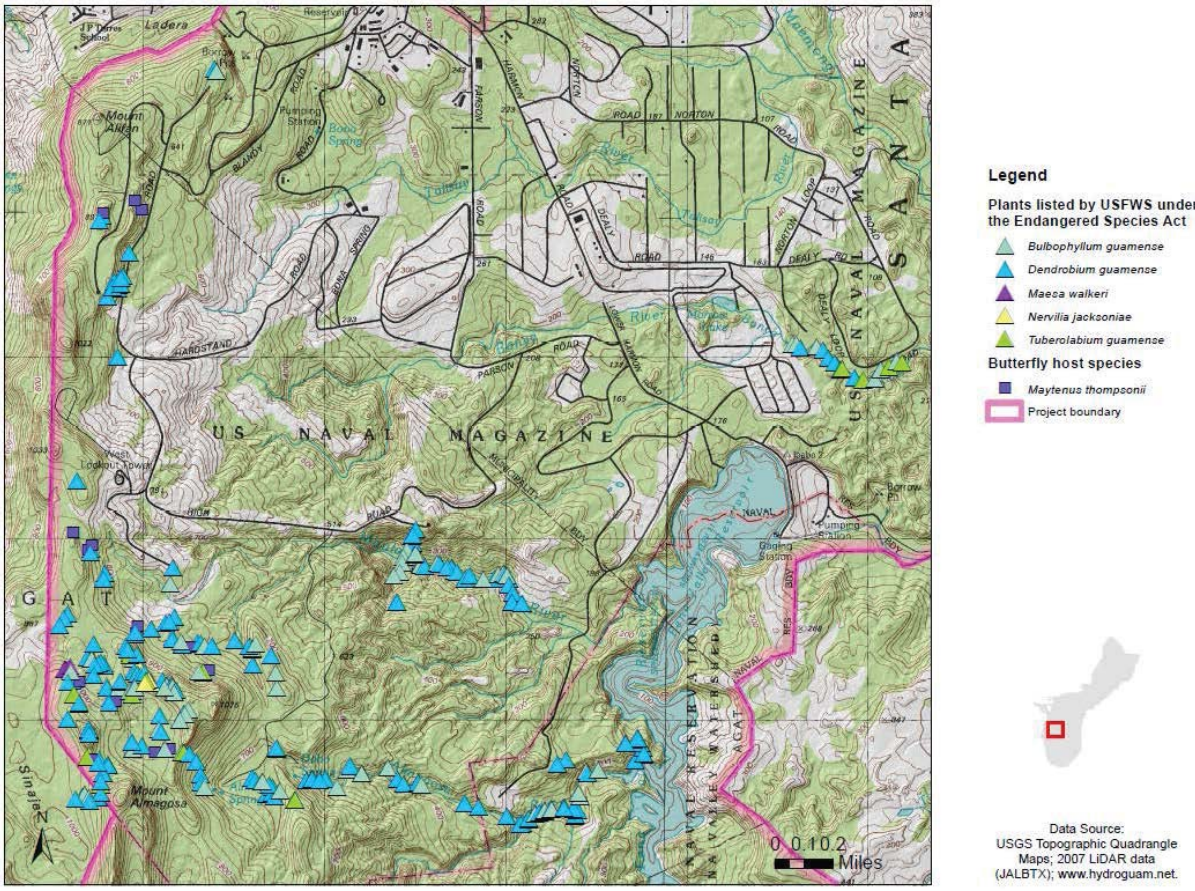
walkeri was known from five occurrences on Guam and Rota, totaling at least 686 individuals. On Rota, there are 684 individuals spread out across the Sabana with a population structure consisting of seedlings, juveniles, and adults (USFWS, 2015) and only two individuals were known on Guam. Subsequent surveys on Mt. Lamlam discovered 45 individuals (GPEPP, 2015). Recent surveys in the Naval Munitions have discovered a total of seven mature adults, but no recruitment was noted (JRM, 2016). **Figure 1** shows the known distribution of *M. walkeri* within the NMS.

Nervilia jacksoniae (no common name) is a small herb in the orchid family (Orchidaceae), and is found only in the Mariana Islands. It typically grows in shady areas from a small subterranean tuber. It remains dormant for a portion of the dry season. Flowers open in June or July and only remain open for a short period. The seed capsule takes a month to mature. Leaves are small (about 5 x 3 centimeters), kidney-shaped, and emerge as the seed capsule is developing (Raulerson and Rinehart, 1992). Threats to *N. jacksoniae* include habitat loss and destruction from development as well as damage due to ungulates (wallows, digging, and browsing) as well as predation from invasive slugs, and damage from fire events. At the time of listing, it was known from two occurrences totaling fewer than 200 individuals on Guam and 13 occurrences of 320 individuals on Rota (USFWS, 2015). Recent surveys on NMS have discovered 204 mature individuals within the river valleys (JRM, 2016). Surveys of the limestone forest in the NMS to determine the full extent of the species have not been completed. **Figure 1** shows the known distribution of *N. jacksoniae* within the NMS.

Eugenia bryanii (no common name) is a small perennial shrub in the Myrtle family (Myrtaceae), and is known only from Guam. *E. byranii* is a multi-stemmed shrub with small elliptical leaves. Flowers are short with four white petals and numerous stamens. Fruits are round and bright red, with edible pulp surrounding one or two seeds (Raulerson and Rinehart, 1991). *Eugenia bryanii* primarily occurs on limestone clifflines along the west and east coasts of Guam (Raulerson and Rinehart, 1991). At the time of listing only five occurrences were known with approximately 420 individuals (USFWS, 2015). Surveys by DOD have since discovered large numbers of individuals along the cliffline at Ritidian Point. Approximately 2,000 individuals were discovered within the ungulate fenced area along the cliffline (JRM, 2016). Threats to *E. bryanii* include habitat loss and destruction from development as well as damage due to ungulates (browsing) as well as predation from invasive slugs, and damage from fire events. **Figure 2** shows the distribution of *E. bryanii* within the proposed LFTRC lands on the island of Guam.

Maesa walkeri and *N. jacksoniae* populations occur within the NMS. Potential physical disturbance includes trampling by soldiers or vehicles, destruction by the creation of roads and trails, or placement of bivouacs. DON will ensure that military training units work in close coordination with Joint Region Mariana's Mariana Island Range Complex (MIRC) to clearly define authorized training restrictions, and where appropriate, designate No Wildlife Disturbance (NWD) areas or other designations to prohibit training in sensitive areas. DON will work closely with DON Biologists to identify new NWD areas, consistent with USMC combat readiness and training requirements. Proper designation of NWD areas will ensure that bivouacs do not cause additional disturbance to endangered species (USFWS, 2017).

Figure 1: Locations of M. walkeri and N. jacksoniae within the NMS (JRM, 2016)

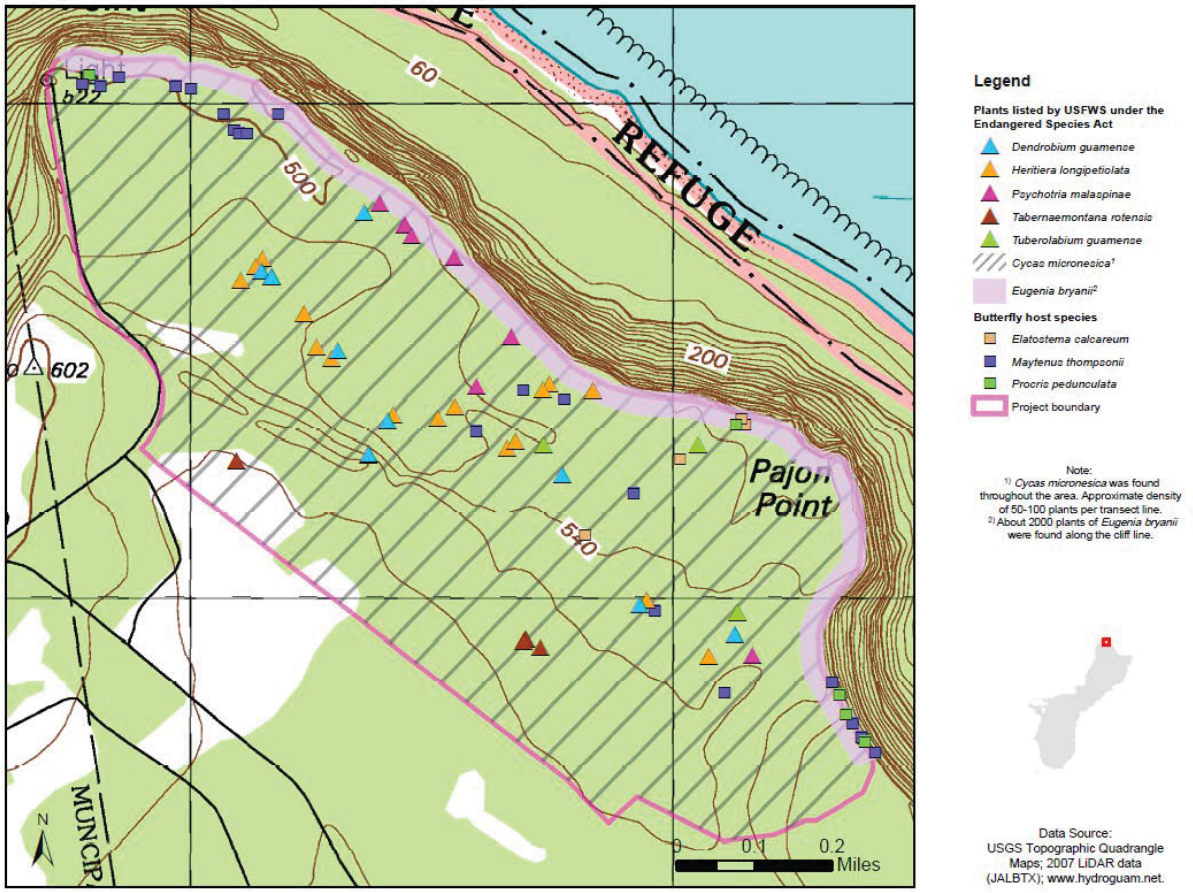


Eugenia bryanii occurs along the cliffline at the northernmost edge of the LFTRC complex footprint. As all individuals occur within 50 meters of the cliffline no direct loss is expected from the construction of the LFTRC. One individual plant occurs within the footprint of the LFTRC, but occurs over the cliff edge and is not expected to be affected by construction (DON, 2017). Habitat fragmentation is expected to be minimal. The primary benefit to the species will be the removal and restriction of ungulates from the area to relieve browsing pressure (DON, 2017). Specific measures to enhance the conservation of *E. bryanii* are listed in the DON BA (2017). These measures include prioritization of fire suppression activities in areas known to contain ESA-listed species; creation of an ungulate management fence and removal of ungulates; as well as translocation and propagation of individuals. These conservation measures are expected to provide a beneficial effect by primarily removing ungulate herbivory as a constraint to recovery.

Based on the information and analysis above, we agree with your determination that the proposed projects effects to the three listed plant species would not exceed insignificant or discountable levels. Therefore, we concur with your determination that the proposed project may affect, but is not likely to adversely affect the three listed plant species *E. bryani, M. walkeri* and *N. jacksoniae* pursuant to section 7 of the ESA. Our basis for this conclusion is that the DON will implement the proposed actions and conservation measures specified in the accompanying 2017 USMC Relocation BO, and herein. Actions other than those specified in the Marine

Relocation BO and in this informal consultation have the potential to result in harm to listed species and therefore may require reinitiation of section 7 consultation. In addition, if new information reveals that the proposed project may affect listed species in a manner or to an extent not considered, or a new species or critical habitat is designated that may be affected by the proposed action, reinitiation of consultation pursuant to section 7 of the ESA may be necessary.

Figure 2: Distribution of E. bryanii along the cliffline within NW Field (DON, 2017).



Thank you for your ongoing efforts to conserve listed species. If you have questions, please contact Jacqueline Flores, Mariana Islands Team Manager (phone: (671) 989-6744, email: jacqueline_flores@fws.gov). In future communications with us regarding this project, please refer to this project by these reference numbers, 01EPIF00-2015-F-0025 and 01EPIF00-2016-F-0185.

Sincerely,

MARY ABRAMS

Digitally signed by MARY ABRAMS
Date: 2017.07.19 06:57:49 -10'00'

Mary Abrams
Field Supervisor
Pacific Islands Fish and Wildlife Office

REFERENCES

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APPENDIX C **- Figures**

APPENDIX D - Figures

Figure 1. Map overview of the proposed action's project components and their location within the action area for the BO, which is the entire Island of Guam. The project construction footprint and all earthmoving activities are shown in blue.

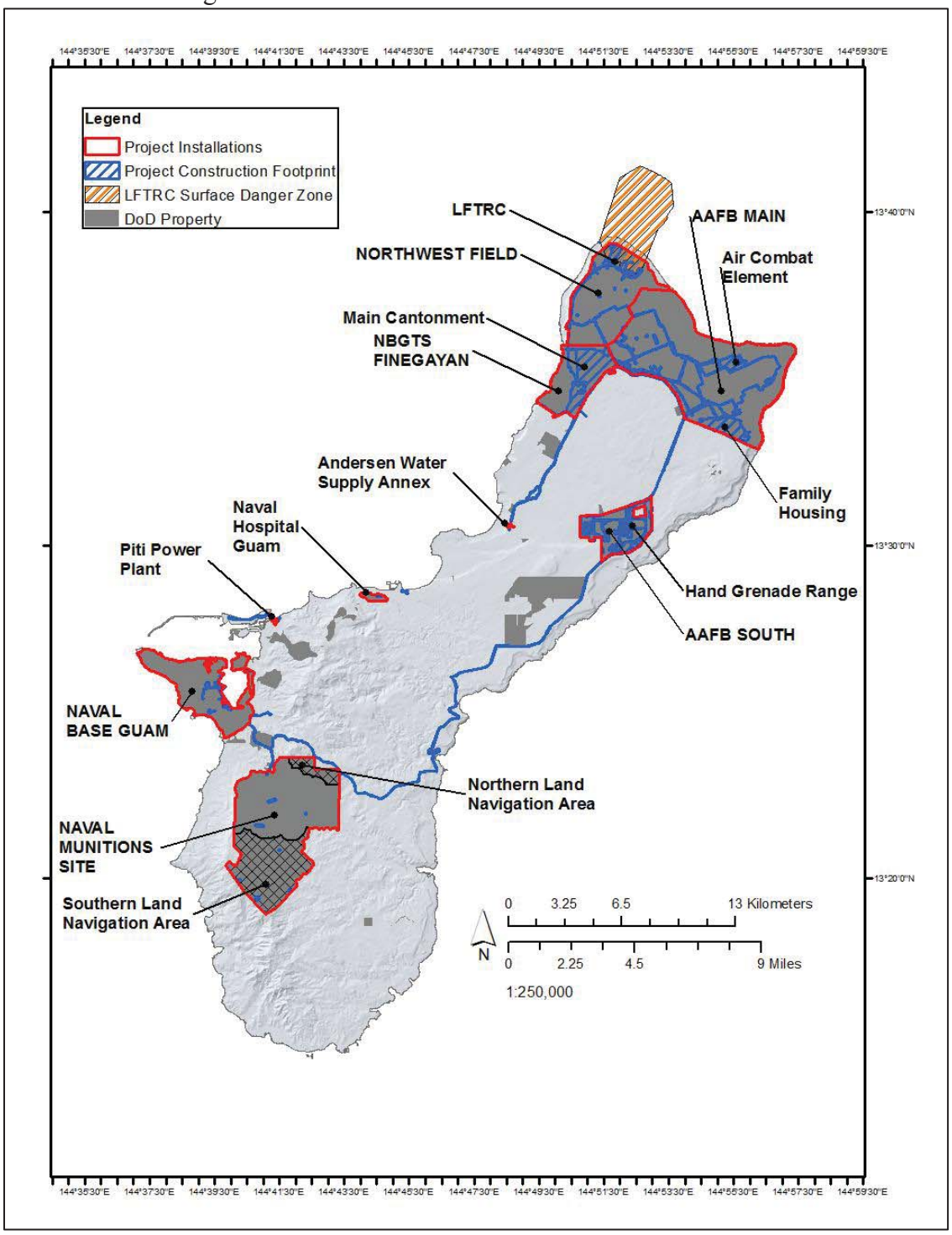


Figure 2. Areas for Utility and Site Improvements (U&SI) include all project areas where clearing, grading, or other earthwork would occur. (Adapted from DON 2015b, p. 2-91)

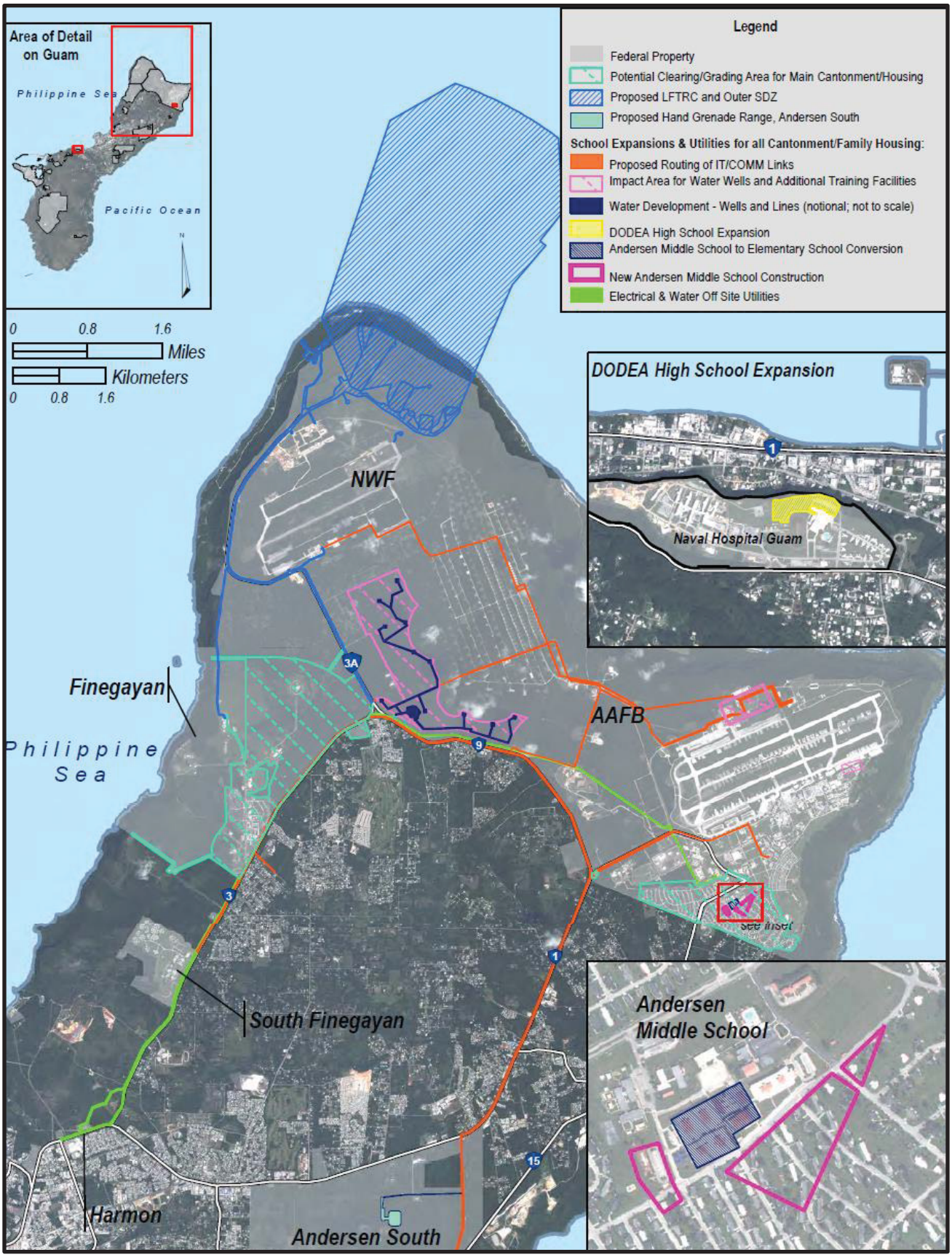


Figure 3. Proposed Live Fire Training Range Complex at Andersen Air Force Base, Northwest Field overlaid with current vegetation classes provided by the DON (DON 2017a).

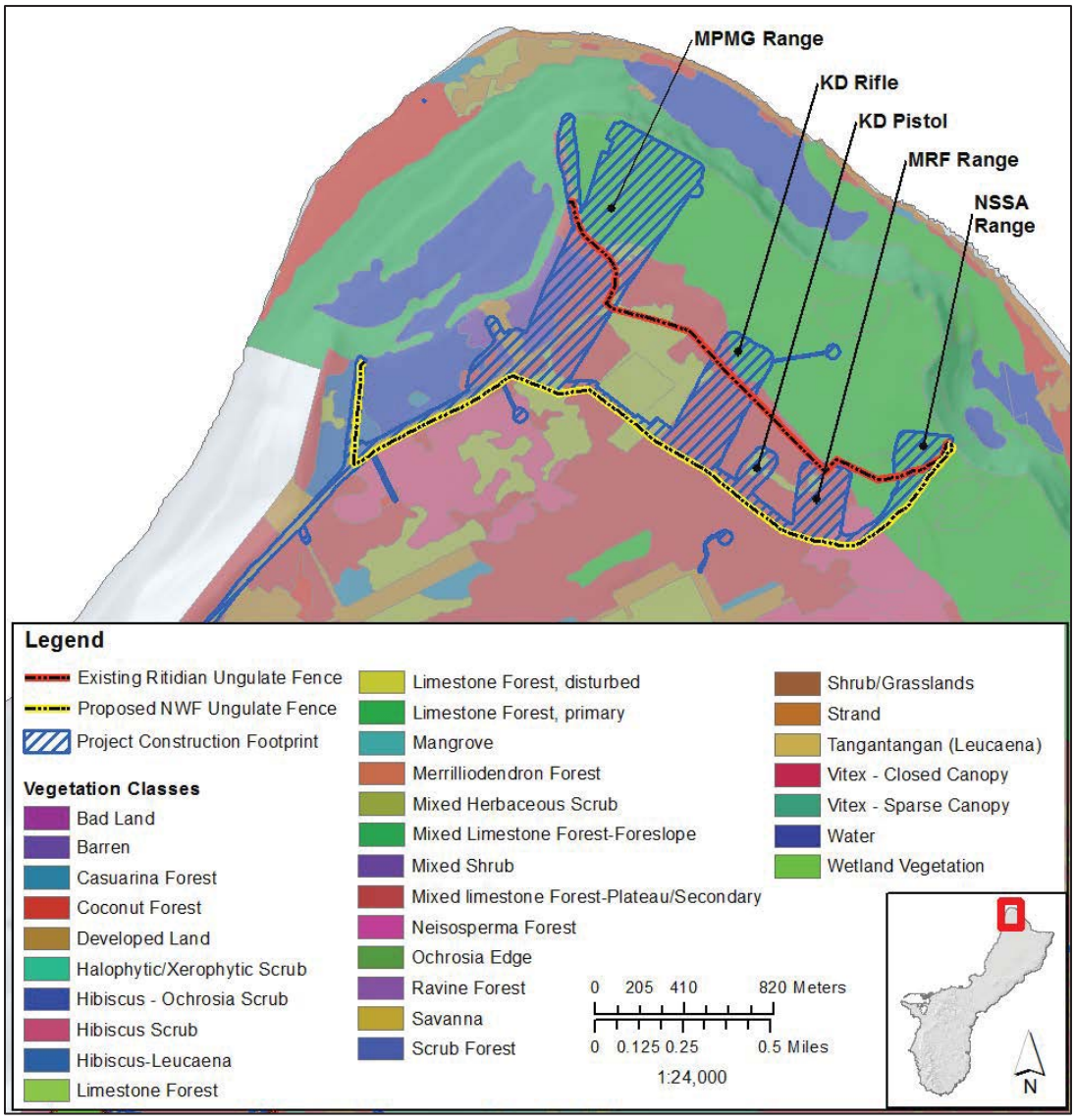


Figure 4. Surface Danger Zone (SDZ) within the Northwest Field and Guam National Wildlife Refuge.

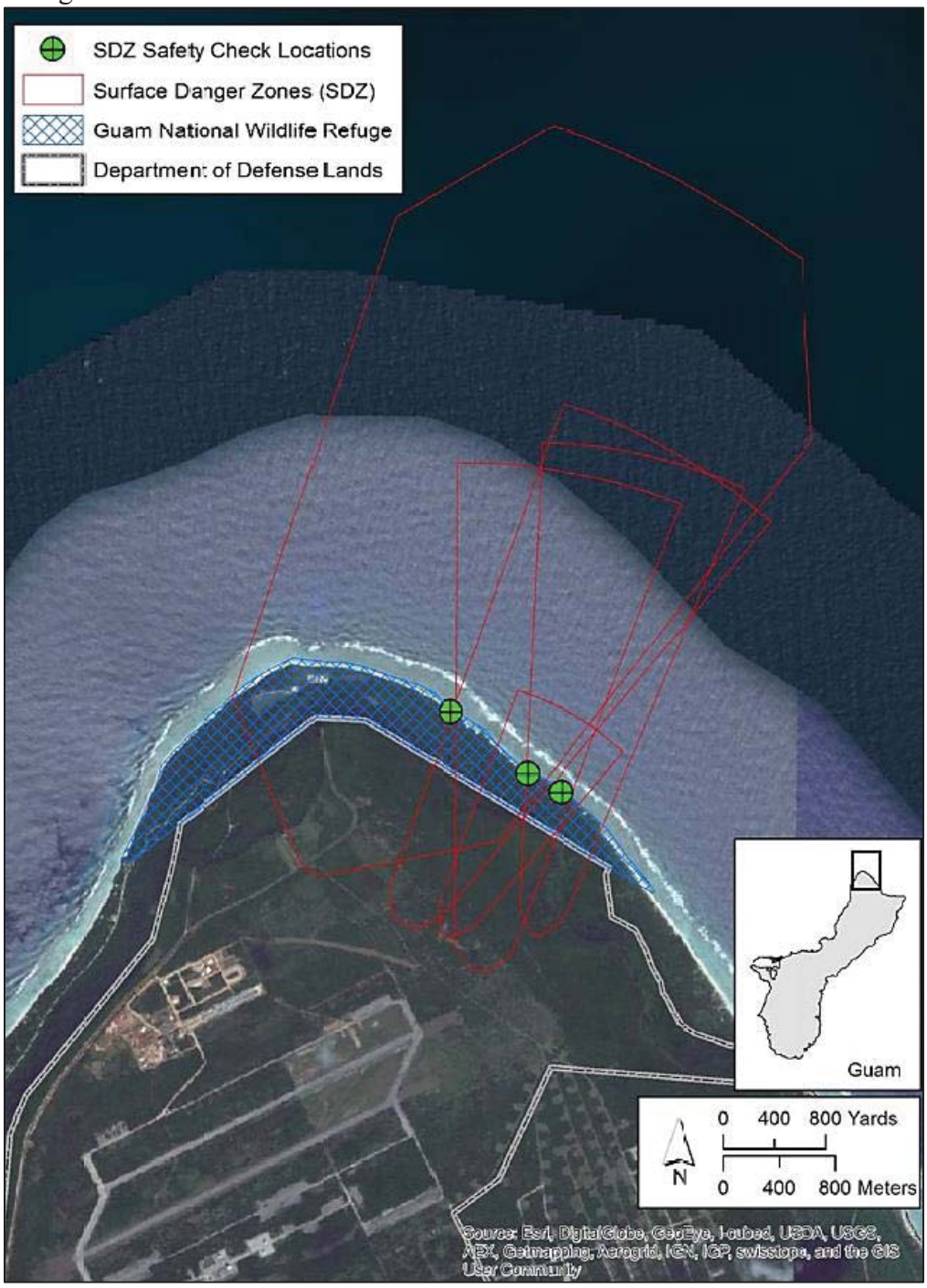


Figure 5. Map of the proposed action's conservation measures designed to benefit listed species.

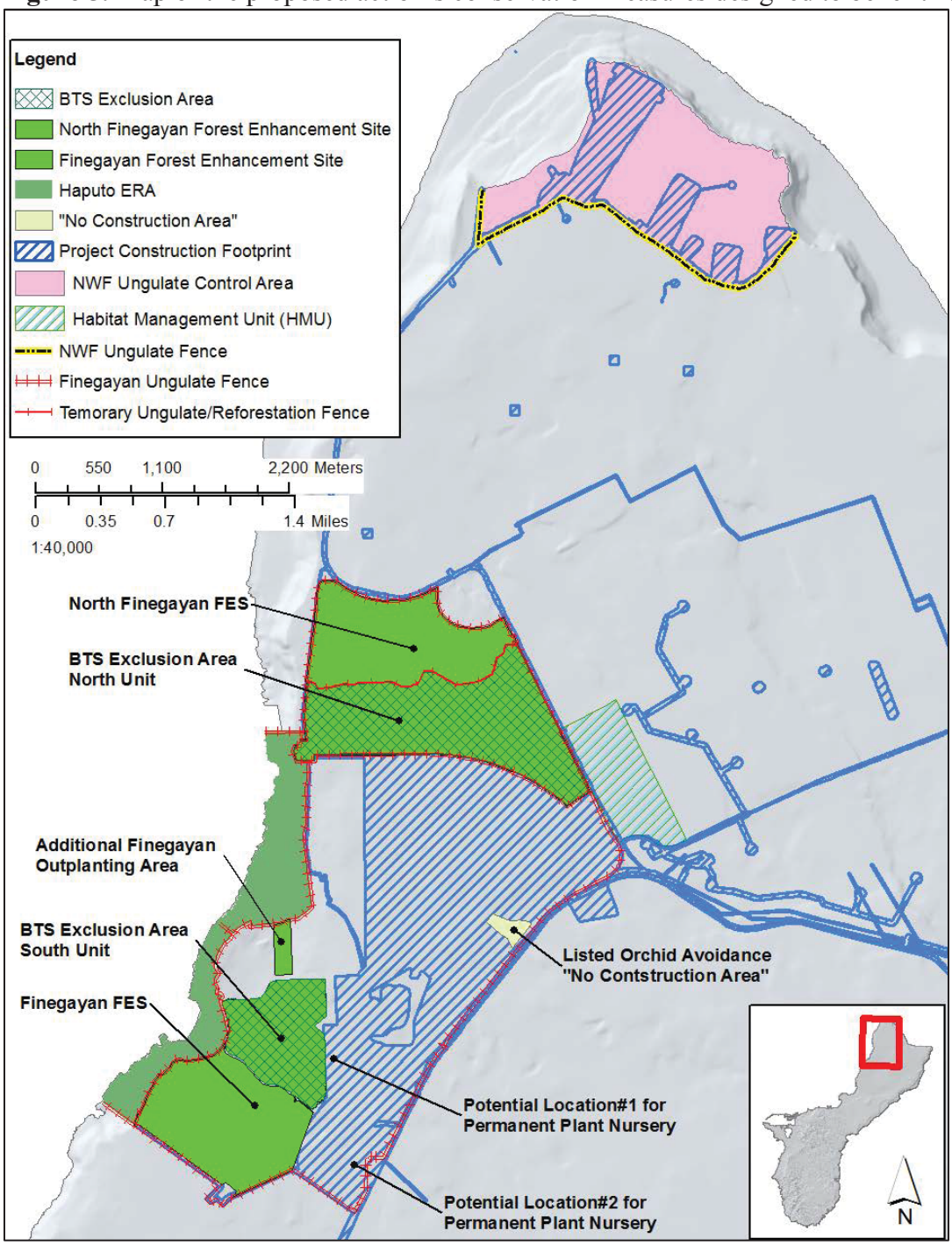


Figure 6. The Mariana fruit bat is found on all 15 islands within the Mariana Archipelago, except for Uracas Island.

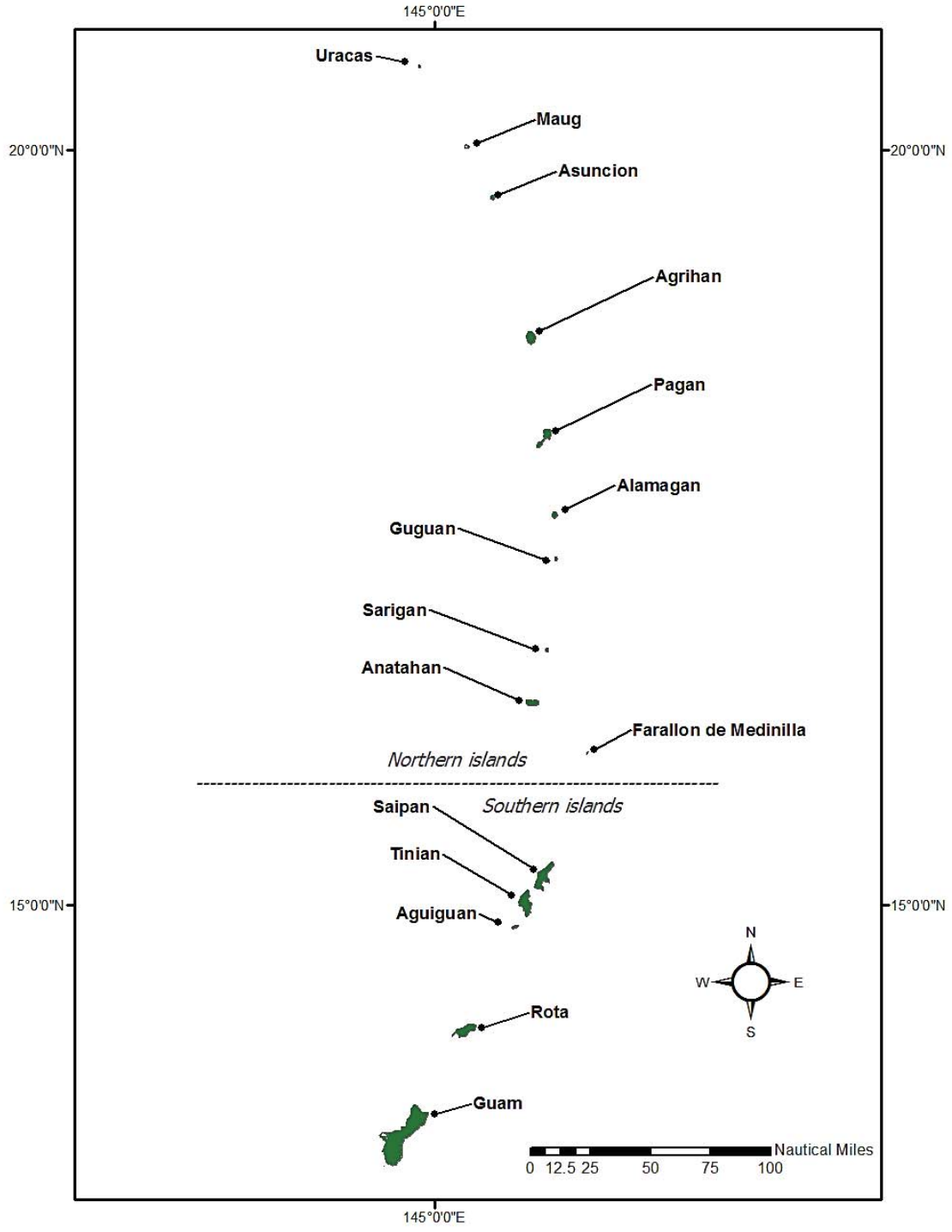


Figure 7. Mariana fruit bat detections and habitat within the action area.

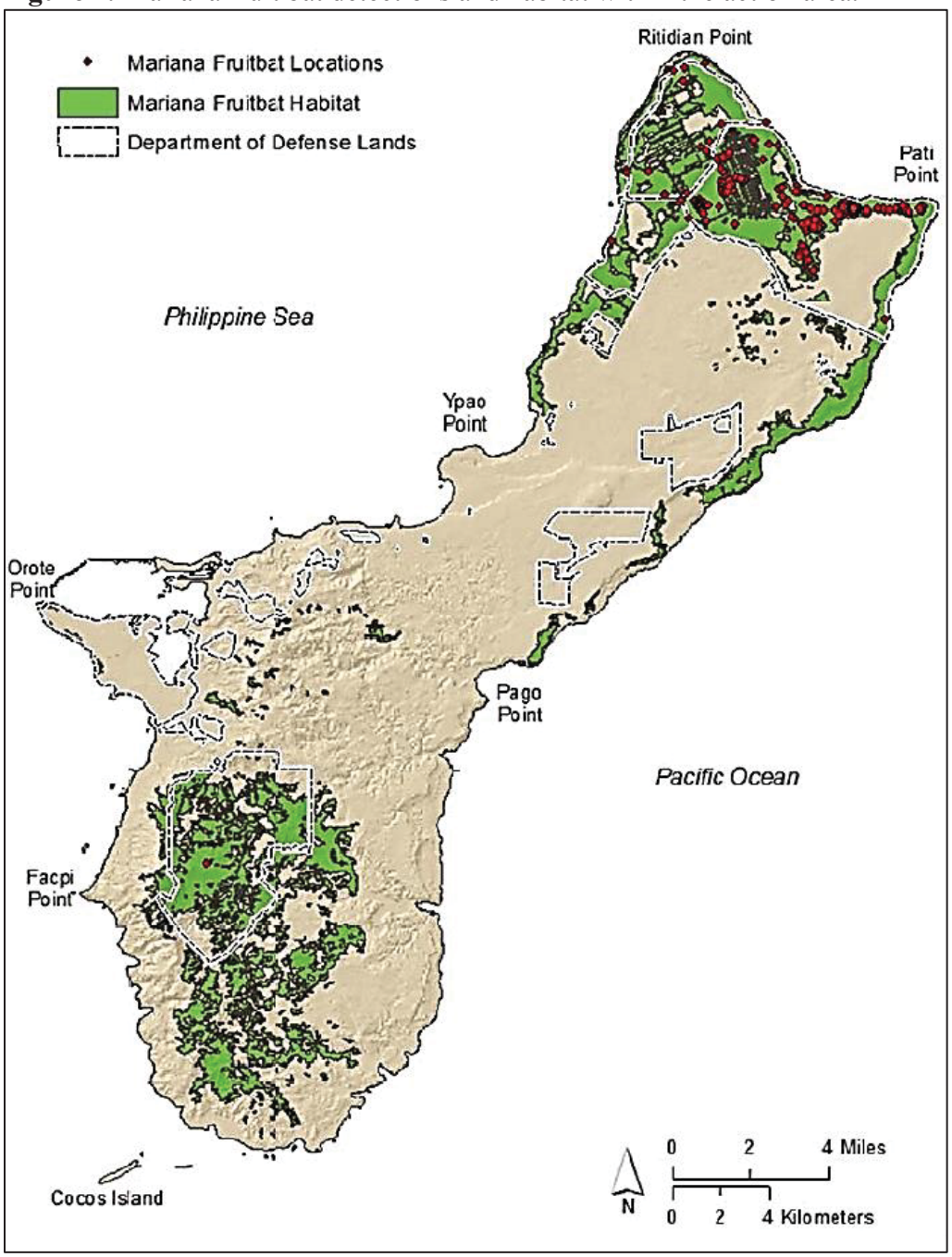


Figure 9. Map of all locations where Mariana eight spot butterflies were documented within the action area.

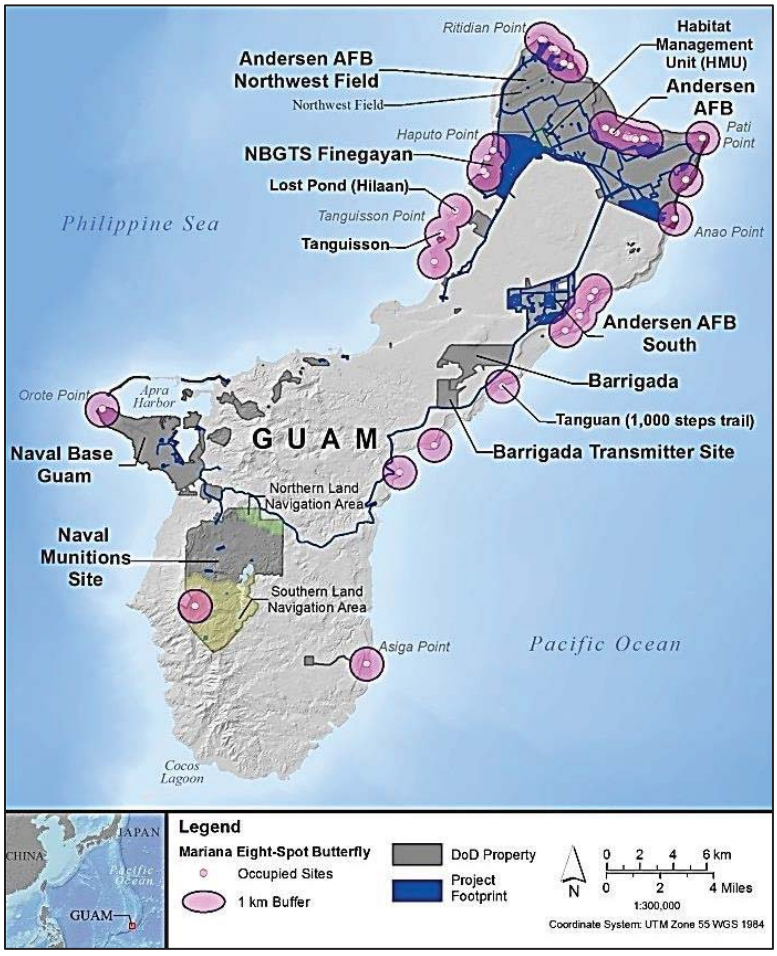


Figure 60. Documented occurrences of *Partula radiolata* within the project footprint of Andersen Air Force Base, South.

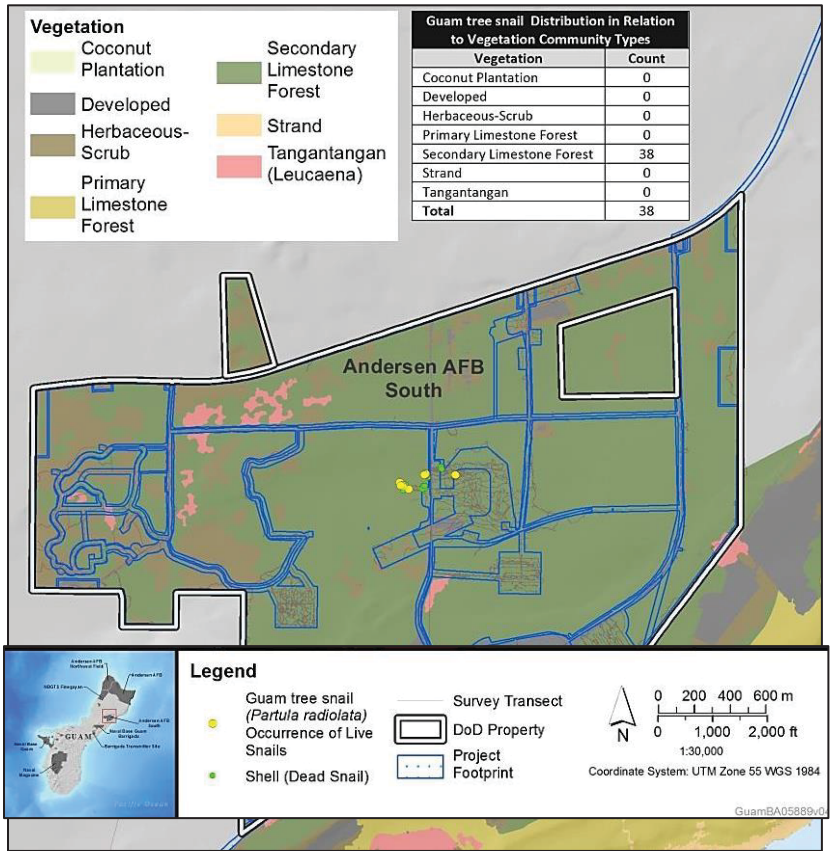


Figure 71. Map of all known *Bulbophyllum guamense* individuals or occurrences within the action area.

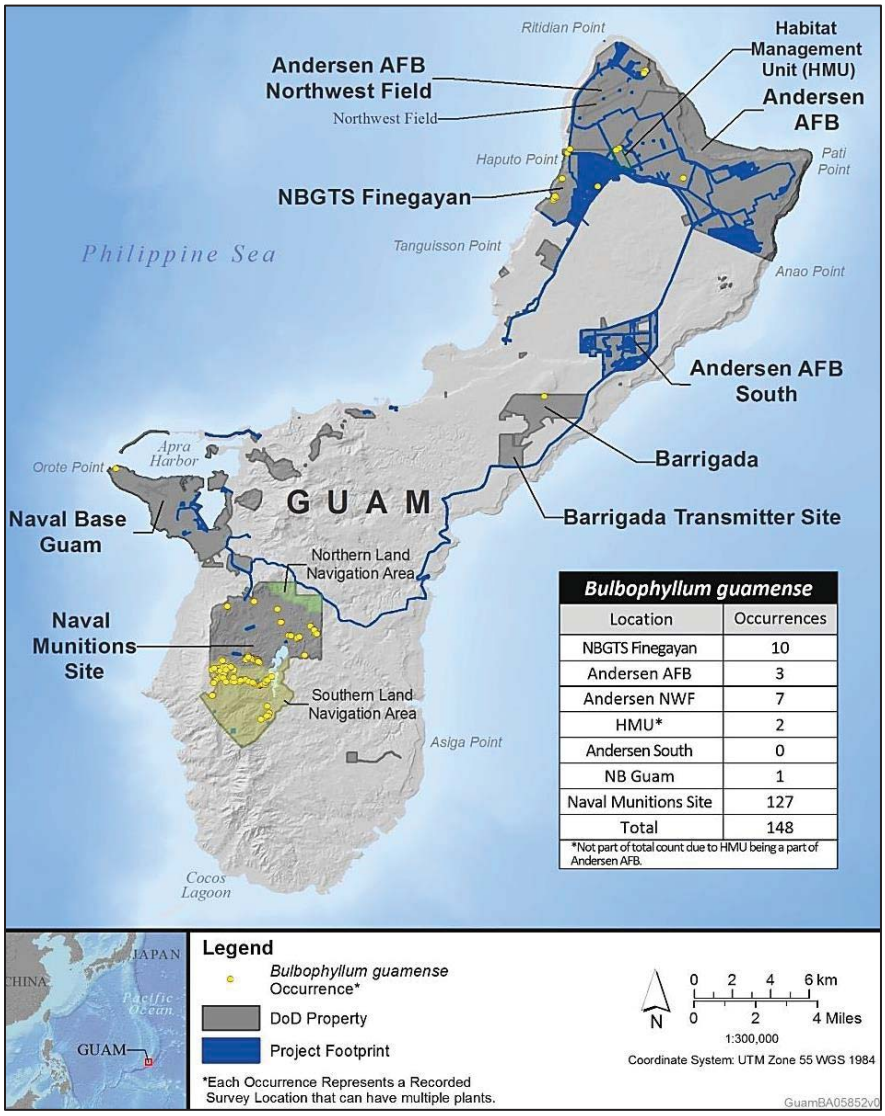


Figure 82. Map of all known *Dendrobium guamense* individuals or occurrences within the action area.

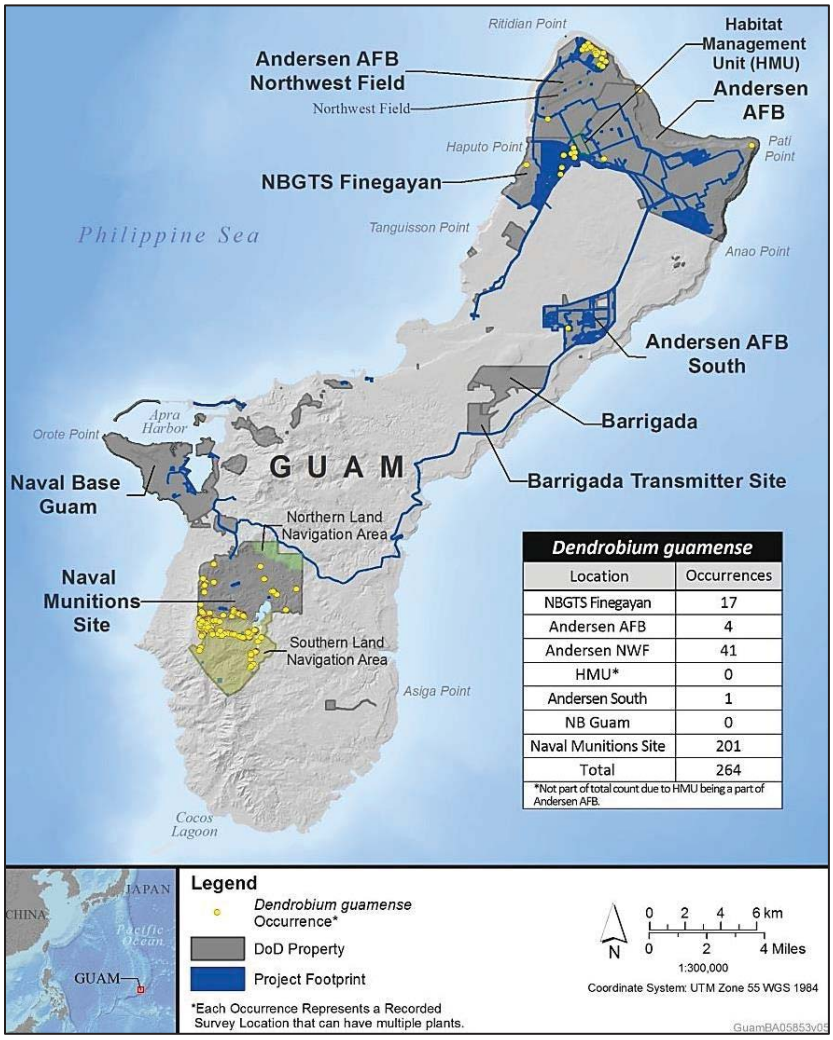


Figure 13. Map of all known *Tuberolabium guamense* individuals or occurrences within the action area.

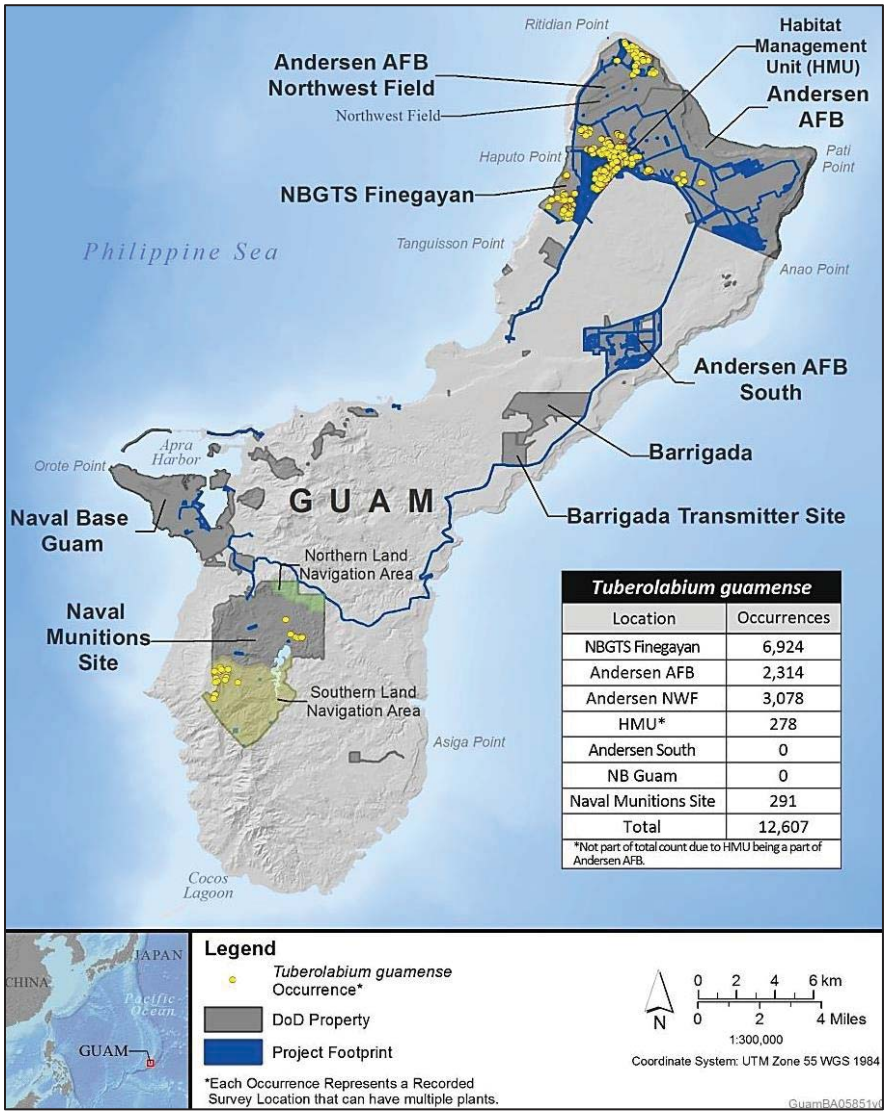


Figure 94. Map of all known *Cycas micronesica* individuals within the action area.

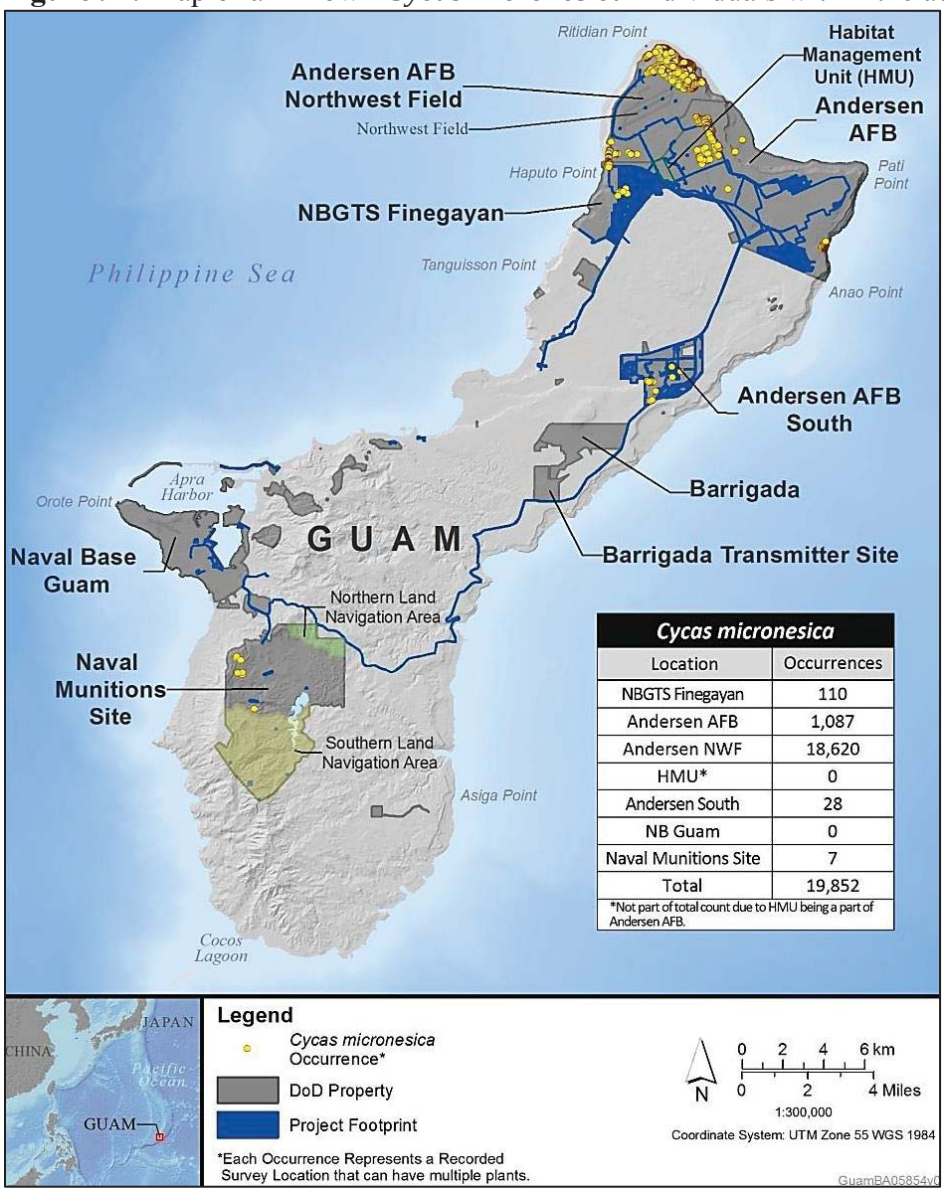


Figure 105. Map of all known *Heritiera longipetiolata* individuals within the action area.

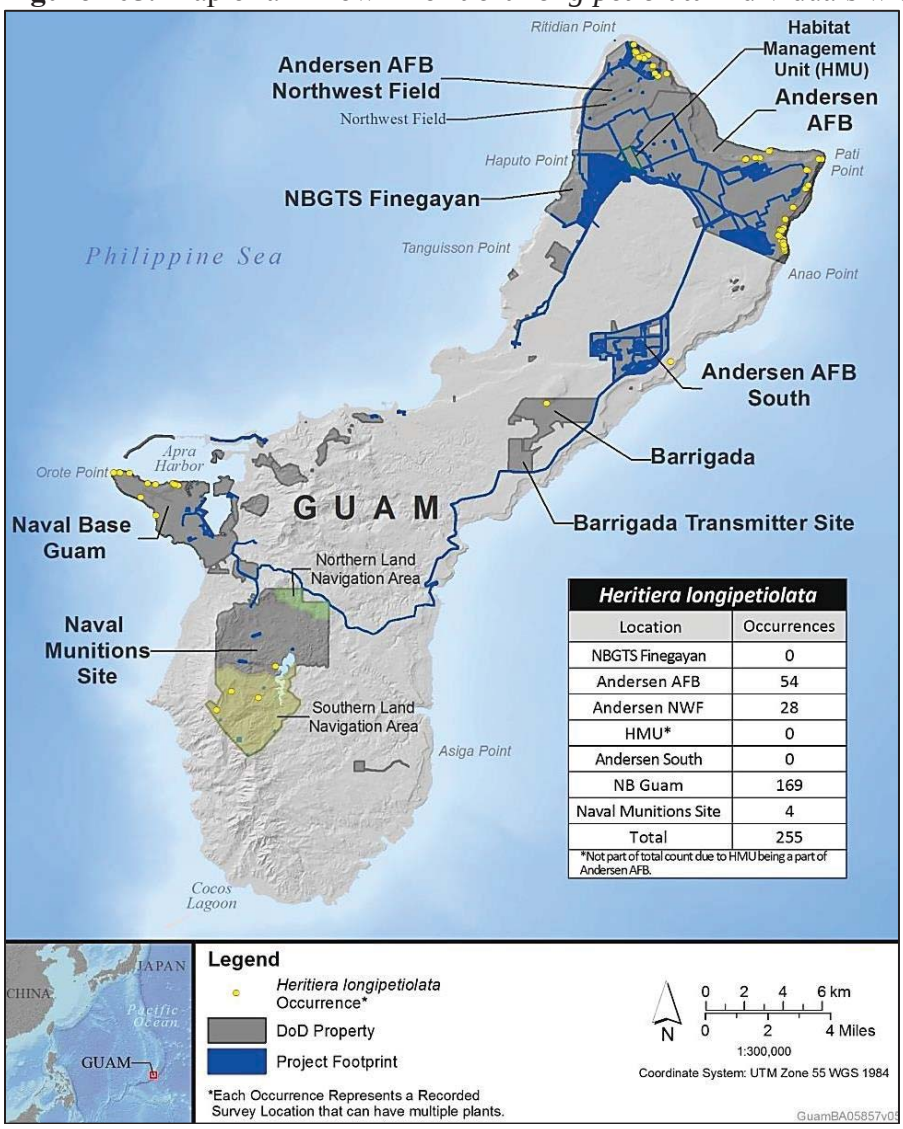


Figure 16. Map of all known *Tabernaemontana rotensis* individuals within the action area.

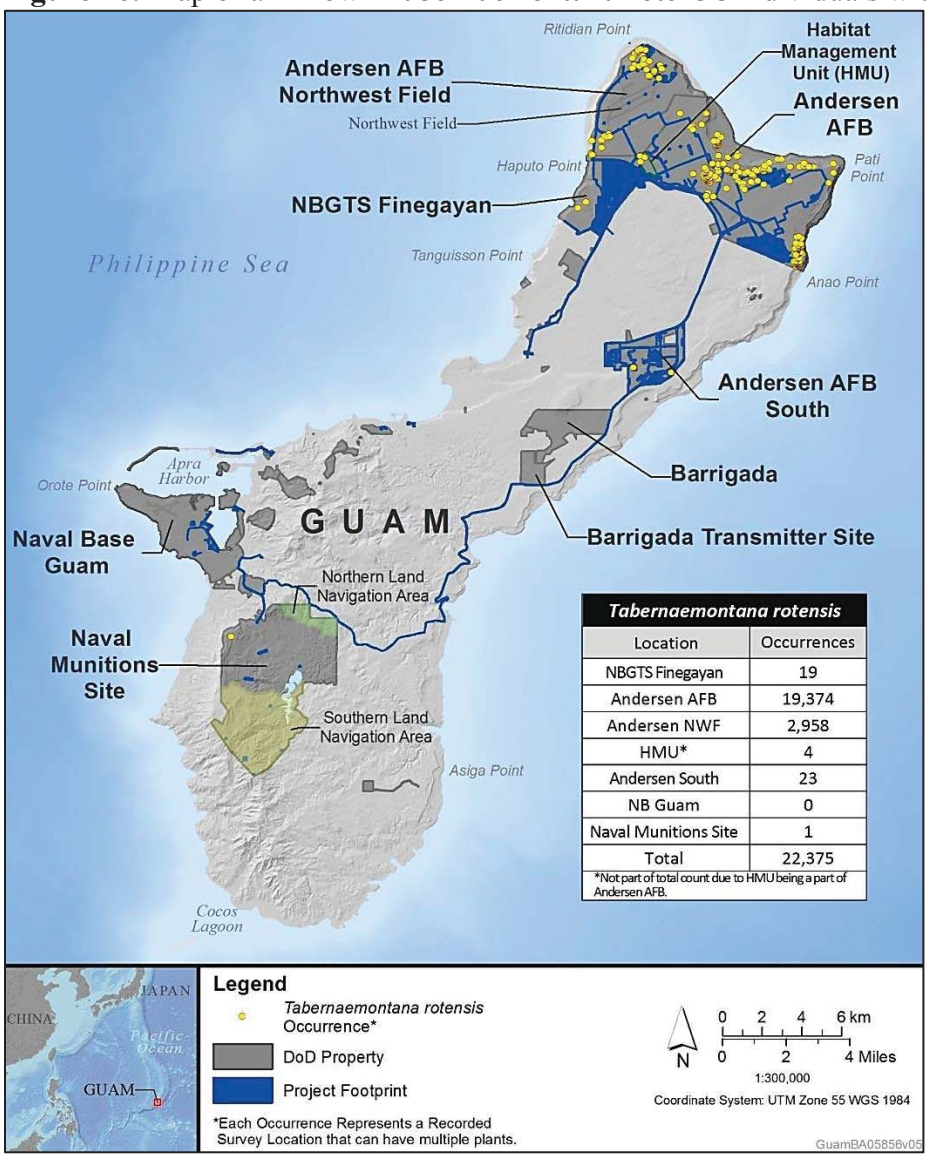


Figure 17. Vegetation survey results conducted in 2016 at the North Finegayan Forest Enhancement Site and the South Unit BTS Exclusion Fence, prior to restoration activities. Vegetation surveys for the Finegayan Outplanting site were not conducted.

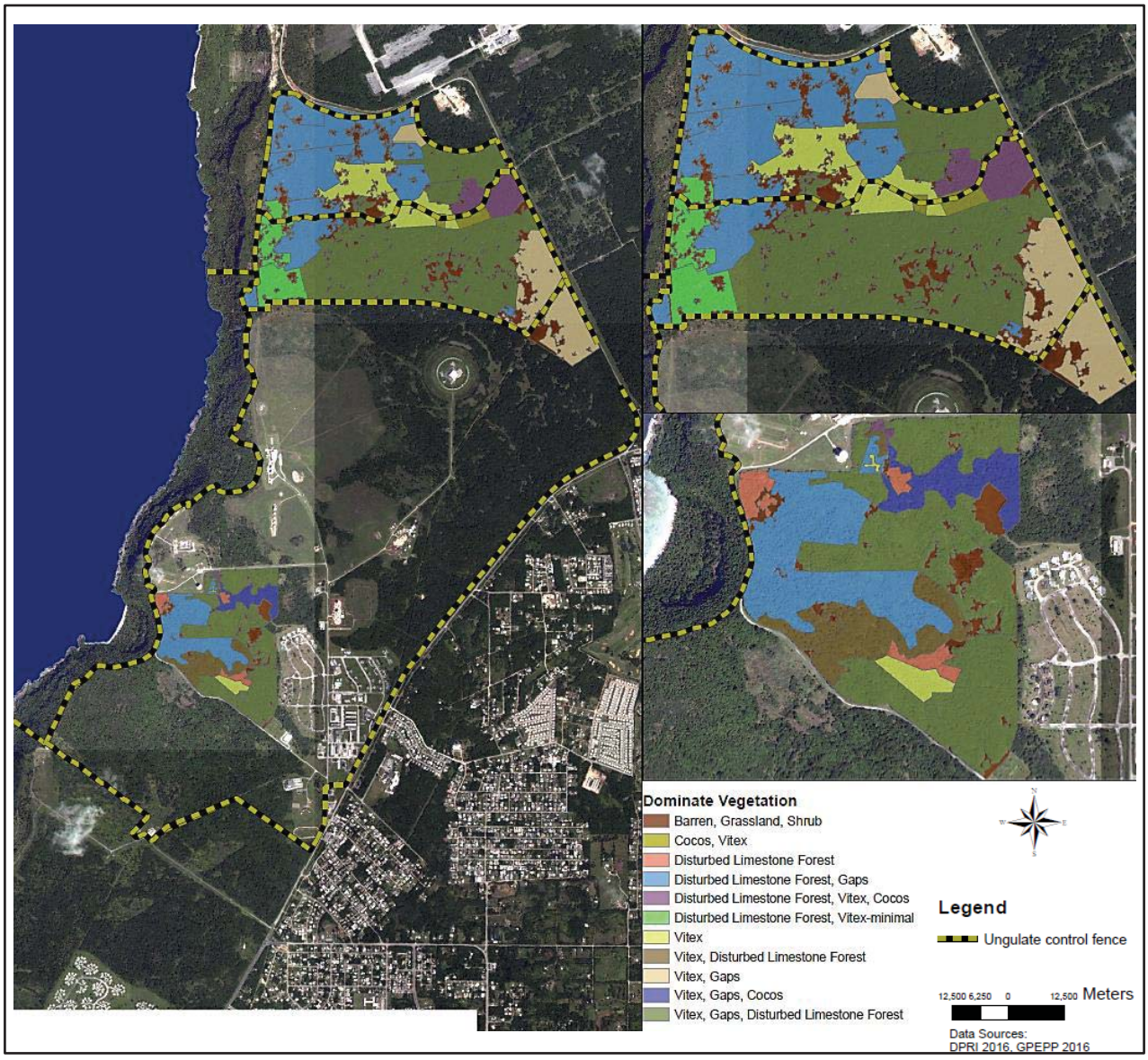


Figure 118. Average daily noise level (ADNL) contours at various decibel levels (dB) estimated for all areas of the proposed action, including the Live Fire Training Area Complex (LFTRC), Andersen Air Force Base (AAFB), AAFB South, and aviation training activities in the Naval Munitions Site (NMS) and its effects on existing Mariana fruit bat suitable habitat (Amidon in litt., 2015).

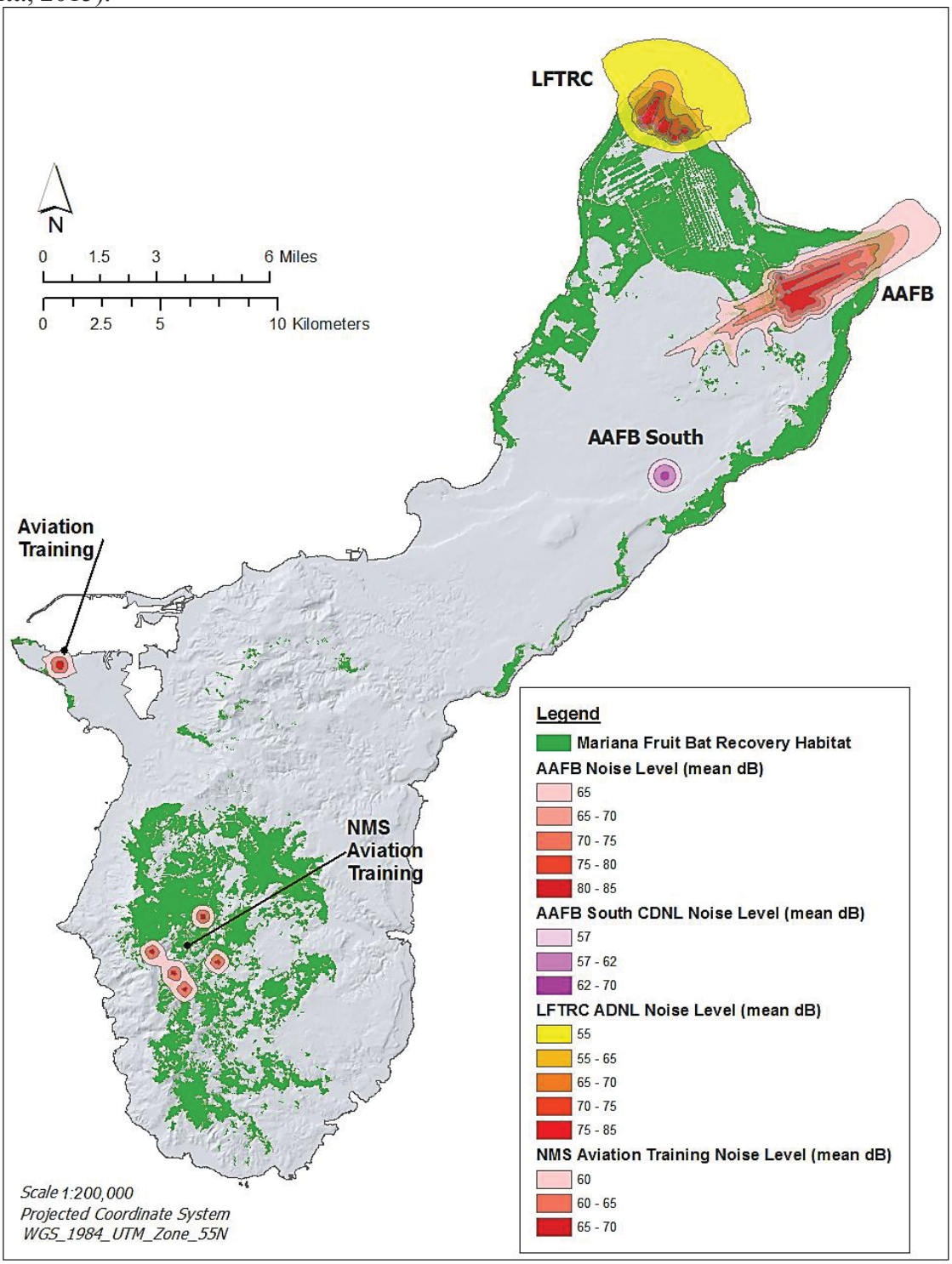


Figure 129. Extent of Mariana fruit bat habitat in Northern Guam expected to be lost or degraded due to noise greater than 65 dB, generated by military training and aircraft flights. Total habitat affected is approximately 1,817 ac (735 ha). As part of the DON's conservation measures, 3,271 ac (1,324 ha) of existing Mariana fruit bat suitable habitat will be protected away from noise effects.

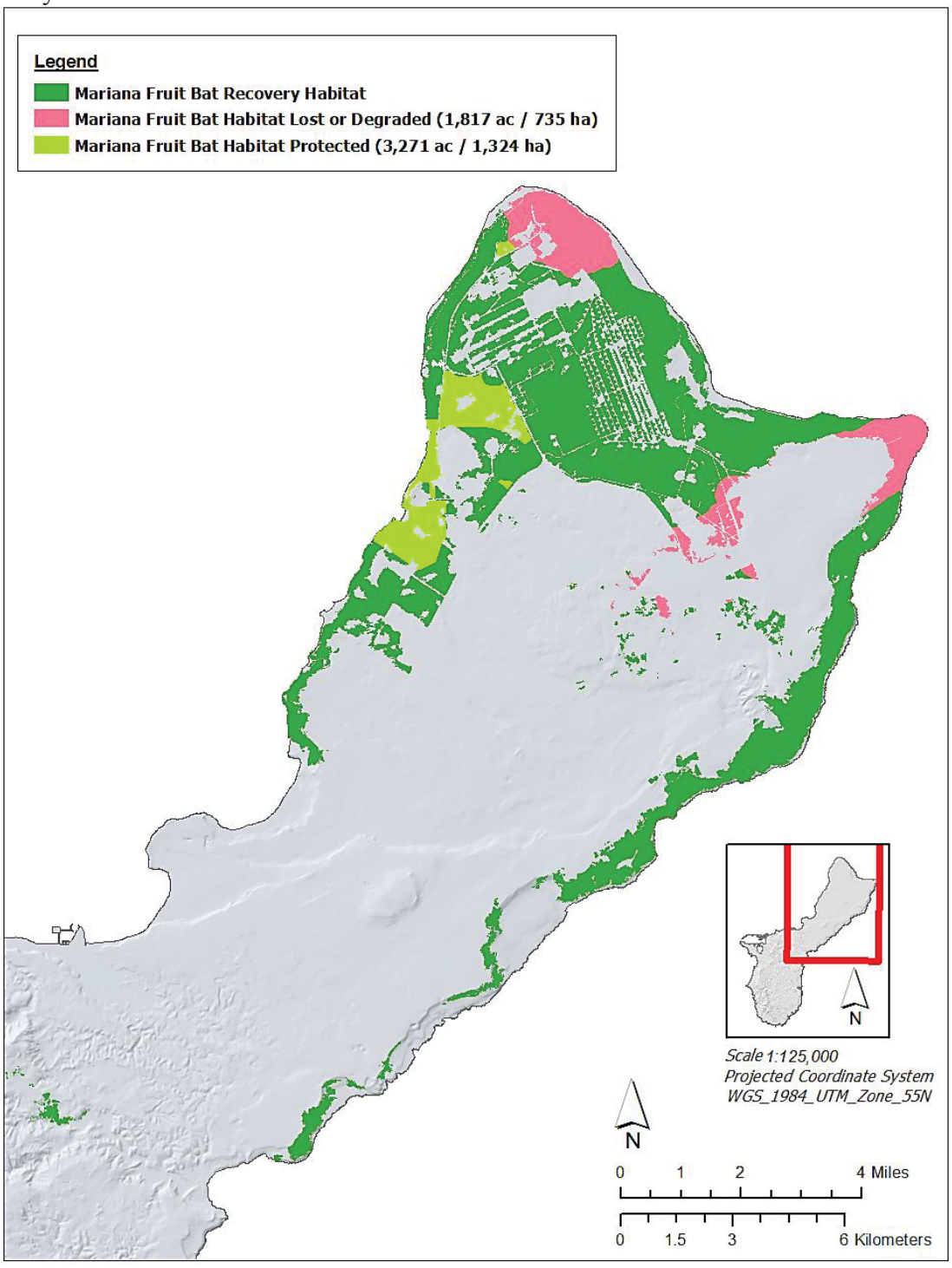


Figure 20. Extent of Mariana fruit bat habitat in Southern Guam expected to be temporarily lost or degraded due to noise greater than 65 dB, generated by intermittent military aircraft flight training. Total habitat affected will be approximately 319 ac (129 ha).

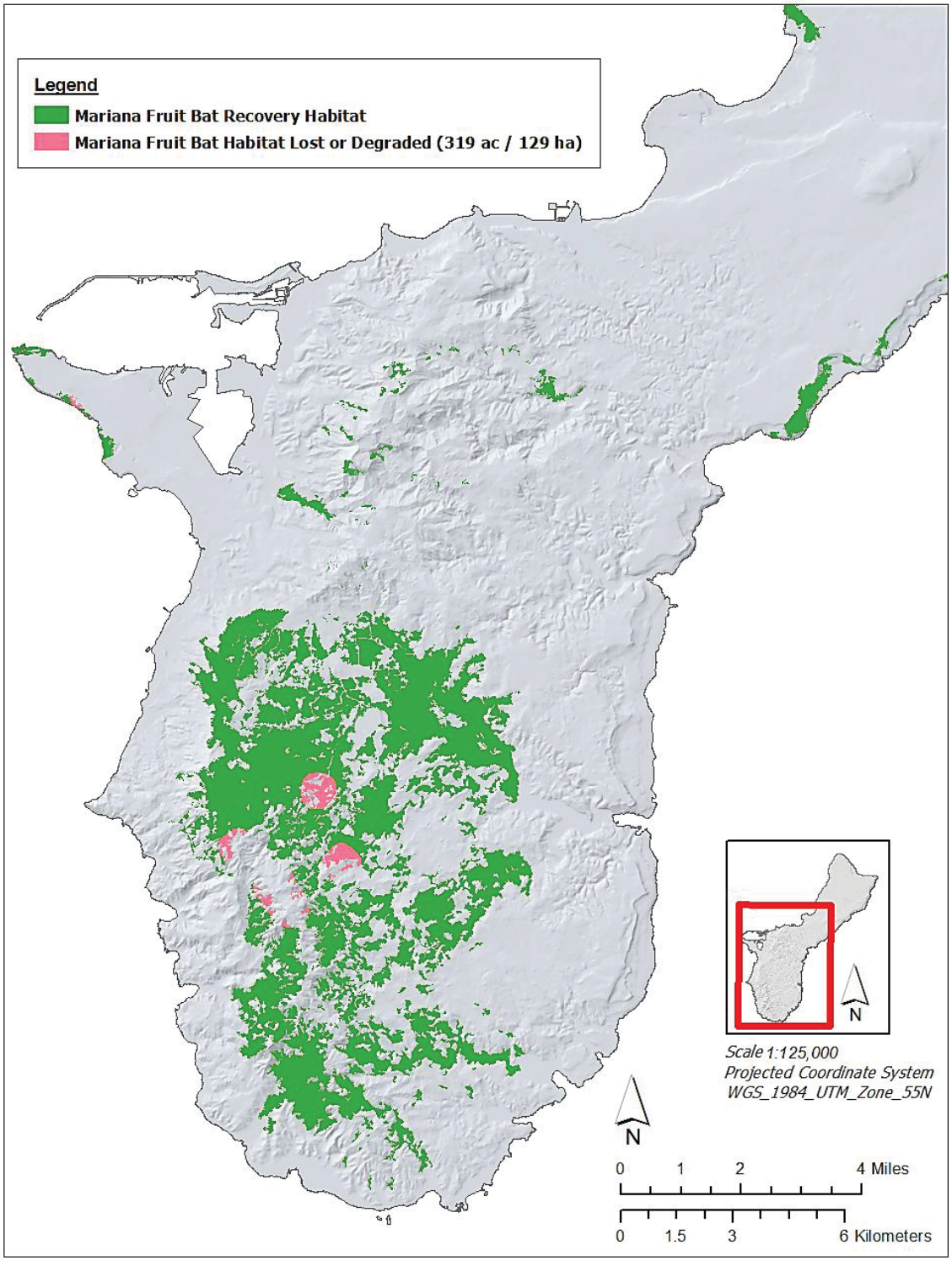
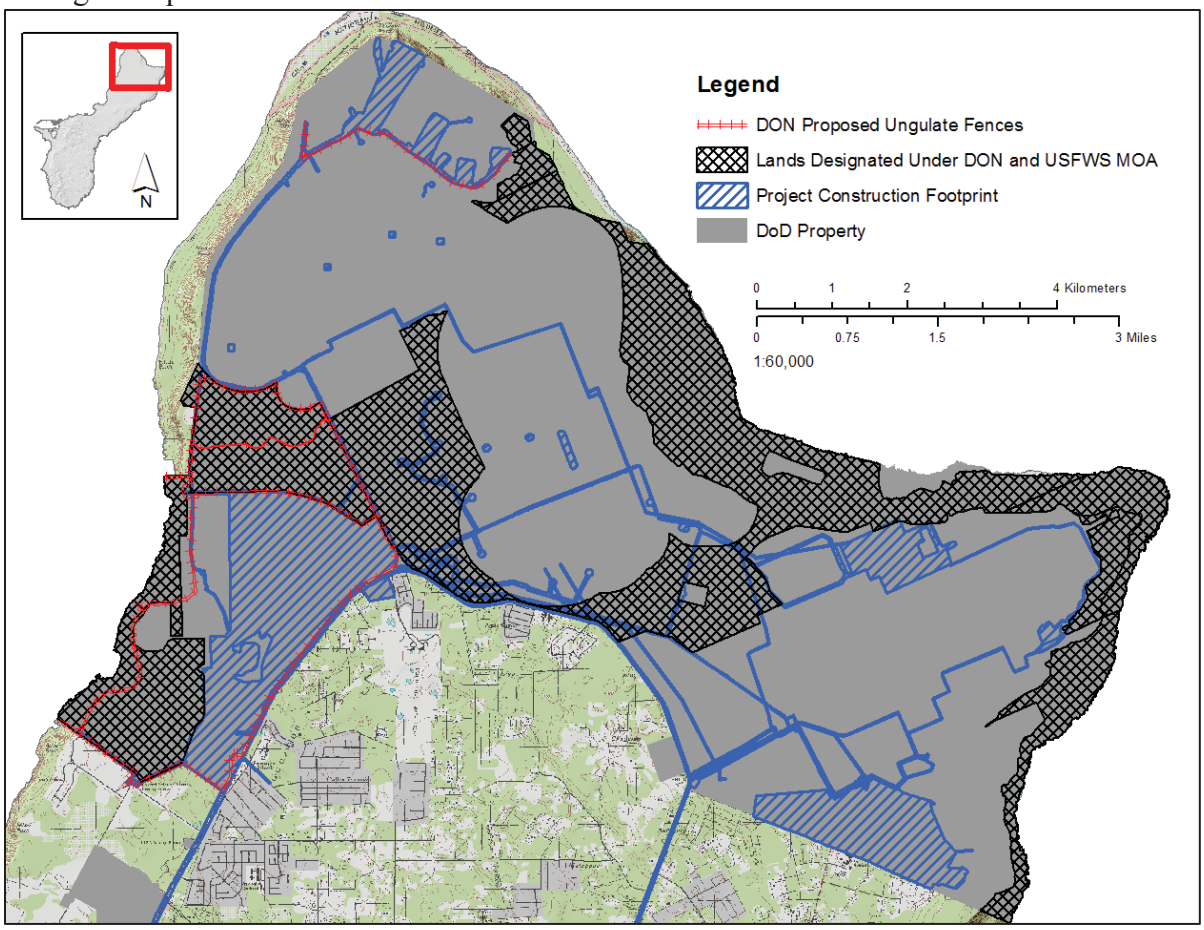


Figure 21. Map of lands designated by DON in the Memorandum of Agreement (MOA) between the DON and the Service (DON and Service 2015). The lands (black cross-hatched) total 5,234 acres and are set aside for the survival and recovery of the Guam Micronesian kingfisher and other federally-listed species, including those listed in Table 1, addressed in this Biological Opinion.



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F1I USFWS, Biological Opinion, Formal Consultation for Divert Activities and Exercises at the Saipan International Airport, Commonwealth of the Northern Mariana Islands (June 2013)

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United States Department of the Interior

FISH AND WILDLIFE SERVICE
Pacific Islands Fish and Wildlife Office
300 Ala Moana Boulevard, Room 3-122, Box 50088
Honolulu, Hawaii 96850

JUN 2 7 2013

In Reply Refer To:
2012-F-0445

Mr. Marc M. Aoyama, P.E.
Chief, Programs Division
Directorate of Installations and Mission Support
Department of the Air Force
Pacific Air Forces
25 E Street, Suite D-306
Joint Base Pearl Harbor-Hickam, Hawaii 96853

Subject: Formal Consultation for Divert Activities and Exercises at the Saipan International Airport, Commonwealth of the Northern Mariana Islands

Dear Mr. Aoyama:

This document represents the U.S. Fish and Wildlife Service's (Service) Biological Opinion on the U.S. Air Force's (USAF) proposed Divert Activities and Exercises (Divert) at the Saipan International Airport (GSN) in accordance with section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C 1531 et seq.). This Biological Opinion addresses the potential impacts of Divert on the endangered nightingale reed-warbler (*Acrocephalus luscinia)*. Your request for formal consultation was received on September 10, 2012. An informal consultation addressing potential impacts to the endangered Mariana moorhen (*Gallinula chloropsis guami*), Mariana swiftlet (*Aerodramus bartschi*), and threatened green sea turtle (*Chelonia mydas*), is found in Appendix 1.

Overall island-wide effects to the nightingale reed-warbler are addressed through the October 23, 2008, *Programmatic Biological Opinion Regarding the Reestablishment, Management, and Use of the Saipan Upland Mitigation Bank, Saipan* (2008-F-0033) (Programmatic Biological Opinion). The Programmatic Biological Opinion addressed the creation of the Saipan Upland Mitigation Bank (SUMB) to protect and manage 419 hectares of land on Saipan in perpetuity for the nightingale reed-warbler. The findings and recommendations in this consultation are based on: (1) the USAF Biological Assessment for Divert received on September 10, 2012; (2) phone calls, meetings, and emails between Rachel Rounds (Service) and the USAF and its contractors; (3) the SUMB Programmatic Biological Opinion and; (4) other information available to us. A complete administrative record is on file in our office.

CONSULTATION HISTORY

June 17, 2013. The USAF and the Service agree upon final language for the invasive species conservation measures.

May 9, 2013. The Service provided the USAF with proposed edits to the invasive species section of conservation measures.

April 10, 2013. The USAF provided the Service with a re-written rapid response conservation measure which is acceptable to both agencies.

March 13, 2013. The USAF and Service had a phone call to further discuss the rapid response conservation measure in the draft Biological Opinion.

February 27, 2013. The Service provided USAF with revised invasive species conservation measures for their review.

February 26, 2013. The Service (Rachel Rounds and Domingo Cravalho) had a phone call with USAF and U.S. Navy staff and contractors (William Grannis, Kurt Rautenstrauch, Steve Pyle, Carol Gaudette, Lieutenant Colonel Alves, Steve Mosher, Lance Laughmiller, Mark Cruz, Edward Lynch, Mark Petersen) to discuss invasive species conservation measures.

February 14, 2013. The USAF provided the Service with comments on the draft Biological Opinion.

February 1, 2013. The Service provided the USAF with a draft Biological Opinion for review.

January 25, 2013. William Grannis (USAF) provided Rachel Rounds (Service) with an updated project description.

January 14, 2013. William Grannis (USAF) called Rachel Rounds (Service) to notify the Service that the USAF would like to purchase 17 credits in the SUMB to offset impacts to the nightingale reed-warbler.

December 12, 2012. The Service (Rachel Rounds, Earl Campbell, Brand Phillips, and Domingo Cravalho) had a phone call with USAF staff and contractors (William Grannis, Kurt Rautenstrauch, Shannon Cauley, Steve Pyle, Carol Gaudette, Mark Ingoglia, and Lieutenant Colonel Alves) had a conference call to discuss invasive species conservation measures.

November 16, 2012. William Grannis (USAF) sent Rachel Rounds (Service) a revised project description.

October 18, 2012. Kurt Rautenstrauch (HDR) provided Rachel Rounds (Service) with maximum noise estimates for four aircraft types and 10 locations around GSN.

October 11, 2012. Rachel Rounds (Service) and USAF staff and contractors (William Grannis, Daniel Robinson, Dale Clark, Steve Pyle, Julie Hong, Major Toves, Kurt Rautenstrauch, Tanya Perry) had a phone call to discuss the timeline for re-initiation of the Biological Opinion, the noise disturbance analysis, and joint military training exercises.

October 1, 2012. Rachel Rounds and Domingo Cravalho (Service) and USAF staff and contractors (William Grannis, Major Toves, Kurt Rautenstrauch, Shannon Cauley, Steve Pyle, and Edward Lynch) had a phone call to discuss SUMB credit purchases, Biological Opinion timeline, and brown treesnake conservation measures.

September 20, 2012. Rachel Rounds (Service) and USAF staff and contractors (William Grannis, Julie Hong, Major Toves, Bernie Marcos, Shannon Cauley, and Kurt Rautenstrauch) had a phone call to discuss conservation measures, SUMB credit purchases, monitoring projects, and the Divert training schedule.

September 18, 2012. Rachel Rounds (Service) sent William Grannis (USAF) a list of questions on the Divert Biological Assessment.

September 10, 2012. The Service received the Final Biological Assessment from the USAF.

July 26, 2012. Rachel Rounds (Service) and USAF staff and contractors (William Grannis, Edward Lynch, Stephen Pyle, Shannon Cauley) had a phone conversation to discuss Service comments on the draft Biological Assessment.

July 19, 2012. The USAF submitted a draft Biological Assessment to the Service for review.

May 31, 2012. The USAF and its contractors (Kurt Rautenstrauch, William Grannis, Mark Ingoglia, Edward Lynch, Mark Petersen, Shannon Cauley, and Major Pete Toves) and Service staff (Rachel Rounds and Earl Campbell) met to discuss the results of threatened and endangered species surveys at the Saipan International Airport and the section 7 consultation process.

July 15, 2011. USAF and its contractors (Edward Lynch, Carol Gaudette, William Grannis, Shannon Cauley, Julie Hong, and Mark Ingoglia) presented to the Service (Loyal Mehrhoff, Earl Campbell, Annie Marshall, Steve Miller, Fred Amidon, Domingo Cravalho, and Rachel Rounds) initial information regarding the Divert Project, discussed threatened and endangered species in the potential project areas, and discussed the section 7 consultation process.

ACTION AREA

The action area for the proposed project is the airport and surrounding areas (Figure 1), the seaport (Figure 2), and the Saipan Upland Mitigation Bank Conservation Area, which will be used for mitigation actions.

Figure 1. Proposed Facilities at Saipan International Airport

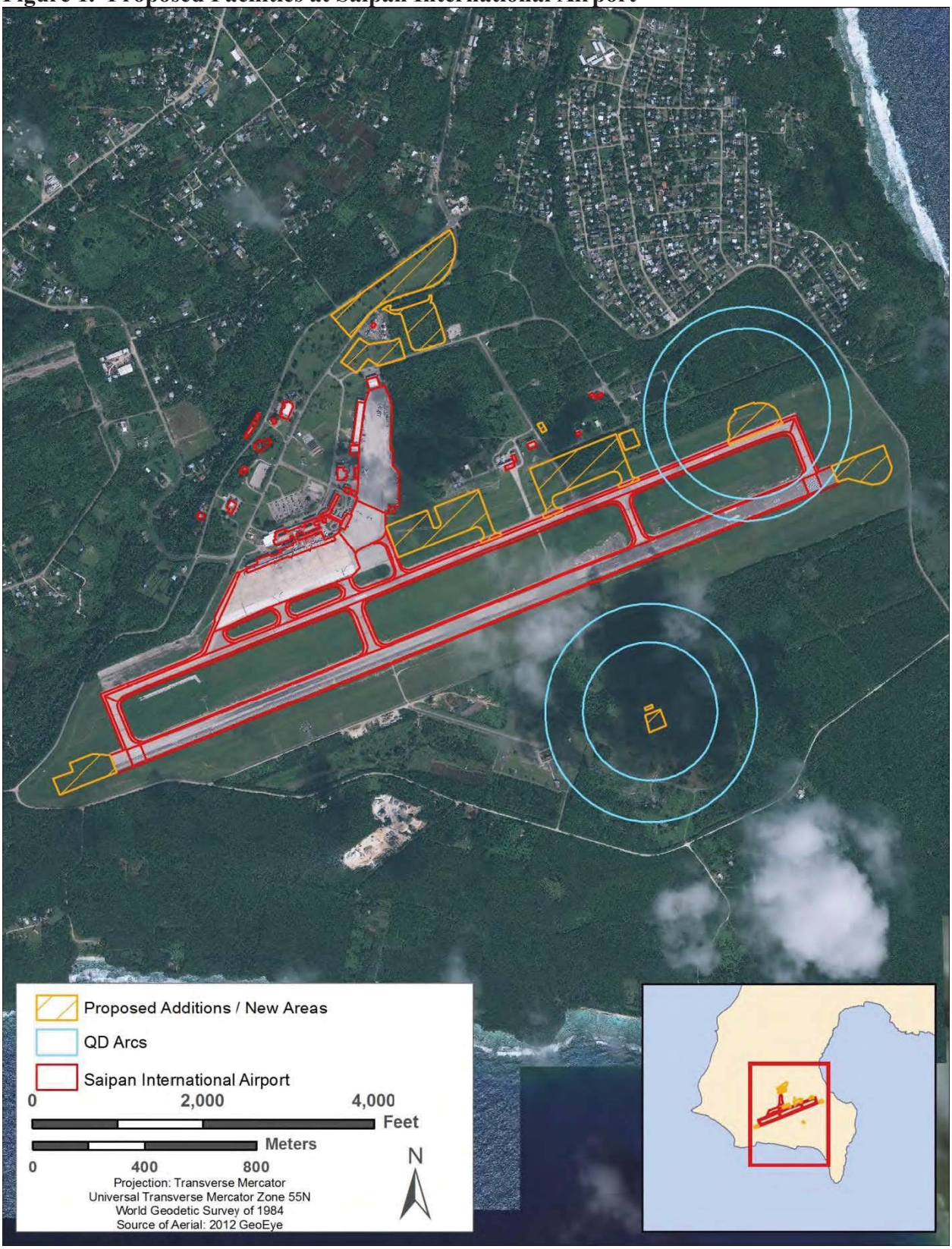
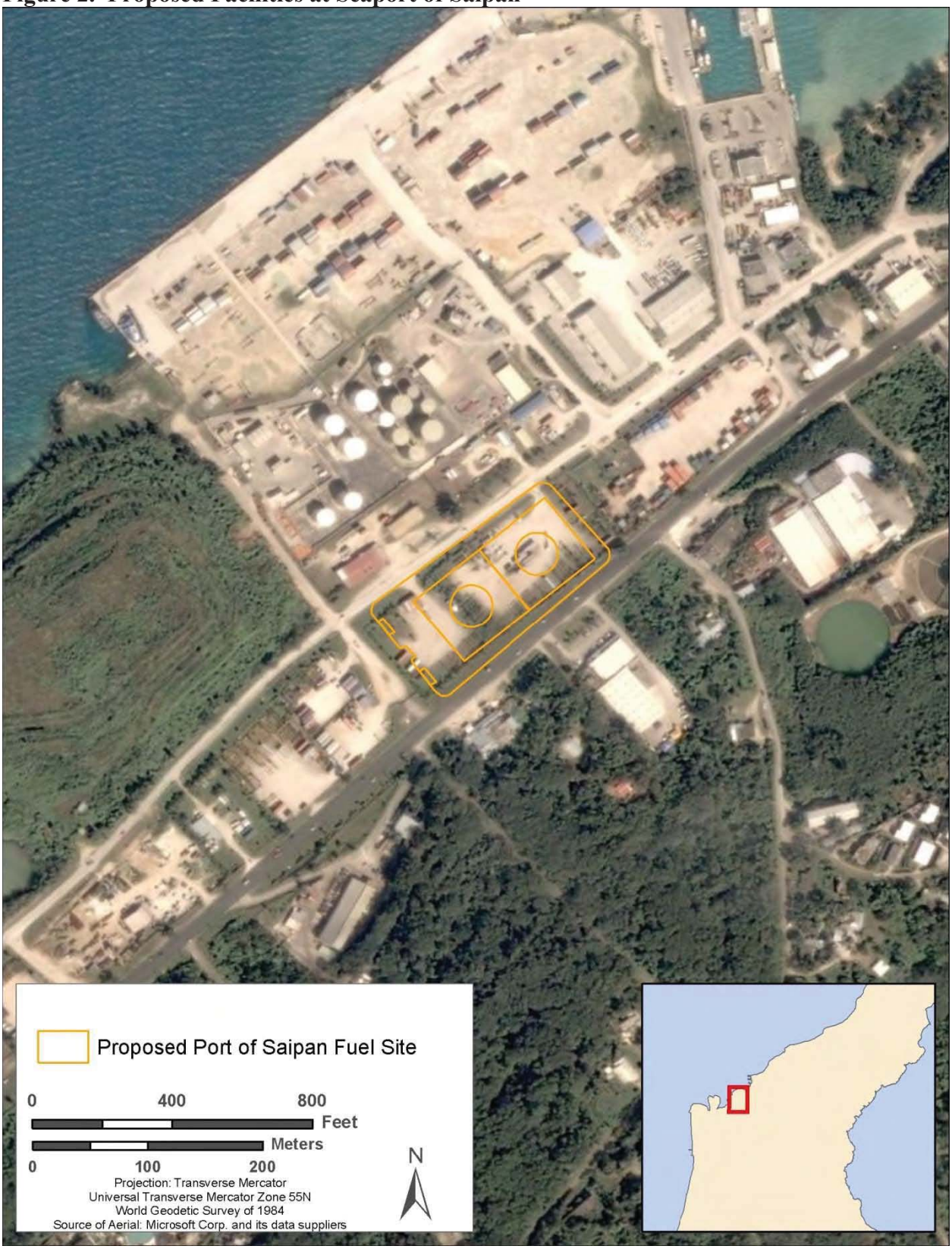


Figure 2. Proposed Facilities at Seaport of Saipan



DESCRIPTION OF THE PROPOSED ACTION

The Biological Assessment for Headquarters Pacific Air Forces Divert Activities and Exercises in Saipan fully describes the proposed construction and implementation of the Divert Project and is incorporated by reference herein. A brief description of the proposed action is provided below. This Biological Opinion will include effects from construction, training, joint military exercises, and humanitarian exercises for the lifetime of the Divert action. The purpose of the Divert project is to establish divert activity capabilities to support and conduct current, emerging, and future exercises, while ensuring the capability to meet mission requirements in the event that access to Andersen Air Force Base on Guam, or other western Pacific locations, is limited or denied. The need for humanitarian assistance can arise suddenly and without warning, such as disaster response in Japan during the 2011 earthquake and tsunami. Because of the proximity to forward-deployed forces in the western Pacific, the Marianas provides the best alternative for forward-deployed U.S. forces to train on U.S.-owned lands and to develop the proposed additional divert capabilities.

Construction

Saipan International Airport

The USAF proposes to construct and expand facilities at GSN. New facilities could include an expanded runway; associated pavement markings and lighting; parking aprons; a temporary munitions storage area; a hazardous cargo aircraft parking pad; an arm/disarm pad; an aircraft hangar; a maintenance facility; a jet fuel receiving, storage and distribution system; and navigational aids. Temporary billeting facilities for up to 700 personnel may also be developed adjacent to the airport. The total size of the facilities, if they are all constructed, would be about 24 hectares (59 acres).

Seaport of Saipan

Two hectares (approximately five acres) would be developed at the Port of Saipan for construction of fuel storage tanks. Two aboveground 2.1-million gallon tanks and associated piping would be constructed near the seaport on federally leased land. The site is located adjacent to the U.S. Army Reserve Center between Beach Road and Middle Road. Existing infrastructure at the port would be used to offload fuel from vessels. The site is in an industrial area that has been previously developed.

The timeline of Phase 1 construction is expected to be 24 to 36 months with geotechnical surveys beginning in 2013. The construction schedule for Phase 2 construction is not yet established.

Implementation

After completion of facility construction, the USAF would use GSN periodically and temporarily for ground and air activities, aircraft support activities, and other airfield ground support activities. A mix of joint cargo, tanker, fighter, and other aircraft could be diverted to or fly from the airfield. Implementation activities conducted might include, but are not limited to, divert landings and take-offs, joint military exercises, jet fueling and storage, humanitarian assistance and disaster relief airlift staging including non-combatant evacuation operations, and billeting. Implementation activities are expected to begin in 2016 or 2017.

Joint military exercises at GSN may include scheduled joint, combined, and unit-level military training activities and exercises, as described and analyzed in the Mariana Island Range Complex Environmental Impact Statement (EIS) (U.S. Navy 2010) and Biological Opinion (USFWS 2010). Aircraft and personnel participating in these combined exercises would be temporarily located at and operate from GSN for a combined total of about 60 days (eight weeks) per year. An exercise could last approximately two weeks. No more than 700 personnel would participate in exercises at GSN at any given time. Humanitarian and divert exercises would be short-term events.

A mix of joint fighter, cargo, and tanker aircraft, not to exceed the airport parking capacity could be diverted to or exercised from GSN. A maximum of six tankers or 12 fighters, or a mix of those aircraft, could operate from GSN if one parking apron is constructed. If the second parking apron is constructed, a total of 12 tankers, or 24 fighters, or a mix of those aircraft, could operate from GSN. The exact mixture of aircraft used during implementation will vary depending on mission requirements. Aircraft that would be used for joint military exercises include cargo, air mobility, and refueling aircraft such as the KC-135, and tactical or fighter aircraft such as the F-16, and F-22. The maximum capacity of aircraft anticipated to be used at GSN at any one exercise or Divert event is 24 fighters or 12 tankers, based on the construction of two parking aprons. Military exercises are anticipated to occur no more than eight weeks per year, such as in four, two-week exercises; however, longer exercises of up to four weeks could occur. The on-going joint military exercises, including joint multi-carrier strike group and joint combined exercises, could constitute four of the eight weeks of training under Divert. To model worst-case noise for an average busy day during a military exercise event, the USAF estimated that each aircraft would complete four operations per day (two arrivals and two departures). The USAF assumed that 90 percent of aircraft operations would occur during the day (7 a.m. to 10 p.m.) and 10 percent at night (10 p.m. to 7 a.m.).

In the Divert Draft EIS (USAF 2012), the USAF modeled baseline, low, medium, and high scenarios for military exercises. The USAF anticipates that the Divert military exercises covered by this Biological Opinion will fall in the range of the low and medium scenarios presented in the Draft EIS. In the baseline scenario (current conditions) approximately 140 flights operate out of GSN on a daily basis. The mix and type of aircraft assumed for each modeled scenario is based on construction of two parking aprons and could result in 12 KC-135 under the low scenario, 6 KC-135, 8 F-16, and 4 F-22 under the medium scenario, and 12 F-16 and 12 F-22 under the high scenario. Under the low scenario the number of tanker/cargo aircraft flights (a flight is a take-off and landing) per day would increase to 152 (an increase of 12 flights). Under the medium scenario the number of flights per day would increase to 164 (an increase of 24 flights). Under the high scenario the number of flights per day would increase to 202 (an increase of 62 flights).

Conservation Measures

The following conservation measures, developed in coordination with the Service, will avoid or minimize effects to the nightingale reed-warbler. They are considered part of the project description. Any changes to, modifications of, or failure to implement these conservation measures may result in a need to reinitiate this consultation.

Construction

1. The USAF will purchase one credit in the Saipan Upland Mitigation Bank prior to any construction of the east parking apron (Figure 3). If a credit for Territory Six (see Figure 3) has already been purchased for implementation actions (fighter jet flights) then a credit for Territory Six will not need to be purchased a second time. In accordance with the Nightingale Reed-Warbler Programmatic Consultation and Saipan Upland Mitigation Bank Agreement and Addendum, the agreed-upon credit purchase will be as follows:
    a. Prior to the start of any vegetation clearing or earth-moving activities at the East Parking Apron, the USAF shall purchase one credit at the Saipan Upland Mitigation Bank, which is intended to provide 1.75 nightingale reed warbler territories within the Bank boundary.
    b. Upon written notification that the credit has been purchased (i.e., the CNMI government has received and deposited the funds required to purchase the credit, specified under 1.a. above, within the Commonwealth Mitigation Bank Revolving Fund authorized under CNMI P.L. 10-84 and a receipt is sent to the Service documenting the deposit), the Service will provide a letter to the USAF indicating that the credit purchase obligation has been fulfilled and on-site project activities may begin as outlined within the project description above and the remainder of the conservation measures listed below.

2. Clearing of vegetation at the east parking apron will only occur between October through December or April through June, when nightingale reed-warbler nesting activity is not at its peak.

3. The USAF will not locate a laydown yard or other temporary construction facilities in nightingale reed-warbler habitat or within a 50-meter buffer zone around reed-warbler territories.

4. When possible, the use of very noisy (greater than 60 decibels A-weighted (dBA)) heavy machinery should be limited to the non-active or non-peak breeding seasons or temporary noise barriers or buffer zones should be installed to protect nightingale reed-warblers using buffer zones or areas of connectivity.

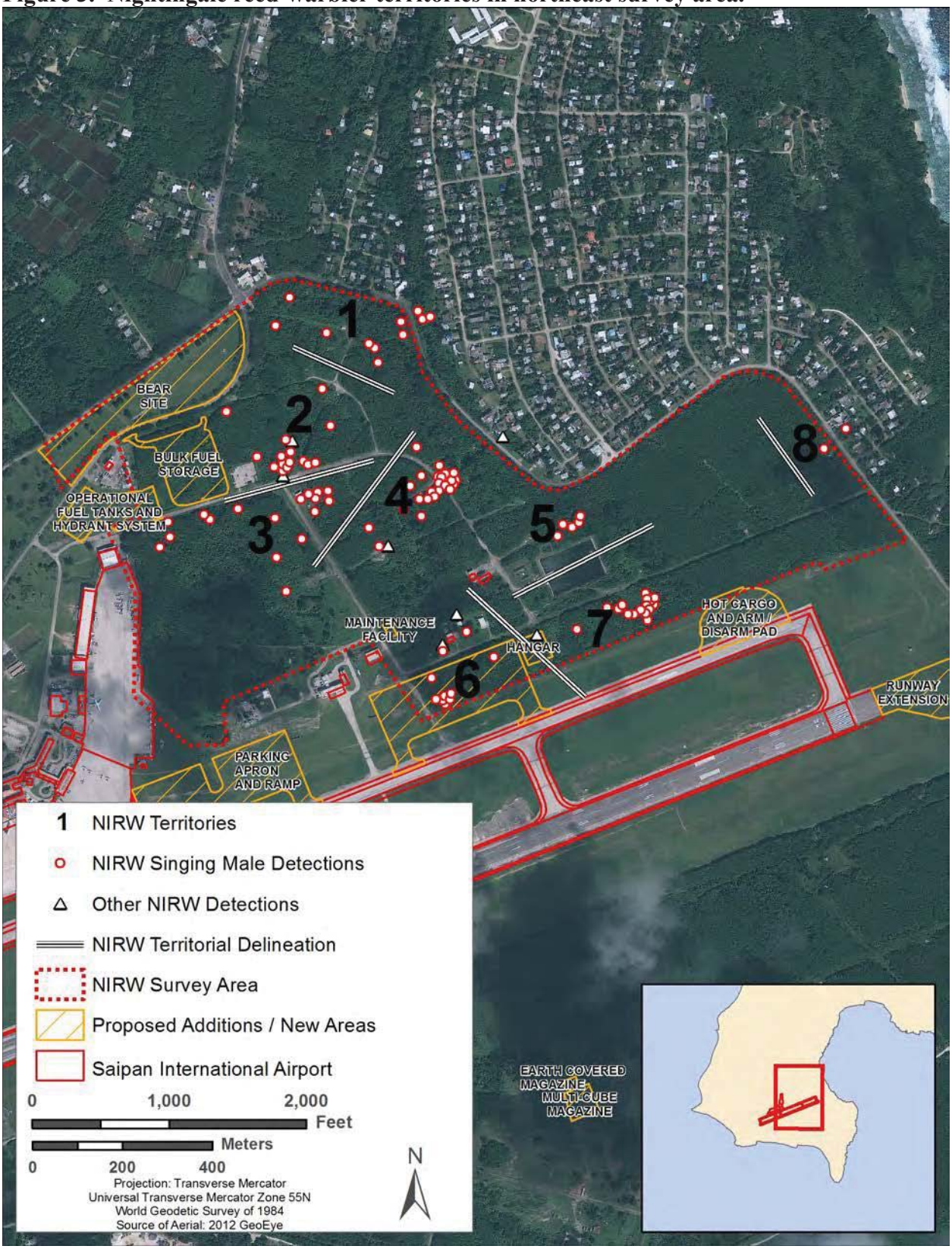
5. Adequate plastic construction fencing will be placed and maintained around any habitat that is to be avoided (including buffer areas and adjacent parcels) to prevent impacts to habitat from construction equipment and personnel.

6. All on-site construction personnel will receive instructions regarding the presence of listed species and the importance of avoiding and minimizing impacts to these species and their habitat.

7. All on-site personnel will receive instruction regarding the brown treesnake (*Boiga irregularis*) and what to do immediately in case of a sighting.

8. The USAF will ensure that no unauthorized take of nightingale reed-warbler or destruction of their habitat occurs. The USAF will have the authority to stop all activities that may

Figure 3. Nightingale reed-warbler territories in northeast survey area.



result in such take or destruction until appropriate corrective measures have been completed. The USAF will report immediately any unauthorized impacts to the Service and CNMI DFW.

9. A litter-control program will be implemented during construction. All tools, gear, and construction scrap will be removed upon completion of work in order to prevent the attraction of non-native pests (e.g., rats). All workers will ensure their food scraps, paper wrappers, food containers, cans, bottles, and other trash from the project area are deposited in covered or closed trash containers. The trash containers shall be removed from the project area and disposed of off-site at an approved landfill at the end of each working day.

10. A brief summary report will be provided to the Service within 30 days of construction implementation to document implementation of any fencing, buffer zones, and minimization measures.

Implementation

To offset impacts from noise disturbance and habitat degradation resulting from implementation of joint military exercises as proposed in the Divert EIS, the USAF will purchase seventeen credits in the SUMB. These credits will be purchased prior to initiation of any proposed Divert exercises out of GSN that use fighter-type jet aircraft. It is expected that proposed Divert exercises will begin in 2016 or 2017. If a credit for Territory Six, which will be cleared for the east parking apron, has already been purchased then a credit for Territory Six will not need to be purchased a second time. In accordance with the Nightingale Reed-Warbler Programmatic Consultation and Saipan Upland Mitigation Bank Agreement and Addendum, the agreed-upon credit purchase will be as follows:

a. Prior to the start of proposed Divert exercises out of GSN that use fighter-type jet aircraft, the USAF shall purchase seventeen credits at the Saipan Upland Mitigation Bank, which is intended to provide 29.75 nightingale reed warbler territories within the Bank boundary.
b. Upon written notification that the credit has been purchased (i.e., the CNMI government has received and deposited the funds required to purchase the credit, specified under 1.a. above, within the Commonwealth Mitigation Bank Revolving Fund authorized under CNMI P.L. 10-84 and a receipt is sent to the Service documenting the deposit), the Service will notify the USAF indicating that the credit purchase obligation has been fulfilled and on-site project activities may begin as outlined within the project description above and the remainder of the conservation measures listed below.

Invasive Species Interdiction and Control

The USAF will be responsible for oversight of avoidance, minimization, and mitigation implementation by the construction contractors for projects associated with the proposed Divert activities. In addition, the USAF will be responsible for oversight of training, review, and guidance on Hazard Analysis and Critical Control Point (HACCP) plan development, implementation and revision during the construction phase of the project. The HACCP plans will incorporate measures to ensure invasive species, including the brown treesnake, are not transported to the CNMI from Guam via project vehicles, materials and equipment. The USAF

will be responsible for assuring that any HACCP plans are implemented by construction contractors to prevent the inadvertent movement of non-native, invasive species from other locations to the project site. The USAF will coordinate development of HACCP plans with the Service, including, but not limited to, annual meetings and reports to ensure the actions to eliminate or reduce risk are sufficient and on-going during construction activities.

Brown Treesnake Interdiction and Control

1. Per Public Law 110-417, [Division A], title III, Section 316, October 14, 2008, 122 Statute 4410 and per DoD Defense Transportation Regulations, Chapter 505 protocols, the USAF, with support from Joint Region Marianas (JRM), commits to implementing 100 percent inspection of all outgoing cargo and aircraft that are leaving from Guam associated with the Divert project. Inspections will be performed with trained quarantine officers and dog detection teams, which could be supplemented by other pest control expertise (with appropriate U.S. Department of Agriculture-Wildlife Services (USDA-WS) brown treesnake detection training and oversight) to meet 100 percent inspection goals for training activities, as required by Joint Region Marianas Instruction 5090.4. As a stakeholder, the Service will have input on the USAF protocols for implementing brown treesnake interdiction and control strategies. The USAF will work cooperatively with JRM, the Service, and USDA-WS to seek information in development of protocols for implementation of interdiction and control methods aimed at controlling brown treesnake as related to Divert training activities. On an as needed basis, the Service, USDA-WS, and USAF may request meetings to discuss interdiction and control method protocols as related to Divert military exercises.

   a. In the event military units, vehicles, and equipment accidentally leave Guam without inspection, as soon as possible, the USAF will notify: (1) USDA-WS and (2) the point of destination port or airport authorities and work with the destination port to resolve the issue. Urgency of notification is a priority so that rapid response or other actions can be implemented to reduce risk.

   b. In addition, the USAF will route inbound personnel and cargo for tactical approach exercises or humanitarian operations (that require an uninterrupted flow of events) directly to CNMI training locations to avoid Guam seaports and airfields. If Guam cannot be avoided, the USAF, in cooperation with USDA-WS and the Service, shall identify, and USAF will implement appropriate interdiction methods that may include redundant inspections (see 1c) or other interdiction methods as agreed to by the Service, USDA-WS, USAF and JRM. Additionally, tactical approach exercises will involve only cargo equipment that has not originated from areas containing a brown treesnake population or will be 100 percent inspected by certified brown treesnake canine programs. If the USDA-WS develops performance standards for this activity, the USAF will adopt those standards, provided they are compatible with military mission.

   c. The USAF is committed to implementing 100% redundant inspections after discussions with appropriate stakeholders. Redundant inspections include inspections on Guam and at the receiving jurisdiction for administrative and logistical movements that do not require a tactical approach to complete the training requirements. It is anticipated that

redundant inspections to the extent possible would utilize existing quarantine and inspection protocols at receiving ports, but in the event that there is inadequate inspection coverage the USAF will coordinate with the USDA-WS to provide additional canine inspection teams that will augment quarantine and inspection protocols at the receiving ports. Appropriate stakeholders include, but are not limited to: the Service to ensure the inspections are adequate to reduce risks to trust resources, USDA-WS, receiving jurisdictions and their supporting agencies with expertise in invasive species control, and other inspection authorities as needed to ensure inspection methods are current and revised as new techniques, technology, or data become available.

2. The USAF will also establish snake-free quarantine areas (barriers) for cargo traveling from Guam to CNMI and other brown treesnake-free areas. These barriers will be subject to: (1) multiple day and night searches with appropriately trained interdiction canine teams that meet performance standards under 1b; (2) snake trapping; and (3) visual inspection for snakes. In lieu of permanent barriers, temporary barriers may be preferable to permanent exclosures because of the variable sizes needed to handle different cargo amounts for the various training activities. The USAF will produce standard operating procedures for temporary barrier construction and use within two years of the issuance of this Biological Opinion. Standard operating procedures will ensure that temporary barriers will be constructed and maintained in a manner that assures the efficacy of the barrier and that staff maintaining and constructing the temporary barriers will receive training related to this activity prior to construction. The construction and maintenance of temporary barriers utilized for cargo traveling from Guam to CNMI and other brown treesnake-free areas must be approved by the Service prior to use. During the construction phase of this project, the existing permanent snake-free quarantine area at the Saipan seaport should be utilized for surface cargo following relevant CNMI and DoD regulations. Standard operating procedures will be developed in cooperation with the Service, U.S. Geological Survey, Fort Collins Science Center, Invasive Species Science Branch, and the USDA-WS to ensure risk to trust resources is adequately minimized. If risks are not adequately minimized, additional recommendations will be provided for incorporation into the protocols until the USAF and Service mutually agree the risk has been minimized. The Service, USAF, and other appropriate parties will meet, if necessary, to resolve concerns such that the protocols ensure risk is adequately minimized.

3. The USAF, in conjunction with the Service and JRM, will develop procedures and protocols specific to Divert training events that will support a rapid response action in the event of a brown treesnake sighting resulting from Divert activities. Divert activities and exercises will be varied in the number of aircraft and personnel, and each event will have differing logistics support capabilities depending on the nature of the event. The type and amount of logistic support will be agreed to prior to each major event. Logistic support will include consideration of both in-kind assistance through air transport, shared billeting, security detail, food, materials, and ground transportation, and financial compensation for agreed-to response actions that could not be supported by in-kind assistance, including compensation for performance of services to support the deployment and execution of rapid response search teams.

4. The USAF, working in collaboration with the Service, and USDA-WS, will decide how best to implement the Brown Treesnake Control Plan (BTS TWG 2009, 37 pp.) relevant to Divert activities. The USAF and Service must mutually agree on the Brown Treesnake Control Plan implementation.

5. The USAF will provide invasive species awareness training for all military and contractor personnel prior to all training activities. This would include a mandatory viewing of a brown treesnake educational video, distribution of pocket guides with brown treesnake information and personal inspection guidelines to be carried at all times, and assurance that brown treesnake awareness extends from the chain of command to the individual military service member

6. Due to limited availability of inspectors, trained dogs, and quarantine facilities and equipment on Guam and the CNMI, the USAF will coordinate closely with the Service, U.S. Department of Agriculture, CNMI Department of Land and Natural Resources, and Joint Region Marianas staff responsible for managing their brown treesnake program, on planning for training activities on Saipan. The USAF, along with cooperating agencies, will identify the inspection and interdiction requirements for the Divert training, including the number of trained quarantine officers and dog detection teams required. The USAF will coordinate and consult with the Service on the inspection and interdiction requirements identified by the USAF, and the Service must concur with these requirements prior to the implementation of the exercise or training activity. The USAF, along with the cooperating agencies, will develop plans to ensure that inspection personnel are available and that all requirements can be met, and will identify the support that the USAF will need to provide for the inspections. Planning for training exercises generally begins months prior to implementation of an exercise, and planning for complex training that would require a substantial number of inspectors, quarantine areas, or other personnel or equipment for control and interdiction generally begins more than a year in advance. If adequate resources, such as trained inspectors and dog teams, are not available during training activities, training will not occur until resources are available.

<u>Prevention of Invasive Species Introductions and Spread</u>

1. All personnel involved in Divert training will adhere to DoD Instruction 5090.10A and the 2005 Brown Treesnake Control and Interdiction Plan, which calls for individual troops to conduct self-inspections to avoid potential transport of brown treesnakes. Troops will inspect all personal gear and clothing (e.g., boots, bags, weapons, pants), hand-carried equipment and supplies and tent canvas. The intent of this measure is to minimize the potential risks and subsequent effects associated with transport of troops and personnel from Guam to the CNMI and other areas that do not have brown treesnakes.

2. In addition to self-inspections, each training action will undergo a pathway risk analysis as a tool to improve programmatic efficiency while preventing the spread and introduction of invasive species. Actions at risk of transporting invasive species will have prevention tasks identified and implemented to reduce risk. Methods employed such as HACCP planning

development and implementation by the USAF may be utilized to conduct pathway analysis. Pathway risk analysis must be completed prior to each training action being implemented.

3. The USAF is a participating agency in the development of the Micronesia Biosecurity Plan. The Micronesia Biosecurity Plan is intended to coordinate and integrate inter-agency invasive species management efforts such as control, interdiction, eradication, and research. Once completed, any portions of the Micronesia Biosecurity Plan determined to be applicable to Divert construction and training activities, will be implemented when such procedures do not unduly interfere with military training. The USAF will continue to work cooperatively with the Service and U.S. Department of Agriculture in development of protocols for implementation of interdiction and control methods in accordance with recommendations contained in the Micronesia Biosecurity Plan identified as being tied to USAF actions.

STATUS AND ENVIRONMENTAL BASELINE OF THE SPECIES

A complete Status of the Species for the nightingale reed-warbler can be found in the October 23, 2008, *Programmatic Biological Opinion Regarding the Reestablishment, Management, and Use of the Saipan Upland Mitigation Bank, Saipan* (2008-F-0033). The nightingale reed-warbler was federally listed as an endangered species in 1970 (Service 1970, p. 18321). No critical habitat has been designated for this species. The main threats currently facing the nightingale reed-warbler are: (1) habitat loss and degradation *(e.g.,* wetland destruction, upland forest conversion, habitat destruction by feral ungulates, and habitat degradation by non-native invasive plant species); (2) potential for the establishment of the brown treesnake on Saipan; and, (3) predation by introduced animals such as rats *(Rattus* spp.), cats *(Felis catus),* and possibly monitor lizards *(Varanus indicus).* Island-wide surveys for the nightingale reed-warbler were completed on Saipan in 1982, 1997, and 2007 (Engbring et al. 1986, USFWS 1998a, Camp et al. 2009). These data indicate nightingale reed-warbler populations on Saipan declined by approximately 61 percent from 1982 to 2007. While we do not have updated population information for the last 5 years, we assume that the population has continued to decline as threats to the species have not changed. Habitat loss through development has continued and predator control has not been implemented. However, most habitat loss has been permitted through use of the Saipan Upland Mitigation Bank which will have a long-term benefit to the species. The population of nightingale reed-warblers in the Saipan Upland Mitigation Bank Conservation Area has not been surveyed since 2008. From 1999 to 2008 the population fluctuated yearly but tended to remain stable over the 10-year period (CNMI DFW, unpublished data, 2013).

Environmental Baseline

Micronesian Environmental Surveyors, a contractor for the USAF, conducted avian surveys around GSN in February and March of 2012. Surveys were conducted on the northeast side of the airport where most facilities would be constructed and an area south of the runway slated for the munitions storage facility (Figure 4). Eight nightingale reed-warbler territories were defined in the northeast survey area (see Figure 3). No nightingale reed-warblers were detected south of the runway.

Figure 4. Nightingale reed-warbler survey areas



Additional nightingale reed-warbler territories are likely present in areas surrounding the airport that were not surveyed as part of the proposed project. These territories would not be subjected to construction disturbance, but are within areas that will have increased noise due to additional overflights. There is potential nightingale reed-warbler habitat in As Gonno to the northwest of the airport, east and west of the runway, and south of the runway near Obyan. Comprehensive nightingale reed-warbler surveys were not conducted in these areas, but roadside point-counts were conducted three times at east and west ends of the runway. A nightingale reed-warbler was heard at the west end of the runway, and potential habitat was observed at both ends. In addition, surveys conducted in 2007 by the Service and CNMI DFW detected two nightingale reed-warblers near the west end of the runway, confirming that there are reed-warblers in the area. It is assumed, therefore, that nightingale reed-warbler territories are present at both ends of the runway.

Using vegetation mapping, existing CNMI DFW and USFWS unpublished survey data, and information from Camp et al. (2009), we have estimated the potential number of nightingale reed-warbler territories in the non-surveyed areas around the airport. The two areas that will have the loudest noise from Divert training are the east and west ends of the runways (see Figure 4).

We estimate there are potentially four nightingale reed-warbler territories at the east and west ends of the runway. Nightingale reed-warblers are also present in habitats to the north and south of the airport. We estimate that there are potentially thirteen nightingale reed-warbler territories within approximately 500 meters north and south of the runways that may experience noise disturbance from Divert training activities.

The most recent data indicates there are approximately 229 nightingale reed-warblers in the Saipan Upland Mitigation Bank Conservation Area (CNMI DFW unpublished data 2008). There are no nightingale reed-warblers located at or adjacent to the seaport site (see Figure 2).

EFFECTS OF THE ACTION

Construction

Evaluation under the SUMB Programmatic Biological Opinion

The proposed project will clear 2.6 hectares of nightingale reed-warbler habitat for construction of the east parking apron. Project activities will include clearing vegetation and use of heavy equipment. Project impacts are assessed by determining the number of territories directly and indirectly affected by the action. Due to vegetation clearing for construction of the east apron, one nightingale reed-warbler territory will be subject to direct impacts including habitat loss, fragmentation and degradation. Indirect impacts to this territory and potential adjacent territories include increased noise during clearing and increased risk of non-native invasive species. Under the SUMB Programmatic Biological Opinion, project impacts are assessed by determining the number of territories directly and indirectly affected by the action. For habitat clearing for the east apron, impacts to nightingale reed-warblers will be minimized by purchasing one credit in the Saipan Upland Mitigation Bank commensurate with the direct and indirect impacts associated with the project, and by implementing conservation measures.

Implementation

The implementation of Divert will cause an increase in noise levels around GSN and in surrounding nightingale reed-warbler habitats. The effects analysis for implementation of Divert will therefore focus on potential noise impacts to nightingale reed-warblers from the increase in flights at GSN. This section will first review existing knowledge and literature regarding the impacts of noise on avian species, with an emphasis on military noise and its impacts on songbirds. The noise review is followed by an overview of potential impacts to nightingale reed-warblers from Divert, and then an assessment of the level of take that is expected from Divert.

Noise review

Studies on the impacts of aircraft overflights to wildlife have been primarily limited to work on ungulates (e.g., Krausman et al. 1998; Maier et al. 1998; Frid 2003; Landon et al. 2003; Krausman et al. 2004; Lawler et al. 2005), birds of prey (e.g., Andersen et al. 1989; Watson 1993; Trimper et al. 1998; Delaney et al. 1999; Palmer et al. 2003), and waterbirds (e.g. Ward et al. 1999; Conomy et al. 1998 a,b; Komenda-Zehnder et al. 2003). These studies report a wide range of reactions to overflights depending on the biology of the species, its previous exposure to overflights, whether the species is breeding, the type of aircraft, the altitude of the aircraft, and the lateral distance between aircraft and the species. The variability in these reactions and their specific circumstances make it difficult to be certain how a particular species, such as the nightingale reed-warbler, will react to aircraft overflights.

Avian behavioral responses to noise may range from flushing and body shifting to physiological responses such as an increase in heart rate or hormone balance (Brown 2000, p. 11; Barber et al. 2010, p. 181). Specific reactions will vary by species and by an individual's previous exposure to noise disturbance (Manci 1998, p. 15). Individuals with previous exposure to aircraft overflights may display less reaction to overflights then individuals without previous exposure (Andersen et al. 1989, Conomy et al. 1998b). This reduced reaction is believed to be a sign of habituation; however, the habituation may be individual or species specific. For example, Conomy et al. (1998b) found that black ducks (*Anas rubripes*) did not become habituated to noise. Larkin (1996, p. 1) in a review of noise impacts on wildlife, reported that decreased responsiveness from wildlife after repeated noise is frequently observed and attributed to habituation. However, the degree of disturbance to which a species can habituate may be limited (National Park Service 1994, p. 5.17). Francis et al. (2011a, pp. 6-7) state that overall most species, even urban-adapted species, respond negatively to noise.

Whether a bird moves away from a site of disturbance or stays on site will be dependent on the quality of the current site, the distance to other suitable sites, the relative risk of predation or density of competitors at different sites, and the investment an individual has made to a site (i.e. establishing a territory) (Gill et al. 2001, p. 266). A bird with suitable habitat nearby may avoid disturbance because it has alternative sites to go to, but a bird with no suitable habitat nearby will be forced to remain onsite despite the disturbance, regardless of whether or not this will affect survival or reproductive success (Gill et al. 2001, p. 266). The cost of moving to a new site for a territorial species could be high (Gill et al. 2001, p. 266).

Habitat Degradation

There are multiple ways for anthropogenic noise to cause habitat degradation including noise pollution, masking of avian acoustic signals, changes in predation risk, and reduction in reproductive success. Noise pollution is defined as undesirable human noise, and has increased in most environments over the last century (Ortega 2012, p. 7). Noise pollution can affect birds in numerous ways including physical damage to ears; stress, fright and avoidance responses; changes in reproductive success and in vocal communication; and interference with ability to hear predators and other sounds (Ortega 2012, p. 8). Anthropogenic noise could be a factor driving bird species out of urban areas, even when other habitat requirements are still sufficient (Slabbekoorn and Ripmeester 2007, p. 73).

Most studies on habitat degradation from noise have focused on highway and gas drilling compressor pads, and these studies demonstrate that habitat near a noise source is less suitable than habitat farther away. Francis et al. 2011b (p. 1269 and 1278) found that compressor noise at gas wells caused a five percent lower occupancy of avian species near the pads. Bayne et al. 2008 (p. 1190) found that passerine density was significantly influenced by chronic anthropogenic noise from gas compressors, and that noise levels from compressor stations affected birds up to 700 meters into the surrounding forest. Ovenbirds (*Seiurus aurocapilla*) were found to have lower pairing success near compressor pad sites compared with noiseless well pads (Habib et al. 2007, p. 176). Foppen and Deuzeman (2007; reported in Slabbekoorn and Ripmeester 2007, p. 9) found that great reed warblers (*Acrocephalus arundinaceus*) had higher densities of territories in a wetland near a busy road during two years when the road was closed, compared to years both before and after the road closure. Kuitunen et al. 1998 (p. 297) found that land bird density was lower closer to highways, but this was not the case for the only *Acrocephalus* species in the study area, *Acrocephalus schoenobaenus* (p. 299). The willow warbler (*Phylloscopus trochilus*) had a much lower density of territorial males within 0-200 meters from a highway compared to habitat farther away, yearling males were found 50 percent more often in the road zone, and the study indicated that the road zone probably serves as a sink for young males due to reduced habitat quality from noise (Foppen and Reijnen 1994, p. 99). These studies generally show that noise pollution can cause habitat degradation.

Masking

Anthropogenic noise that drowns out vocal communication between birds is called masking. Masking can have serious consequences because birds communicate vocally to attract mates and defend territories (Ortega 2012, p. 10; Slabbekoorn and Ripmeester 2007, p. 1; Barber et al. 2010, p. 180). Masking of communication necessary for territory defense and mate attraction may have a negative impact on reproductive success and exclude birds from otherwise suitable habitat (Halfwerk et al. 2011, p. 210). Halfwerk et al. (2011, pp. 217-218) suggest four mechanisms related to masking that could reduce avian reproductive success: (1) female birds interpret male songs masked by high noise as of lower quality and put less energy into the breeding cycle; (2) a noisy territory may be perceived of as being a lower quality and avoided, reducing the number of available territories for breeding; (3) increased noise levels cause physiological stress due to reduced foraging opportunities if prey are less easy to detect or because the bird has to spend more time scanning for predators; and, (4) noise could have a negative impact on parent-offspring communication.

Anthropogenic noise is typically loud and low in pitch (Slabbekoorn and Ripmeester 2007, p. 1). Birds with low-frequency signals are more likely to abandon noisy areas (Francis et al. 2011a, p. 7), including noisy roads (Slabbekoorn and Ripmeester 2007, p. 1), and birds inhabiting noisy areas may sing at a higher frequency to reduce masking by noise (Francis et al. 2011a, p. 6; Barber et al. 2010, pp. 185-186; Slabbekoorn and Ripmeester 2007, p. 3). How well a species can survive in urban and other noisy environments may depend on how well they can adjust the frequency of their vocal communication (Slabbekoorn and Ripmeester 2007, p. 3). *Luscinia megarhynchos*, an urban nightingale in Berlin, was found to sing at higher sound levels in noisy locations and raised their song volumes in response to traffic noise by singing louder on weekday mornings than weekends (Brumm 2004, pp. 434-435). Slabbekoorn and Peet (2003, p. 267) found that urban great tits (*Parus major*) at noisy locations sang with a higher frequency. Males singing at higher vocal amplitudes may be at a disadvantage due to increased energetic costs of singing loudly (Brumm 2004, p. 439). Noise pollution can also inhibit a bird's ability to detect predators (Habib et al. 2007, p. 181; Ortega 2012, pp. 13-14) or drown out alarm calls warning of approaching predators (Barber et al. 2010, p. 182 and 184).

The Service does not have data on the frequency of the nightingale reed-warbler song (Marshall 2012, pers. com.). Few songbird species rely just on low frequencies but one species that does is the great reed-warbler, and other nightingale species are known to use a wide range of frequencies, including very low ones (Slabbekoorn and Ripmeester 2007, p. 9).

Breeding

Anthropogenic noise can have negative effects on avian breeding (Halfwerk et al. 2011, p. 210; Slabbekoorn and Ripmeester 2007, p. 2; Ortega 2012, p. 10). Noise may affect egg production, incubation, brooding and nest abandonment (Ortega 2012, p. 10). Halfwerk et al. (2011, p. 210) found that females laid smaller clutches in noisier areas, and that noise recorded in April had a negative effect on the number of great tit fledglings independent of clutch size, compared to noise in March. High noise levels could lead females to breed later, allocate less energy to care of eggs and chicks, and cause communication difficulties between parents and offspring (Halfwerk et al. 2011, pp. 217-218).

Habib et al. (2007, p. 176) found that ovenbird pairing success was reduced, and more inexperienced birds were breeding for the first time, near noisy compressor sites compared to noiseless sites. This reduction in ovenbird pairing success near compressor sites was likely caused by noise interfering with a male's song, thereby inhibiting communication with females and reducing pair success (Habib et al. 2007, p. 176). Foppen and Reijnen (1994, p. 95) found that the zones nearest to a highway served as a sink for male willow warblers, and that the proportion of successful yearling males was 50 percent lower in the road zones compared to zones farther away from the highway.

There may be differences between the effects of chronic noise and intermittent loud noise in the responses of breeding birds. Birds that select nest sites with chronic noise may "accept" the noisy conditions and not abandon nests in response to the noise. However, birds that select nest sites during quiet times, and then become disturbed by noisy conditions later, may abandon nests (Ortega 2012, p. 10).

In a study of the effects of helicopter noise from the Marine Corps Air Station Miramar (MCAS) on California gnatcatcher (*Polioptila california californica*) reproduction, Hunsaker and Rice (2006, p. 101) found that noise levels at MCAS did not affect reproductive success. California gnatcatchers found and inhabited suitable nesting sites in spite of the noise environment, and the factors affecting nest success were habitat, topography, and rainfall. Awbrey and Hunsaker (1997, p. 3177) found that fixed-wing aircraft noise at Naval Air Station Miramar was correlated with fewer California gnatcatcher nest attempts and eggs laid, but that once a nest was established with eggs in it, military aircraft noise had no detectable influence on reproductive success. In Hawaii, Vanderwerf (2000, p. 9) studied the response of Oahu elepaio (*Chasiempis sandwichensis ibidis*) at eight nests to military noise (artillery blasts ranging from 89-116 dB). No elepaio flushed from a nest in response to artillery noise. A mild response was only observed twice by the same incubating male who raised his head and scanned the area after an artillery blast then resumed preening after 1-2 seconds (Vanderwerf 2000, p. 38). Delaney et al. (2002, p. 54) found that the nesting success of red-cockaded woodpeckers (*Picoides borealis*) near Fort Stewart, Georgia, was not significantly affected by experimental and passive military training noise. However, red-cockaded woodpeckers did flush from their nests repeatedly due to nearby (less than 100 meters) artillery and blank fire events, but returned to their nests quickly and without impact to nesting success (Delaney et al. 2002, p. 59). The effects of aircraft noise on Oahu elepaio or red-cockaded woodpeckers were not tested in either study.

Birds may also suffer physical damage to their ears from loud noise (Barber et al. 2010, p. 181). Damage can occur from single blasts (>140 dBA), multiple blasts (>125 dBA) or continuous exposure to noise at greater than 110 dBA (Ortega 2012, p. 9; Dooling and Popper 2007, p. 23). Birds are able to regenerate the sensory cells of the inner ear providing a way for them to recover from physical damage to the ear from loud noise, and so do not suffer permanent hearing loss like mammals (Dooling and Popper 2007, p. 5 and p. 25). However, in their review, Dooling and Popper (2007, p. 27) state that the effects of short, intermittent, and high intensity sounds on avian hearing are much less known than that from highway noise.

Effects of Aircraft Overflight Noise on Nightingale Reed-Warblers

Upon implementation of Divert, military training flights would occur up to eight weeks a year at GSN. Exact training exercises are not defined at this time. Humanitarian operations occurring outside the eight week training time may also occur but are not expected to significantly disturb nightingale reed-warblers above current baseline conditions at the airport. The focus of this section will be the effects of increased noise from aircraft overflights on nightingale reed-warblers from eight weeks of joint military exercises at GSN.

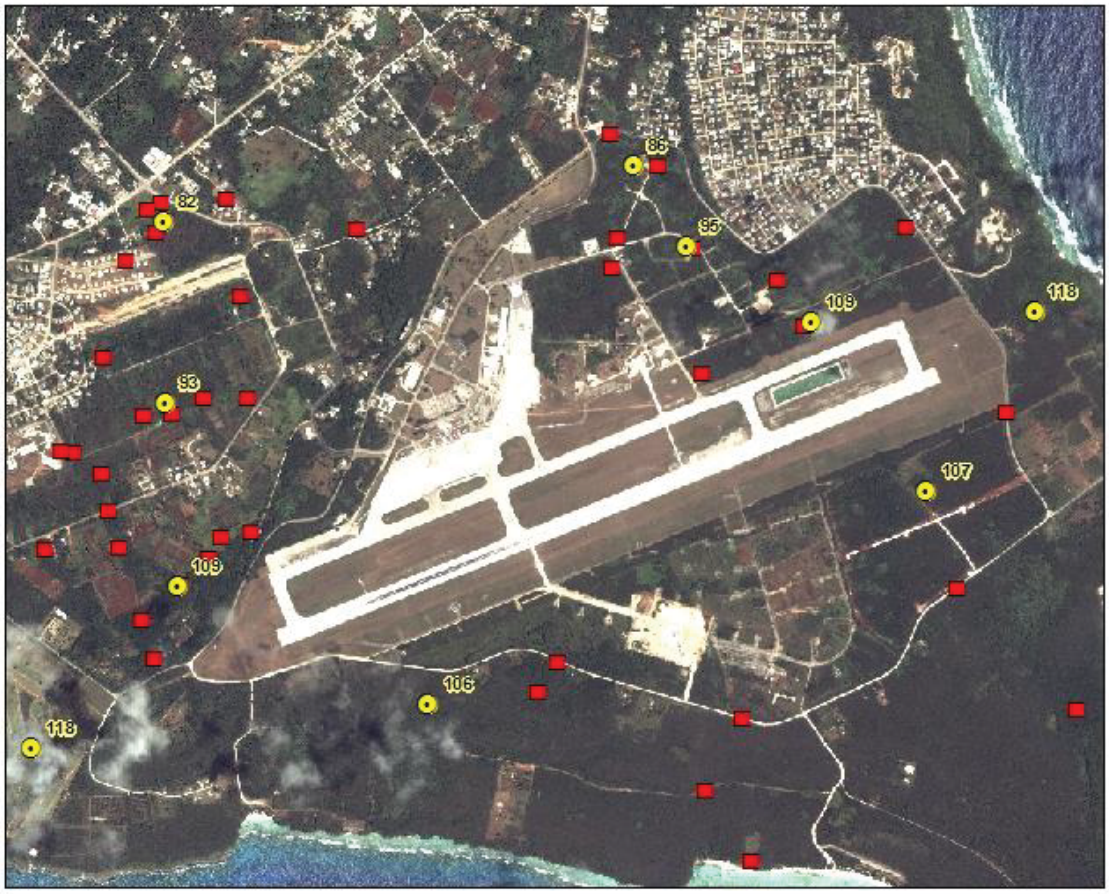
The noise disturbance from the training will be short-term, high-intensity, repeated single pulse, and intermittent. In the areas closest to the runway the average daily noise (DNL), as presented in the medium scenario in the DEIS (USAF 2012), would increase approximately 20 to 25 dBA over baseline conditions, with average daily sound levels not rising above 83 dBA. However, the maximum noise from each individual aircraft overflight will increase from baseline conditions between 10 to 29 dBA for F-22 (or similar fighter jet) training flights, depending on proximity to the airport runways (Table 1, Figure 5). The loudest noise would occur at the east and west ends of the runway where noise from F-22 training flights could reach 118 dBA for each take-off or landing. The maximum number of F-22 flights per day would be 48, and the

noise event would last less than 60 seconds, with the maximum sound level occurring only briefly. Flights from KC-135, and similar aircraft, will also occur; however noise from these flights does not rise above current conditions and therefore no adverse effect is expected from operation of these planes.



U.S. Fish & Wildlife Service

Figure 5. Noise Levels and Nightingale Reed-Warblers Locations





1:26,000

0 02 04 Miles

0 0.25 0.5 Kilometers

DIVISION OF ECOLOGICAL SERVICES
HONOLULU, HI : MAP DATE: 12/3/12

NIRW Locations

Lmax F22 dBA

Table 1. Noise levels (in dBA) from current aircraft operations and proposed military operations for ten points surrounding GSN in occupied or potential nightingale reed-warbler (NIRW) habitat.

	Current	Proposed Military		
Location	**767**	**KC-135**	**F-16**	**F-22**
East end of runway	89.4	95.2	115.9	118.1
West end of runway; east golf course pond	92.6	97.3	115.8	117.7
Occupied NIRW territory north of runways	85.4	79.1	105.7	108.7
As Gonno farm area; occupied NIRW territories	84.1	81.2	99.1	108.7
Obyan area south of runways	85.2	76.5	103.5	106.4
Obyan area south of runways	83.8	78.0	104.8	106.5
Occupied NIRW territory north of runways	76.5	64.7	85.7	94.5
Koblerville; occupied NIRW territories	73.3	60.0	83.3	93.0
Occupied NIRW territory north of runways	76.4	55.7	78.8	86.3
Koblerville; occupied NIRW territories	68.3	45.4	73.1	82.2

The nightingale reed-warblers that have territories surrounding GSN may be habituated to current airport noise levels, along with noise from vehicular traffic and rural residential areas. The most frequent aircraft flying currently out of GSN is the Piper Cherokee (a single-engine aircraft) with 113 daily flights, followed by the Cessna 441 (13 daily flights), the 747-200 (6 flights), and the 767-300 (6 flights) (USAF 2012, p. 3-4). The 767 is the loudest aircraft currently operating out of GSN, and is similar in noise level to the 747. Noise from 767 and 747 takeoffs and landings range from approximately 75 dBA to 93 dBA 12 times a day in areas surrounding GSN (see Table 1).

Male nightingale reed-warblers have high site-fidelity to their established territories, remaining in the same location for multiple years (Craig 1992; Mosher 2006; Johnson 2003). It is not known what levels of disturbance or habitat degradation would cause a male reed-warbler to abandon an established territory. However, as described above, some birds may be forced to stay in habitat made unsuitable by noise disturbance because suitable habitat is limited elsewhere. The nightingale reed-warbler is a strongly territorial species (Mosher 2006, USFWS 1998b) and could appear habituated to airport noise but actually be maintaining territories in the area due to habitat limitations not habituation, and may suffer fitness costs due to this. Habitat loss is considered one of the primary threats to the nightingale reed-warbler (USFWS 1998b), and this, combined with territoriality, may mean that some pairs are forced into lower-quality habitat. There are no studies comparing reproductive success of reed-warblers in undisturbed versus disturbed habitats, so it is unknown if the birds near GSN suffer fitness costs because of the noise disturbance in the area.

Nightingale reed-warblers have been observed to be tolerant of noise disturbance (Rounds pers. com. 2012). They have been observed in urban areas of Garapan, on the edges of residences, farms, and industrial areas where use of heavy equipment and construction occurs, and successfully nested with heavy equipment operating 75 meters away at a quarry site (Rounds pers. com. 2012; Gourley and Johnson 2002). While there have been no comprehensive studies of reed-warbler response to noise, it does appear that the species is tolerant to some levels of noise disturbance.

For eight weeks a year, both the noise level and frequency of aircraft flights will increase under Divert. During the non-breeding season, nightingale reed-warblers could be disturbed by military training flights while foraging or roosting. In these cases responses may include startling, fight-or-flight responses, and/or flushing. Since the noise is of short-duration, it is not expected that these responses would significantly disrupt foraging or roosting and most likely the birds will quickly return to what they were doing. Nightingale reed-warbler communication may be disrupted in the short-term if aircraft noise exceeds reed-warbler song frequency.

Eight weeks of military training during the nightingale reed-warbler breeding season could have adverse effects on breeding success for pairs with territories near the airport. The adverse effects are most likely to occur during the territory formation, nest building, egg-laying, and early incubation stages (see Awbrey and Hunsaker 1997). If military training occurred during these early stages it is possible that a pair could abandon a territory or a nest due to the new noise disturbance (Ortega 2012, p. 10). What seemed high-quality suitable habitat without the noise disturbance may degrade to unsuitable habitat after military training begins.

Incubating or brooding birds may flush off nests as with red-cockaded woodpeckers (Delaney et al. 2002, p. 55) or may stay on the nest similar to the Oahu elepaio (Vanderwerf 2000, p. 38). Because no studies have monitored reed-warbler nests during disturbance events, it is unknown how incubating or brooding nightingale reed-warblers will react to F-22s or other fighter jets flying overhead. Once a nest is established it is less likely that the pair will abandon the nest or the territory and the noise disturbance at this point is less likely to reduce reproductive success. Begging calls from nestlings or juveniles could be temporarily masked by the loud noise but because the noise is of short-duration it is unlikely to affect provisioning rates.

The noise pollution from the military training could lead to overall habitat degradation around the airport. It is possible that during training events birds could abandon territories and look for new less-disturbed habitats for breeding. Once the training session is over the habitat will become quiet again, and the same pairs, or new ones, could move back in. In a worst-case scenario a cycle could be repeated of birds abandoning and reestablishing territories and the area could become a sink for nightingale reed-warbler breeding (see Halfwerk et al. 2011, Ortega 2012, Habib et al. 2007).

Predation is a primary cause of nightingale reed-warbler nest failure (Mosher 2006; USFWS 1998b). Feral cats or rats stalking a nightingale reed-warbler are likely to prey on the birds regardless of noise. Predation from Micronesian starlings (*Aplonis opaca*) or collared kingfishers (*Todiramphus chloris*) on nightingale reed-warbler nests is possible, though not documented in the literature (Mosher 2006, p. 60). If noise disturbance causes a nightingale reed-warbler to flush from incubating or brooding at a nest it is possible an avian predator more tolerant of noise could take advantage of the absence and prey upon the nest, but again, a cat or rat is likely to predate regardless of the noise. Overall, it is not expected that noise from Divert training will cause an increase in nightingale reed-warbler predation because the noise disturbance will be intermittent and short in duration.

As described above, hearing damage from single, repeated loud noises typically occurs at noise levels greater than 125 dBA. Noise from the Divert training is not expected to rise above 120

dBA in nightingale reed-warbler habitat. Therefore, we do not expect hearing damage from the proposed training activities.

Take assessment

Guidance on potential effects of noise on endangered wildlife and when disturbance rises to the level of take was taken from USFWS (2006), Pater et al. (2009), and Dooling and Popper (2007). While nightingale reed-warblers may be disturbed by many human activities, we anticipate that such disturbance rises to the level of harassment under a limited range of conditions. For the Divert project, we are assuming that harassment may occur when nightingale reed-warblers demonstrate behavior suggesting that the safety or survival of the individual is at significant risk, or that a reproductive effort is potentially lost or compromised. Examples of this behavior include, but are not limited to:

- An adult is repeatedly flushed from a nest during the incubation, brooding, or fledging period, that potentially results in egg failure or reduced juvenile survival.
- An adult is repeatedly flushed from a nest resulting in increased energetic costs.
- An adult or juvenile abandons a territory.

The amount of incidental take of the nightingale reed-warbler that will occur is difficult to quantify because the effects of noise on nightingale reed-warblers is not well studied, and it is unknown how frequently joint military exercises will occur during the nightingale reed-warbler breeding season. For this Biological Opinion, we quantified take using the best available data on effects of noise on songbirds (described above), our knowledge of nightingale reed-warbler behavior, and best estimates of joint military exercises training schedules provided by the USAF.

We estimate that there are potentially four nightingale reed-warbler territories at the west and east ends of the runway where the loudest noise will occur. These territories will be subject to noise levels up to 118 dBA from F-22, or similar fighter jets, overflights. The maximum number of F-22 (or similar fighter jet) flights per day would be 48 and the best estimate of a training event is two weeks. This level of training and noise disturbance could cause nightingale reed-warblers to abandon territories or nests, especially if the training occurred immediately prior to or at the beginning of a nesting attempt. Birds may also have startle responses and/or flush from nests. Nightingale reed-warblers may suffer increased energetic costs due to repeated loud noises and flushing. The increased energetic costs could adversely affect reed-warblers by decreasing the energy available to them for foraging and reproduction. The noise levels in these areas could cause these four territories to become unsuitable habitat for reed-warblers, though they may still occupy the area, and breed successfully, during quiet times.

Adults displaced by habitat degradation will attempt to establish new territories in areas that may already be occupied by other nightingale reed-warblers. Since the nightingale reed-warbler is territorial, neighboring pairs are likely to aggressively confront the displaced adults. A frequently observed pattern of intra-specific passerine bird territorial behavior is that the bird defending its territory is more aggressive than an intruder and is usually successful at driving the intruder away (Van Tyne and Berger 1976). The confrontation could disrupt the neighboring pairs' normal nesting behavior patterns by taking adults away from nests during the breeding season to defend their territories. However, this disruption is unlikely to rise to the level of take.

Nightingale reed-warblers are also present in habitats to the north and south of the airport runways in areas that will experience periodic noise up to 110 dBA from military training events. These areas, within approximately 500 meters of the runways, may support up to 13 nightingale reed-warbler pairs (based on survey data for Divert and habitat estimations). In our opinion it is less likely that birds will abandon territories in these areas, but birds could flush from nests if they are startled, especially during early training events before they are habituated to the noise. The noise disturbance will increase to over 20 dBA greater than ambient nesting conditions in these areas, and that has been used by the Service as a threshold for disturbance reaching the level of take (USFWS 2006). However, the birds in these areas currently experience daily noise, from take-offs and landings of commercial aircraft, that reaches up to 90 dBA. We feel that the noise disturbance may cause increased energetic costs for nightingale reed-warblers flushed from nests due to joint military exercise; however, we do not expect this disturbance to result in reduced reproductive success. Therefore, we expect a low level of take of nightingale reed-warblers, in the form of harassment and increased energetic costs from flushing, in the 13 territories that will experience increased noise (but below 110 dBA) from joint military exercises.

Evaluation under SUMB Programmatic Biological Opinion

Due to noise disturbance from implementation of Divert military exercises, four nightingale reed warbler territories will be subject to direct impacts including habitat loss and degradation and thirteen nightingale reed-warbler territories will be subject to direct impacts of habitat degradation. Under the SUMB Programmatic Biological Opinion project impacts are assessed by determining the number of territories directly and indirectly affected by the action. For noise disturbance, ESA responsibilities will be addressed by the purchase of 17 credits and by implementing associated conservation measures.

Biosecurity

To reduce the risk of introduction and spread of non-native, invasive species via Divert activities, the USAF has proposed to implement a variety of conservation measures throughout the action area. Effective interdiction of brown treesnakes on Guam and the CNMI is critical to preventing the spread of this species. The USAF has committed to snake inspection (100% as a goal), construction of snake barriers and brown treesnake rapid response to support military training. In addition, the USAF has committed to the establishment of a biosecurity program during construction and implementation of the proposed project. Successful implementation of the biosecurity program will prevent adverse effects to listed species, and other native wildlife, from introduction of non-native species.

CUMULATIVE EFFECTS

Cumulative effects include the effects of future non-Federal actions that are reasonably certain to occur within the area of action subject to consultation. Future Federal actions will be subject to the consultation requirements established in section 7 of the ESA and, therefore, are not considered cumulative for the proposed action. Sustenance farming, clearing, and burning are ongoing and are likely to continue to be implemented on the island of Saipan. However, use of the SUMB to off-set impacts from authorized habitat clearing will limit adverse effects to nightingale reed-warblers from habitat loss. Unauthorized clearings are also likely to continue on Saipan, further reducing the amount and quality of nightingale reed-warbler habitat. Natural disasters, such as typhoons, also occur regularly on Saipan further damaging habitat. Persecution of nightingale reed-warblers by people resentful of ESA restrictions has also been reported, and may continue in the future.

CONCLUSION

The Service anticipates that the direct and indirect effects of the proposed action will result in take of the nightingale reed-warbler in the form of harassment from noise disturbance and harm from habitat clearing. Adverse effects of the proposed actions on nightingale reed-warblers will be minimized by avoidance and minimization measures. For the nightingale reed-warbler, the Service has determined that the proposed action conforms with the SUMB Programmatic Biological Opinion based upon the nature of the action and the incorporation of avoidance, minimization, and offsetting measures as described in that document. Additionally, the status, baseline, and potential project impacts are current and consistent with those evaluated within the SUMB Programmatic Biological Opinion. After reviewing the current status, the environmental baseline, the effects of the proposed action, and the cumulative effects, it is the Service's biological opinion that implementation of the proposed action discussed herein is not likely to jeopardize the continued existence of the nightingale reed-warbler.

INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and Federal regulations promulgated pursuant to section 4(d) of the ESA prohibit the take of endangered or threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct. Harm is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavior patterns which include, but are not limited to, breeding, feeding, or sheltering. Harass is defined by the Service as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, carrying out an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2) of the ESA, taking that is incidental to and not intended as part of the agency action is not considered a prohibited taking under the ESA provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The measures described below are non-discretionary, and must be undertaken by the USAF so that they become binding conditions of any grant, permit, or permissions issued by the USAF, as appropriate, for the exemption in section 7(o)(2) to apply. The USAF has a continuing duty to regulate the activity covered by this incidental take statement. If the USAF (1) fails to assume and implement the terms and conditions or (2) fails to require the adherence to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit, grant document, or other permissions, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the USAF must report the progress of the action and its impact on the species as specified in the Incidental Take Statement.

AMOUNT OR EXTENT OF TAKE

Based on the proposed project description and the analysis of the effects of the proposed action provided above, the Service anticipates that construction and implementation of Divert on Saipan may cause take of the nightingale reed-warbler. The Service is tracking the loss of the nightingale reed-warbler and its habitat permitted under the SUMB Programmatic Biological Opinion, and we evaluate each project to ensure that continued implementation will not result in unacceptable effects to the listed species. The conservation measures appropriate to avoid, minimize and offset project impacts as identified in the SUMB Programmatic Biological Opinion have been included within the project description above. We estimate the following forms of incidental take will occur from construction and implementation of Divert training:

1. One nightingale reed-warbler territory will be cleared for construction of the east parking apron resulting in harm of up to two adults and up to four juveniles.

2. Four nightingale reed-warbler territories could be abandoned due to habitat degradation from repeated and loud noise from fighter jet training resulting in harassment of up to eight adults and up to sixteen eggs, chicks, or juveniles.

3. Thirteen nightingale reed-warbler territories will suffer habitat degradation from noise disturbance from fighter jet training resulting in periodic, but rare, harassment of up to twenty-six adults.

Effect of the Take

The level of Incidental Take anticipated from this project is consistent with the SUMB Programmatic Biological Opinion and will not jeopardize the survival or recovery of the nightingale reed-warbler.

Reasonable and Prudent Measures

The reasonable and prudent measures given below, with their implementing terms and conditions, are designed to minimize the impacts of incidental take that might otherwise result from the proposed actions. If, during the course of the action, the level of incidental take is exceeded, such incidental take represents new information requiring reinitiation of consultation and review of the reasonable and prudent measures provided. In addition, the action that caused the taking must cease; the action agency must immediately provide an explanation of the causes of the taking; and must review with the Service the need for possible modification of the

reasonable and prudent measures. The following reasonable and prudent measures are necessary and appropriate to minimize the effect of take on the nightingale reed-warbler. The measures described below are non-discretionary and must be implemented.

1. The USAF shall minimize the potential for harassment, harm, or mortality of nightingale reed-warblers.

Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the ESA, the USAF must ensure compliance with the following terms and conditions, which implement the reasonable and prudent measure described above. These terms and conditions are nondiscretionary.

The following terms and conditions implement reasonable and prudent measure number one.

1(a) To the extent practicable, consistent with national security and contingency requirements, and military safety and security requirements, the USAF will notify the Service on an annual basis of upcoming Divert training events at GSN including timing and description of the joint military exercises.

1(b) The USAF will submit annual reports to the Service on the first of December of each year beginning in 2014. The purpose of the annual report is to discuss successes and failure of all avoidance, minimization, and conservation measures, and terms and conditions listed in this biological opinion in relation to the anticipated and observed impacts and incidental take. The report will include details regarding invasive species control and interdiction including which cargo/flights were inspected or non-inspected, potential level of risk associated with each cargo/flight type, and where the cargo/flights originated from for training related actions only. The reports should include explanations if specific inspections were missed and document all snake detections or other high risk incidents and the method used for the detection for training related actions only. The report will also include the number of brown treesnake kills during training actions.

The annual report will also include a description of all actions that occurred at GSN related to Divert (including humanitarian operations, flight diversions, and joint military exercises).

1(c) The USAF will convene an annual coordination meeting or conference call prior to 28 February of each year, starting in 2015, to discuss findings within the compliance report and adapt avoidance, minimization, and conservation measures to further reduce incidental take.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs Federal agencies to utilize their authority to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. The term "conservation recommendations" has been defined as suggestions

from the Service regarding discretionary measures to minimize or avoid adverse effects of a proposed action on listed species or critical habitat or regarding the development of information. The recommendations provided here relate only to the proposed action and do not necessarily represent complete fulfillment of the agency's 7(a)(1) responsibilities for these species.

1. The USAF should implement a monitoring project, using qualified avian biologists, when joint military exercises begin operating out of GSN (anticipated in 2016 or 2017). The monitoring project could occur in habitats experiencing noise above 100 dBA from take-off and landings of fighter jets (see Figure 3). The monitoring project could be used to:
   - Determine noise levels in nightingale reed-warbler territories surrounding the airport when fighter jets take-off and land at GSN.
   - Determine if take-off and landing of fighter jets from GSN cause a behavioral response (i.e. startle, alert, flushing, stress, etc.) in nightingale reed-warblers.
   - Determine the effect of take-off and landing of fighter jets from GSN on nightingale reed-warbler breeding success in areas surrounding the airport.
   - Determine population trends and territory fidelity of nightingale reed-warblers surrounding the airport.

2. The USAF should implement rat and/or cat control at nightingale reed-warbler territories, and monitor nightingale reed-warbler nest success, to determine how predator control affects breeding success.

REINITIATION-CLOSING STATEMENT

This concludes formal consultation on this action. As required in 50 CFR § 402.16, reinitiation of consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operation causing such take must cease pending reinitiation.

As stated in the Conclusion (above), the Service's finding of non-jeopardy is based in large part on the conservation measures. Should there be a failure to carry out any or all of the described measures, or if the measures are not effective, or if these measures are modified in any way without Service coordination, reinitiation of consultation will be required. If you have any questions regarding this Biological Opinion, please contact Rachel Rounds at (808) 792-9400.

Sincerely,

for Loyal Mehrhoff
Field Supervisor

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Appendix 1. Not Likely to Adversely Affect Determination for the Mariana Common Moorhen, Mariana Swiftlet, and Green Sea Turtle

This Appendix is in response to your request for our concurrence with your determination that the Divert Project, as described above, will not adversely affect the endangered Mariana common moorhen, Mariana swiftlet, or green sea turtle. The findings and recommendations in this consultation are based on: (1) your Biological Assessment dated August, 2012; and (2) other information available to us. A complete administrative record is on file in our office. This response is in accordance with section 7 of the Endangered Species Act of 1973 (Act), as amended (16 U.S.C. 1531 *et seq.*).

Mariana common moorhen

Listing Status

The Mariana common moorhen was federally listed as an endangered species in 1984 (USFWS 1984). The recovery plan for the Mariana common moorhen was finalized in 1991 (USFWS 1991a, 55 pp.). A five-year status review completed in 2009 determined that the Mariana common moorhen still meets the definition of endangered (USFWS 2009, p. 9).

Historic and Current Distribution

The Mariana common moorhen is currently found on Saipan, Tinian, Rota, and Guam. The Mariana common moorhen is believed to be extirpated from Pagan due to the volcanic eruption in May, 1981, and destruction of vegetation by feral ungulates (Stinson et al. 1991, pp. 41–42). In 2004, it was estimated that there were approximately 90 Mariana common moorhen on Guam, 154 on Saipan, 41 on Tinian, and only two individuals on Rota (Takano and Haig 2004, p. 247 (Table 9)). On Guam, the number of Mariana common moorhens has recently decreased at the Fena Valley Reservoir potentially due to the loss of *Hydrilla verticillata,* a wetland plant used as a nesting substrate, as a result of eutrophication of the lake after a typhoon (Brooke and Grimm 2008, p. 2). While it is possible that the Fena Reservoir birds moved to other wetlands and the Guam population has not declined overall, comprehensive surveys on Guam would be needed to determine the impact of the loss of habitat at Fena Lake to the overall population. Moorhen surveys are conducted by the CNMI Division of Fish and Wildlife at 22 wetland sites on Saipan. Data from these surveys shows that population numbers were stable on Saipan from 2007-2010 (CNMI DFW 2010).

Ecology and Life History

The Mariana common moorhen prefers wetlands with diverse, non-persistent, emergent vegetation containing deep and shallow water areas with equal areas of vegetation cover and open water (Ritter and Savidge 1999, p. 286; Stinson et al. 1991, p. 39). Primary habitats (as defined in the recovery plan) include: Agana marsh, Fena Valley reservoir, and the Naval Station Marsh, Guam; Lake Hagoi on Tinian; and Lake Susupe, Puntan Muchot, and Garapan wetlands on Saipan (USFWS 1991a, pp. 4–16). Several secondary wetland habitats were identified on Guam and Saipan; only one secondary wetland (Magpo) on Tinian was considered important for the recovery of the species (USFWS 1991a, pp. 4–16).

Mariana common moorhens feed on plant and animal matter in or near wetlands (USFWS 1991a). Seale (1901, p. 31) found grass, insects, and larvae in the stomachs of the Mariana

common moorhen on Guam. Pratt et al. (1987, p. 128) reported that Mariana common moorhen eat mollusks and plants. Little is known about the reproduction of the Mariana common moorhen (USFWS 1991a, p. 17). Nests have been constructed in *Scirpus litoralis*, *Panicum muticum*, and *Cyperus* spp. (Ritter 1994, p. 128; USFWS 1996, p. 7). Birds often nest multiple times in a year and juveniles from early broods are known to stay on their natal territory and help rear siblings from later broods (Ritter 1994, p. 130; Takano 2003, pp. 4–5).

Threats

Currently, the main two threats to the Mariana common moorhen are: (1) loss and degradation of wetland habitat, including filling, alteration of hydrology, invasion of habitat by non-native plants, and unrestricted grazing of domestic and feral ungulates; and 2) predation by introduced species (USFWS 1991a, p. 19; USFWS 1996, pp. 11–12).

Conservation Needs

Only interim recovery objectives were identified in the recovery plan due to a lack of data necessary to fully understand the needs of viable populations of this species (USFWS 1991a, p. 21). The primary task is to promote the survival of the species by providing stable, productive habitat throughout the historical Mariana common moorhen range. This entails 1) securing and managing all primary habitats to maximize the habitat conditions; 2) maintaining the secondary habitats as wetlands or creating new wetlands for those that are lost; and 3) minimizing mortality from predation, poaching, and other factors including human disturbance.

Environmental baseline

In 2001, an island-wide survey produced an estimate of 154 Mariana moorhens on Saipan (Takano and Haag 2004, p. 245). The CNMI Division of Fish and Wildlife conducts quarterly surveys at 22 wetlands on Saipan. From 2007 to 2010 the total number of moorhens detected at these sites has remained stable between 70 to 80 moorhens per survey (CNMI DFW 2010, p. 44).

Surveys conducted from January to March of 2012 by USAF contractors detected a single adult Mariana common moorhen at the Coral Ocean Point golf course east pond. No moorhens were detected at the GSN water catchment basin or the Coral Ocean Point golf course west pond, and no other potential moorhen habitat is located within the action area. The Coral Ocean Point golf course east pond has an impervious lining that inhibits the growth of shoreline vegetation. The moorhen was observed roosting and taking cover under a *Bougainvillea spectabilis* plant along the northeastern shoreline. Mariana common moorhens have also been detected repeatedly at the Coral Ocean Point golf course east pond by the CNMI DFW during quarterly waterbird surveys. Due to the lack of vegetation around the golf course pond, suitable habitat for Mariana common moorhen breeding is not present, and Mariana common moorhen have not been observed nesting at either golf course pond. There are no moorhens located near the Saipan port facilities or the Saipan Upland Mitigation Bank.

Not Likely to Adversely Affect: Mariana common moorhen

The Coral Ocean Point golf course east pond is located approximately 650 meters from the southern edge of GSN and from the nearest potential construction site. Noise from construction of Divert facilities is unlikely to disturb Mariana common moorhens at the east pond because moorhens at this pond would be habituated to noise disturbance from the airport, golf course

operations, and a nearby helicopter launching pad. Mariana moorhens are not found close enough to airport runways to be at risk of a bird strike.

However, increased aircraft operations at GSN under Divert operations will cause an increase in ambient noise at the east pond. Operation of civilian 767 at GSN result in a noise level of approximately 93 dBA from at the east pond (Table 1) from take-offs and landings. Under implementation of the Divert Project, noise levels at the east pond will rise to approximately 118 dBA with take-off and landings of F-22 or similar fighter jets.

There have been numerous studies on the impacts of aircraft overflights to wildlife including studies of waterbirds (e.g., Ward, et al. 1999; Conomy, et al. 1998 a,b; Komenda-Zehnder, et al. 2003). These studies report a wide range of reactions to overflights depending on the biology of the species, its previous exposure to overflights, whether the species is breeding, the type of aircraft, the altitude of the aircraft, and the lateral distance between aircraft and the species. The variability in these reactions and their specific circumstances make it difficult to be certain how a particular species, such as the Mariana moorhen, will react to aircraft overflights.

Individuals with previous exposure to aircraft overflights may display less reaction to overflights than individuals without previous exposure (Andersen et al. 1989, Conomy et al. 1998b). This reduced reaction is believed to be a sign that these individuals have habituated to these overflights. This habituation, however, may be individual or species specific. For example, Conomy and others (1998b) found that black ducks (*Anas rubripes*) became habituated to aircraft noise with continued exposure while wood ducks (*Aix sponsa*) did not.

Given that Mariana common moorhens have been using the east pond for at least a decade, it can be assumed that these individuals have habituated to the current level of aircraft overflights. There is no moorhen habitat near Andersen Air Force Base on Guam to use as a comparison airport with high aircraft overflights. Moorhens on Saipan have also been found in other highly disturbed and noisy locations, including the flooded parking lot of an abandoned garment factory at a busy intersection on Saipan (Rounds 2012, pers com). On Guam, Mariana common moorhens nest in a pond immediately adjacent to a busy parking lot at an industrial fuel facility (Rounds 2012, pers com.). Use of these sites indicates that moorhens can tolerate high levels of human disturbance.

There will be a long-term and permanent increase in aircraft operations from the proposed Divert Project, and noise levels from aircraft overflights will increase with F-22 and other figher jets operating out of GSN. Moorhens do not breed at the east pond so disturbance of nesting birds will not occur. Moorhens using the east pond may notice the increase in noise levels from aircraft overflights. However, given their tolerance of human disturbance and habituation to current noise levels, we do not believe this disturbance will rise to the level of harass or harm as defined by the ESA. Therefore, we have determined it is discountable that a Mariana common moorhen would be adversely affected by increased aircraft overflights at GSN given that moorhens are not breeding at the site, appear tolerant of some levels of human disturbance, and are habituated to the current noise levels from GSN.

Because comprehensive biosecurity measures, including HACCP planning and redundant brown treesnake inspections, will be implemented by the USAF to keep brown treesnakes, and other invasive species, off of Saipan, we do not expect adverse effects to Mariana moorhens from introduction of invasive species.

Mariana swiftlet

Listing Status

The Mariana swiftlet was federally listed as endangered on August 27, 1984 (USFWS 1984). A five-year status review was completed in 2010 (USFWS 2010) and a recovery plan for the Mariana swiftlet was completed in 1991 (USFWS 1991b).

Historic and Current Distribution

The Mariana swiftlet is endemic to Guam and the four southern islands of the CNMI (Cruz et al. 2008, p. 233). A population also became established on Oahu, Hawaii, between 1962 and 1965 (Wiles and Woodside 1999, p. 57). Most historical information on the species comes from Guam, where it was reported as being common and the third most abundant species seen during roadside counts, but declined to approximately its current levels by the late 1970s (USFWS 1991b, p. 7). The total number of Mariana swiftlets occurring within its historical range is currently over 6,000 individuals and it currently occurs on Guam (in three known caves within the Naval Munitions Site), Aguiguan (in nine known caves), and Saipan (ten known caves), and is considered extirpated from Tinian and Rota (CNMI DFW 2010, pp. 45-46; Navy 2011, p. 4; USFWS 1991b, pp. 8, 13–14; Engbring et al. 1986, pp. 58–59). Long-term data from swiftlet surveys at 10 caves on Saipan shows that swiftlet numbers have been steadily increasing, to a total count of over 5,500 individuals in 2010 (CNMI DFW 2010).

Ecology and Life History

The Mariana swiftlet nests and roosts in limestone caves with the following characteristics: entrances typically a minimum of 2 m (6.2 ft) high; chambers with dark zones; and fresh air (USFWS 1991b, p. 2). Most birds leave their cave at dawn and return at sunset, but often return from foraging to roost in caves during the day. Swiftlets navigate through the darkest portions of caves using echolocation (Vogt and Williams 2004).

Mariana swiftlets capture prey while flying, and foraging has been observed to occur over a wide variety of habitat types, including cleared and forested areas, but they appear to favor ridge crests and open grassy savanna areas (USFWS 1991b, p. 6). Large flocks have been reported to form in the evening with birds congregating and feeding close to the ground until it is dark (Chantler and Driessens 1995, p. 130). An analysis of swiftlet guano collected from occupied caves on Saipan found that the remains of flying ants (*Formicidae*) were common, as were the remains of beetles (*Coleoptera*) (Kershner et al. 2007).

Eggs are laid in cup-shaped nests made of moss and saliva attached to cave walls or ceilings. A single egg is laid, usually between January and July, which is incubated for approximately 23 days with fledging occurring after 47 days (Reichel et al. 2007). Both adults care for the nestling which is, on average, fed by each adult 1.8 times a day (Morton and Amidon 1996).

Threats to the Mariana Swiftlet

The restricted distribution of Mariana swiftlets, along with its small population size and dependence on caves, makes the species vulnerable to threats. The causes for the decline of Mariana swiftlets are mostly unknown, but human disturbance, predation, pesticides, and disease have all been hypothesized as having a role. Swiftlets have been documented to flush or fail to enter their caves when humans are near or within their caves (Wiles and Woodside 1999, pp. 57, 61). Swiftlet sensitivity to human presence has resulted in injuries to chicks and adults and could result in damage to eggs (Wiles and Woodside 1999, p. 61). Sources of human disturbance have included Japanese soldiers during World War II, guano mining, hunters, hikers, and vandalism.

While the introduction of brown treesnake is known to have caused the extirpation of many bird species in Guam and CNMI, it is not known whether it has significantly affected swiftlets. Brown treesnake predation on Mariana swiftlets is considered to be a regular event and only those birds able to find nest or roost sites on high, smooth walls and ceilings are able to avoid snake predation. In August, 2011, seven brown treesnakes were observed climbing the walls of the Mahlec cave on Guam (Mosher 2011, pers. com.). The use of pesticides such as DDT has been suspected of causing the decline of swiftlet populations on Guam (Diamond 1984, p. 452), but the concentrations of pesticide residues found in swiftlet guano have not supported this hypothesis (Grue 1985, p. 301). On Saipan, non-native cockroaches are known to destroy swiftlet nests by consuming the saliva that holds the nests to the walls or ceilings (Cruz et al. 2008, p. 242). Savidge (1986, p. 9) investigated the role of disease in the decline of birds on Guam and found that there is no evidence that it has played a significant role. The typhoons that frequently occur in the area may cause periodic declines in swiftlet populations, but are not expected to threaten the species as a whole since the species has survived numerous such events during its evolutionary history (USFWS 1991b, p. 22).

Conservation Needs

The primary threats to the species continue to be predation by the brown treesnake and disturbance at nesting caves. However, other introduced predators and introduced insect species also may have negative impacts to the species. Efforts to minimize disturbance and control snakes and other predators at some nesting colonies have been undertaken. However, additional efforts are needed to help recover the species.

Ongoing Conservation Actions

Brown treesnake trapping occurs at the three occupied swiftlet caves on Guam on the Naval Munitions Site. No predator trapping currently occurs at caves on Saipan or Aguiguan. Quarterly swiftlet departure counts are conducted on Saipan and Guam to monitor swiftlet population numbers.

Environmental Baseline

Swiftlets have been detected foraging over most areas of Saipan, though they are less frequently detected in urban areas (Marshall 2011, pers. comm.). Ten caves are known in Saipan, in the central portion of the island; however, swiftlets are regularly seen foraging in areas where no caves have been found. The nearest swiftlet cave to GSN is more than three kilometers (2 miles) away and the nearest cave to the Saipan port is approximately 1,200 meters away (0.75 mile). There are no known caves in the Saipan Upland Mitigation Bank, though swiftlets frequently

forage there. No Mariana swiftlets were detected during bird surveys at GSN for the proposed project. Island-wide surveys conducted by the Service and CNMI DFW on established transects on Saipan detected swiftlets primarily in the central parts of the island, but swiftlets were also detected in the vicinity of GSN (USFWS 2008).

Not Likely to Adversely Affect: Mariana swiftlet

There are no Mariana swiftlet caves near the Saipan airport or seaport, and no adverse impacts to swiftlet caves from the Divert project are expected. Mariana swiftlets are not detected frequently in the vicinity of GSN. If construction noise or noise from aircraft overflights disturbs swiftlets, they will easily be able to avoid the disturbance and forage elsewhere. The clearing of 4.5 ha of second-growth forest for the Divert Project would also not adversely affect the availability of foraging habitat in the area, or on Saipan. There have been no reports of aircraft striking Mariana swiftlets and the chance of such a strike is discountable given the distance from Mariana swiftlet caves and low presence of swiftlets in the area. Mariana swiftlets may forage near the Saipan seaport; however, this is an industrial port and the low-level of construction noise from the Divert Project in this area is unlikely to adversely affect a Mariana swiftlet. Mariana swiftlets commonly forage in the Saipan Upland Mitigation Bank. Mitigation actions, such as habitat restoration and invasive species removal, for the nightingale reed-warbler that occur in the SUMB will also beneficially affect the Mariana swiftlet. Overall, effects from the proposed project are discountable. Therefore, the project may affect, but will not adversely affect, the Mariana swiftlet, and mitigation actions may benefit the species.

Because comprehensive biosecurity measures, including HACCP planning and redundant brown treesnake inspections, will be implemented by the USAF to keep brown treesnakes, and other invasive species, off of Saipan, we do not expect adverse effects to Mariana swiftlets from introduction of invasive species.

Green sea turtle

The following section summarizes sea turtle biology based on the information in recovery plans and five-year status reviews developed by the NMFS and Service (NMFS and USFWS 1998, 95 pp.; 2007, 105 pp.). Sea turtles are highly migratory, globally distributed, and generally found in tropical and subtropical waters along continental coasts and islands between 30° north and 30° south latitude and, to a lesser extent, in subtropical waters with temperatures above 20° C. The geographic range of sea turtles includes the Caribbean Sea, Atlantic, Pacific, and Indian Oceans and associated bodies of water.

Sea turtles bury their eggs in the sand in upper areas of oceanic beaches. Reproductive maturity occurs at ages ranging from 20 to 50 years and varies by species. Female sea turtles have high site fidelity to their hatching (natal) beaches, returning close to their own hatching site to lay their nests. Females may nest multiple times over a given nesting season. Nesting seasons typically occur at semi-regular intervals, with inter-nesting intervals ranging between two to more than five years depending on the species. Hatchlings emerge 45 to 90 days after a nest is laid. Emerging hatchlings navigate toward the water using visual cues; they move toward the brighter horizon and away from darker silhouettes formed by dune line, tree lines, or cliff walls (Tuxbury and Salmon 2005, p. 312). In addition to nesting, green sea turtles may also use

beaches to haul out and bask, although this behavior has never been documented in Guam or the CNMI (Kelly, 2009, pers. comm.; Wusstig 2009, pers. comm.).

Numbers of breeding green sea turtle populations in Hawaii, Australia, and Japan are increasing (Chaloupka et al. 2008, p. 299; NMFS and Service 2007, p. 13) and numbers of turtles nesting on Guam have been stable (NMFS and Service 2007, p. 13). Approximately 1,000 to 2,000 green turtles inhabit island reef areas in Guam and the southern CNMI (Kolinski et al. 2004, pp. 98, 111). In 1995 and 2001 (Tinian), 1999 (Saipan), and 2003 (Rota), the majority of individuals observed in the surrounding waters were juveniles or sub adults (Kolinski et al. 2001, pp. 59, 66; Kolinski et al. 2004, p. 107; Kolinski et al. 2006, pp. 514, 517; Pultz et al. 1999, p. 92).

In CNMI, green turtle nesting occurs from March to August with some year round nesting documented. The CNMI DFW Sea Turtle Program has monitored green sea turtle nesting activity on Saipan since 1999, and has documented 4 to 18 nests laid per year (CNMI DFW unpublished annual reports). There are two nesting beaches found within the action area: Obyan beach and Coral Ocean Point beach.

Not Likely to Adversely Affect: Green sea turtle

No green sea turtle nesting beaches will be impacted by construction of Divert facilities. Hatchlings or nesting adult females may be exposed to noise from aircraft overflights on Obyan or Coral Ocean Point beaches. Obyan beach is located approximately 1,000 meters from GSN and in the worst-case scenario would have noise levels from aircraft overflights reaching 65-70 dBA. Coral Ocean Point beach is located approximately 900 meters from GSN, and noise levels from aircraft overflights could reach 70-85 dBA in a worst-case scenario. Noise contour lines under baseline conditions do not reach either beach, indicating that current noise levels are below 65 dBA.

Given the small number of green sea turtles nesting on Saipan, and the short period of time that hatchlings or adult female green sea turtles spend on beaches, there is only a small chance that aircraft overflights, which would occur for a maximum of 8 weeks a year, reaching 85 dBA (at Coral Ocean Point) would occur at the same time a hatchling turtle or adult turtle were on the beach. Based on observations of adult green sea turtles at Obyan beach and their reactions to aircraft overflights, it is not expected that the turtles would be adversely affected by a temporary increase in noise (Summers 2012, pers. com.). Therefore, the Divert Project may affect, but will not adversely affect, green sea turtles.

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United States Department of the Interior

FISH AND WILDLIFE SERVICE

Pacific Islands Fish and Wildlife Office
300 Ala Moana Boulevard, Room 3-122, Box 50088
Honolulu, Hawaii 96850

OCT 30 2015

In Reply Refer To:
01EPIF00-2012-F-0445
01EPIF00-2015-I-0364

Mr. William Grannis
Environmental Program Manager
Facilities Engineering Center of Excellence
Air Force Civil Engineer Center
25 E Street, Suite C-200
Joint Base Pearl Harbor-Hickam, Hawaii 96853-5420

Subject: Amendment to the Biological Opinion for Development of Divert Capabilities and Conducting Divert Activities and Exercises, Saipan and Tinian, Commonwealth of the Northern Mariana Islands (01EPIF00-2012-F-0445)

Dear Mr. Grannis:

This letter acknowledges the U.S. Fish and Wildlife Service's (Service) receipt of your July 8, 2015, letter requesting our concurrence with your determination that extending aircraft Divert capabilities and conducting Divert activities and exercises on Tinian, Commonwealth of the Northern Mariana Islands (CNMI), is not likely to adversely affect the threatened green turtle (*Chelonia mydas*) and the endangered hawksbill sea turtle (*Eretmochelys imbricata*) pursuant to section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 et seq.). You met with us on August 21, 2015 and you provided us with additional information about the project via email on September 14, 2015, by phone on September 22, 2015, and via email on October 6, 2015. On June 27, 2013, we completed a Biological Opinion addressing Divert activities at Saipan International Airport (Divert Biological Opinion; 01EPIF00-2012-F-0445) to satisfy operational requirements for humanitarian assistance, disaster response, and joint exercises in the Pacific in the event that airfield access at Andersen Air Force Base or other western Pacific airfields is limited. The revised proposed action modifies the Divert project to move some or all Divert capabilities and activities to Tinian International Airport.

The Divert Biological Opinion addressed potential adverse project effects to the endangered nightingale reed-warbler (*Acrocephalus luscinia*) and we concurred with the Department of the Air Force's determination the proposed actions on Saipan were not likely to adversely affect the endangered Mariana common moorhen (*Gallinula chloropus guami*), Mariana swiftlet (*Aerodramus bartschi*), and the green turtle. Your September 14, 2015, email, attached herein as Appendix 1, details modifications to the Divert project on Saipan. The extent of Divert construction at Saipan International Airport and Seaport has been reduced and fighter aircraft have been removed from the proposed action on Saipan. Construction disturbance on Saipan has been reduced from the 59 acres addressed in the Divert Biological Opinion to 31 acres. Fewer than 6.6 acres of tangantangan, habitat for the nightingale reed-warbler, will be cleared, down

COPY

from the 11 acres addressed in the Divert Biological Opinion. The Divert Biological Opinion addressed the loss, fragmentation, and degradation of one occupied nightingale reed-warbler territory due to construction of the east parking ramp and the purchase of one credit in the Saipan Upland Mitigation Bank to compensate for the loss of that breeding territory. The Divert Biological Opinion also addressed the habitat loss and degradation of 17 occupied nightingale reed-warbler breeding territories due to fighter aircraft noise disturbance and compensatory mitigation in the form of purchase of 17 credits in the Saipan Upland Mitigation Bank. Because the updated action does not entail construction of the east parking ramp or loss or degradation of any other habitat occupied by the nightingale reed-warbler from the fighter aircraft, the action no longer entails purchase of credits in the Saipan Upland Mitigation Bank.

All other components of the proposed action on Saipan, as detailed in Appendix 1, remain the same as described in the Divert Biological Opinion. Accordingly, these modifications to Divert actions on Sapian do not warrant reinitiation of formal consultation because the effects of the remaining, reduced, actions were addressed in the Divert Biological Opinion. The remaining proposed Divert actions on Saipan will be conducted in conformance with the Divert Biological Opinion, and the effects of those actions will be consistent with the analysis in that Biological Opinion. The Incidental Take Statement, Reasonable and Prudent Measures, Terms and Conditions, and Conservation Recommendations in the Divert Biological Opinion remain in effect. We are providing this Amendment to the Divert Biological Opinion to document these modifications to proposed Divert actions on Saipan and to address effects of new proposed Divert actions on Tinian.

REVISED PROJECT DESCRIPTION - TINIAN

Construction Activities on Tinian

The Divert project will entail development of infrastructure to support up to 12 KC-135 or similar large-bodied aircraft, or a mix of these large aircraft and up to 24 smaller fighter or tactical aircraft, at Tinian International Airport. Figure 1 details the proposed construction of runway, cargo, parking, fueling, and maintenance facilities within and adjacent to existing facilities at Tinian International Airport. No wetlands or limestone forest are within or adjacent to the proposed construction areas. To minimize potential impacts to turtle nesting beaches, Department of Defense policies, will be followed to minimize erosion and sedimentation during construction and to manage storm water runoff after construction.

Page 1 of "Assessment of Potential Effects to Threatened, Endangered, and Proposed Species from Developing Divert Capabilities and Conducting Activities and Exercises on Tinian" (Assessment) indicates a fuel pipeline from the Tinian Seaport to the airport may be constructed. On September 22, 2015, you confirmed this fuel pipeline had been removed from the Divert project.

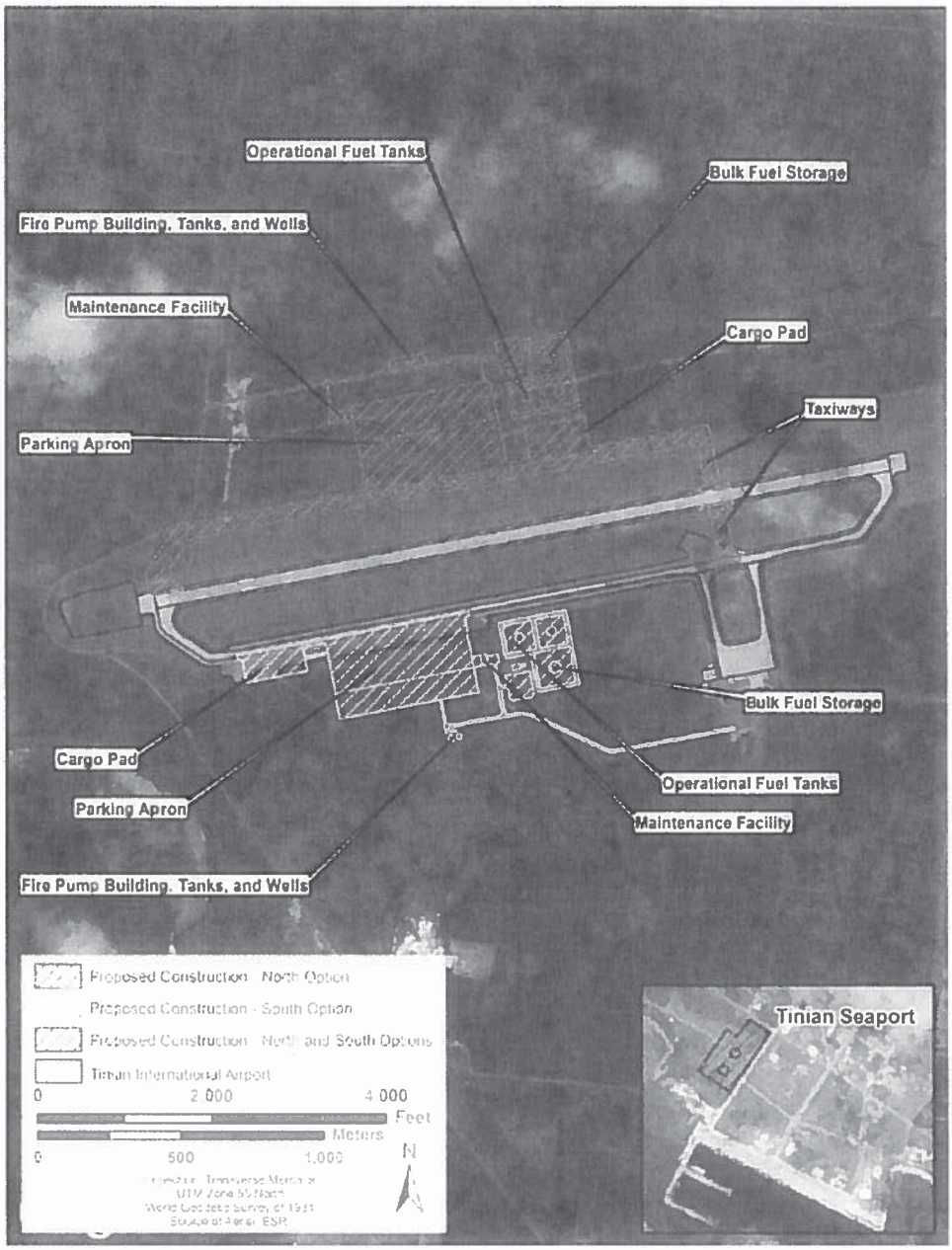

Figure 1. Construction footprint at Tinian Airport.

Divert Operations on Tinian

Divert aircraft training and operations will occur at Tinian Airfield when other locations in the western Pacific, such as Andersen AFB, are unavailable, due to emergencies such as natural disasters and for other operational reasons for a period of up to eight weeks per year. In limited instances such as disasters and humanitarian responses, operations may extend beyond the eight week per year time period. A mix of cargo, tanker, fighter, and other aircraft could be diverted to the Tinian airfield. Activities will include aircraft take-offs, staging, and landings, jet fueling and storage, humanitarian assistance including disaster relief airlift staging including non-combatant evacuation operations and billeting. Personnel and members of the public

accompanying the aircraft on Tinian could number up to 265 during Divert training and operations. These people will be billeted in existing hotel and other accommodations.

Biosecurity Measures to be Implemented During Divert Construction and Operations on Tinian

Invasive Species Interdiction and Control

The U.S. Air Force (USAF) will be responsible for oversight of avoidance, minimization, and mitigation implementation by the construction contractors for projects associated with the proposed Divert activities. In addition, the USAF will be responsible for oversight of training, review, and guidance on Hazard Analysis and Critical Control Point (HACCP) plan development, implementation and revision during the construction phase of the project. The HACCP plans will incorporate measures to ensure invasive species, including the brown treesnake, are not transported to the CNMI from Guam via project vehicles, materials and equipment. The USAF will be responsible for assuring that any HACCP plans are implemented by construction contractors to prevent the inadvertent movement of non-native, invasive species from other locations to the project site. The USAF will coordinate development of HACCP plans with the Service, including, but not limited to, annual meetings and reports to ensure the actions to eliminate or reduce risk are sufficient and on-going during construction activities.

Brown Treesnake Interdiction and Control

1. Per Public Law I 10-417, [Division A], title Ill, Section 316, October 14, 2008, 122 Statute 4356 and per DoD Defense Transportation Regulations, Chapter 505 protocols, the USAF, with support from Joint Region Marianas (JRM), commits to implementing 100 percent inspection of all outgoing cargo and aircraft that are leaving from Guam associated with the Divert project. Inspections will be performed with trained quarantine officers and dog detection teams, which could be supplemented by other pest control expertise (with appropriate U.S. Department of Agriculture-Wildlife Services (USDA-WS) brown treesnake detection training and oversight) to meet 100 percent inspection goals for training activities, as required COMNAVMARIANASINST 5090.10A and 36 Wing Instruction 32-7004. As a stakeholder, the Service will have input on the USAF protocols for implementing brown treesnake interdiction and control strategies. The USAF will work cooperatively with JRM, the Service, and USDA-WS to seek information in development of protocols for implementation of interdiction and control methods aimed at controlling brown treesnake as related to Divert training activities. On an as needed basis, the Service, USDA-WS, and USAF may request meetings to discuss interdiction and control method protocols as related to Divert military exercises.

    a. In the event military units, vehicles, and equipment accidentally leave Guam without inspection, as soon as possible, the USAF will notify: (1) USDA-WS and (2) the point of destination port or airport authorities and work with the destination port to resolve the issue. Urgency of notification is a priority so that rapid response or other actions can be implemented to reduce risk.

    b. In addition, the USAF will route inbound personnel and cargo for tactical approach exercises or humanitarian operations (that require an uninterrupted flow of events) directly to CNMI training locations to avoid Guam seaports and airfields. If Guam cannot

be avoided, the USAF, in cooperation with USDA-WS and the Service, shall identify, and USAF will implement appropriate interdiction methods that may include redundant inspections or other interdiction methods as agreed to by the Service, USDA-WS, USAF and JRM. Additionally, tactical approach exercises will involve only cargo equipment that has not originated from areas containing a brown treesnake population or will be 100 percent inspected by certified brown treesnake canine programs. If the USDA-WS develops performance standards for this activity, the USAF will adopt those standards, provided they are compatible with military mission.

c. The USAF is committed to implementing 100% redundant inspections after discussions with appropriate stakeholders. Redundant inspections include inspections on Guam and at the receiving jurisdiction for administrative and logistical movements that do not require a tactical approach to complete the training requirements. It is anticipated that redundant inspections to the extent possible would utilize existing quarantine and inspection protocols at receiving ports, but in the event that there is inadequate inspection coverage the USAF will coordinate with the USDA-WS to provide additional canine inspection teams that will augment quarantine and inspection protocols at the receiving ports. Appropriate stakeholders include, but are not limited to: the Service to ensure the inspections are adequate to reduce risks to trust resources, USDA-WS, receiving jurisdictions and their supporting agencies with expertise in invasive species control, and other inspection authorities as needed to ensure inspection methods are current and revised as new techniques, technology, or data become available.

2. The USAF will also establish snake-free quarantine areas (barriers) for cargo traveling from Guam to CNMI and other brown treesnake-free areas. These barriers will be subject to: (1) multiple day and night searches with appropriately trained interdiction canine teams that meet performance standards under 1b; (2) snake trapping; and (3) visual inspection for snakes. In lieu of permanent barriers, temporary barriers may be preferable to permanent exclosures because of the variable sizes needed to handle different cargo amounts for the various training activities. The USAF will produce standard operating procedures for temporary barrier construction and use within two years of the issuance of this Biological Opinion. Standard operating procedures will ensure that temporary barriers will be constructed and maintained in a manner that assures the efficacy of the barrier and that staff maintaining and constructing the temporary barriers will receive training related to this activity prior to construction. The construction and maintenance of temporary barriers utilized for cargo traveling from Guam to CNMI and other brown treesnake-free areas must be approved by the Service prior to use. During the construction phase of this project, the existing permanent snake-free quarantine areas at both the Saipan and Tinian seaports should be utilized for surface cargo following relevant CNM I and DoD regulations. Standard operating procedures will be developed in cooperation with the Service, U.S. Geological Survey, Fort Collins Science Center, Invasive Species Science Branch, and the USDA-WS to ensure risk to trust resources is adequately minimized. If risks are not adequately minimized, additional recommendations will be provided for incorporation into the protocols until the USAF and Service mutually agree the risk has been minimized. The Service, USAF, and other appropriate parties will meet, if necessary, to resolve concerns such that the protocols ensure risk is adequately minimized.

3. The USAF, in conjunction with the Service and JRM, will develop procedures and protocols

specific to Divert training events that will support a rapid response action in the event of a brown treesnake sighting resulting from Divert activities. Divert activities and exercises will be varied in the number of aircraft and personnel, and each event will have differing logistics support capabilities depending on the nature of the event. The type and amount of logistic support will be agreed to prior to each major event. Logistic support will include consideration of both in-kind assistance through air transport, shared billeting, security detail, food, materials, and ground transportation, and financial compensation for agreed-to response actions that could not be supported by in-kind assistance, including compensation for performance of services to support the deployment and execution of rapid response search teams.

4. The USAF, working in collaboration with the Service, and USDA-WS, will decide how best to implement the Brown Treesnake Control Plan (BTS TWG 2009, 37 pp.) relevant to Divert activities. The USAF and Service must mutually agree on the Brown Treesnake Control Plan implementation.

5. The USAF will provide invasive species awareness training for all military and contractor personnel prior to all training activities. This would include a mandatory viewing of a brown treesnake educational video, distribution of pocket guides with brown treesnake information and personal inspection guidelines to be carried at all times, and assurance that brown treesnake awareness extends from the chain of command to the individual military service member.

6. Due to limited availability of inspectors, trained dogs, and quarantine facilities and equipment on Guam and the CNMI, the USAF will coordinate closely with the Service, U.S. Department of Agriculture, CNMI Department of Lands and Natural Resources, and JRM staff responsible for managing their brown treesnake program, on planning for training activities on Tinian. The USAF, along with cooperating agencies, will identify the inspection and interdiction requirements for the Divert training, including the number of trained quarantine officers and dog detection teams required. The USAF will coordinate and consult with the Service on the inspection and interdiction requirements identified by the USAF, and the Service must concur with these requirements prior to the implementation of the exercise or training activity. The USAF, along with the cooperating agencies, will develop plans to ensure that inspection personnel are available and that all requirements can be met, and will identify the support that the USAF will need to provide for the inspections. Planning for training exercises generally begins months prior to implementation of an exercise, and planning for complex training that would require a substantial number of inspectors, quarantine areas, or other personnel or equipment for control and interdiction generally begins more than a year in advance. If adequate resources, such as trained inspectors and dog teams, are not available during training activities, training will not occur until resources are available.

Prevention of Invasive Species Introductions and Spread

1. All personnel involved in Divert training will adhere to COMNAVMARIANASINST 5090.10A and the 2005 Brown Treesnake Control and Interdiction Plan, which calls for individual troops to conduct self-inspections to avoid potential transport of brown treesnakes. Troops will inspect all personal gear and clothing (e.g., boots, bags, weapons, pants), hand-carried equipment, and supplies and tent canvas. The intent of this measure is to minimize the potential risks and subsequent effects associated with transport of troops and personnel from Guam to the CNMI and other areas that do not have brown treesnakes.

2. In addition to self-inspections, each training action will undergo a pathway risk analysis as a tool to improve programmatic efficiency while preventing the spread and introduction of invasive species. Actions at risk of transporting invasive species will have prevention tasks identified and implemented to reduce risk. Methods employed such as HACCP planning development and implementation by the USAF may be utilized to conduct pathway analysis. Pathway risk analysis must be completed prior to each training action being implemented.

The USAF is a participating agency in the development of the Micronesia Biosecurity Plan. The Micronesia Biosecurity Plan is intended to coordinate and integrate inter-agency invasive species management efforts such as control, interdiction, eradication, and research. Once completed, any portions of the Micronesia Biosecurity Plan determined to be applicable to Divert construction and training activities, will be implemented when such procedures do not unduly interfere with military training. The USAF will continue to work cooperatively with the Service and U.S. Department of Agriculture in development of protocols for implementation of interdiction and control methods in accordance with recommendations contained in the Micronesia Biosecurity Plan identified as being tied to USAF actions.

ANALYSIS OF EFFECTS OF THE ACTION

Your letter indicates you have determined the proposed actions on Tinian will have no effect to the endangered Mariana fruit bat (*Pteropus mariannus mariannus*), Mariana common moorhen (*Gallinula chloropus guami*), Micronesian megapode (*Megapodius laperouse*), and the proposed species *Heritiera longipetiolata*, *Dendrobium guamense*, and humped tree snail (*Partula gibba*) (these species were listed under the Act on October 1, 2015; 80 FR 59423). The Tinian monarch (*Monarcha takatsukasae*) was delisted in 2004 (69 FR 56367).

To conclude a proposed action is not likely to adversely affect listed species, the Service must find that the effects of the proposed action are expected to be insignificant, discountable, or beneficial. Insignificant effects relate to the size of the impact and should never reach the scale where take occurs, discountable effects are those that are extremely unlikely to occur, and beneficial effects are positive effects without any adverse effects. We applied this standard, as well as consideration of the probable duration, frequency, and severity of potential project stressors in our analysis of effects of the proposed action on the green turtle and hawksbill sea turtle.

Green and hawksbill turtles forage offshore of Tinian (Pultz et al. 1999; Kolinski et al. 2001; Maison et al. 2010) and a small population of green sea turtles nests on most beaches on Tinian (Pultz et al. 1999, NAVFAC 2014). One hawksbill sea turtle nest was found on the northeastern

shore of Tinian (more than two miles from Tinian International Airport) during monthly surveys of beaches conducted 1999 through 2012 (NAVFAC 2015, Table 3.9-3), and nesting by this species on Tinian is uncommon (Pultz et al. 1999; NAVFAC 2014, 2015).

According to your letter, and confirmed by our review of available GIS Tinian imagery GIS analysis of Tinian digital imagery (cnmi_tinian_wv2_08082010_rgb_ps_8bit_lut_v1.sid) no sandy beaches suitable for green turtle or hawksbill sea turtle nesting occur within the loudest areas under the takeoff and landing flight path at Tinian International Airport because the coast is steep and rocky. The turtle nesting beaches Unai Barcinas and Unai Leprosarium (DON 2010, Section 3.8.2.2.1) are located 0.3 to 0.8 miles south to southwest of the TNI runway where they will be exposed to loud noise during takeoff and landing of aircraft (Figure 2). Ninety percent of aircraft operations will occur during the day.

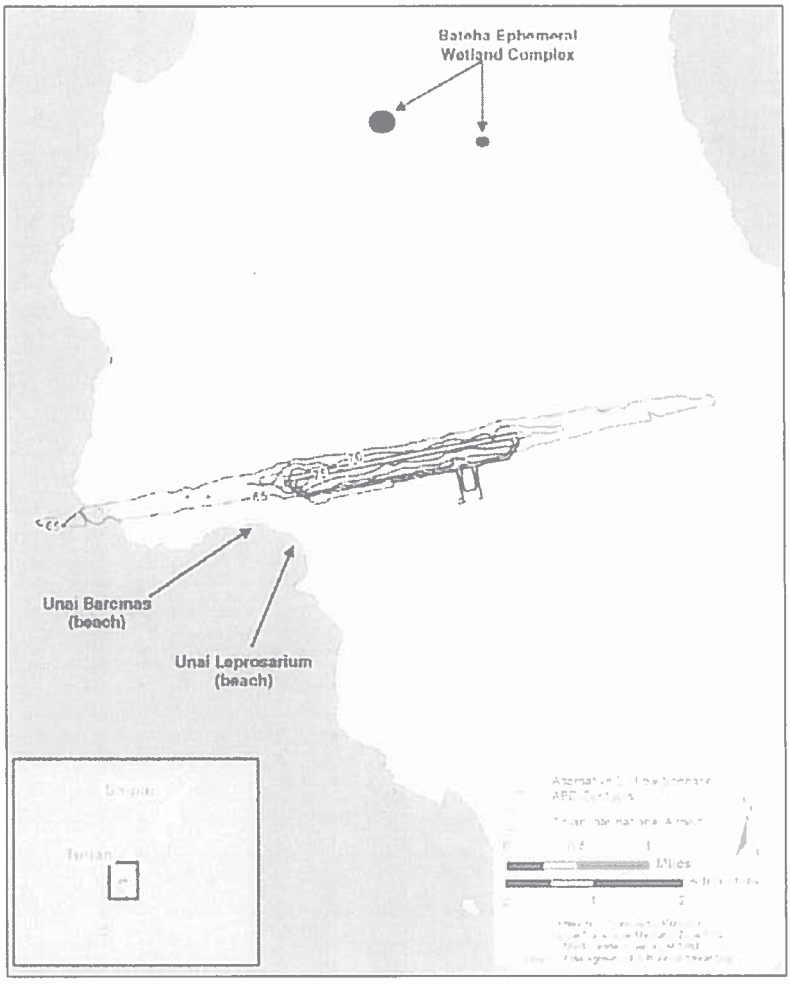

Figure 2. Noise contours (dBA day-night level) during an average busy day at Tinian International Airport for 48 KC-135 operations per day provided in your July 8, 2015, letter.

Your September 14, 2015, email indicates maximum noise levels during takeoff of the loudest aircraft associated with the proposed action could reach 79 dB at Unai Barcinas and 70 dB at Unai Leprosarium. Aircraft noise is below 200 Hz (Hodgdon et al 2007). Nesting and hatching green turtles could therefore be exposed to aircraft noise.

The sea turtle ear appears to be adapted for hearing in water, but on land sea turtle hearing is comparable to that of a person with moderate to severe hearing loss (Ridgway et al 1969, Lenhardt 1994, and Magyar 2009, Lin et al 2011). Findings by Mabyar (2009) indicate that although hatchlings in water are very responsive to noise, displaying agitated behavior, abrupt body movements, and startle responses, on land, airborne experimental and beachside nightclub noise did not elicit a measureable response or affect nestling direction of movement from the nest to the ocean. The shell and bones may conduct noise through the turtle's body to its ears, which are enclosed within soft tissue in its head (Dow Piniak et. al. 2012).

Studies indicate green turtles don't hear airborne sounds unless the sound level intensities are above 50 db (at 200 Hz) and 92 dB (at 50 Hz) (Ridgway et al 1969, Lenhardt 1994, and Magyar 2009). This level of hearing is comparable to a human with moderate (at 200 Hz) to severe (at 50 Hz) hearing loss. For reference, the decibel sound pressure level scale is calibrated at zero to the limits of human hearing (U.S. DOT FHA 2006), whereas predators can hear airborne sounds in the -20 dB range. Therefore, although higher frequency portion of the anticipated 70 – 79 dB aircraft takeoff and landing airborne noise will be audible to green turtles at Unai Barcinas and Unai Leprosarium, the noise is not expected to elicit a measurable response or affect nesting behavior of turtles on these beaches. In addition, because the majority of flights will be during the day, when turtles are not expected to be on the beaches, exposure of turtles to noise related to aircraft takeoff and landing will be minimal. Therefore, effects of the proposed action to sea turtles are expected to be insignificant.

CONSERVATION RECOMMENDATIONS

We are concerned about potential project impacts to the Tinian monarch, a species delisted in 2004. This endemic bird only occurs on Tinian and the population has declined 38 percent between 1996 and 2008. Project activities may result in noise disturbance, habitat loss, and other impacts to Tinian monarchs. We recommend project impacts, including clearing vegetation suitable for Tinian monarch use, be avoided. In 2013, we received a petition requesting that the Tinian monarch be listed as threatened or endangered under the ESA. We are in the process of reviewing the petition.

CONCLUSION

Based on the description of the proposed action and on the best information available to describe the behaviors and biological needs of the species considered here, the Service concurs with your determination that the proposed action on Tinian is not likely to adversely affect the green turtle and the hawksbill sea turtle. In addition, we conclude that activities described in the revised project description for Saipan are within the scope of the project described in the Divert Biological Opinion, and therefore the effects of those actions will be consistent with the analysis in that Biological Opinion.

REINITIATION STATEMENT

Should project plans change, or if monitoring efforts by the Air Force, contractors, or the CNMI, indicate that project components are having an effect on listed species not anticipated in this

consultation, please contact us immediately so we may assist you in ensuring continued project compliance with the ESA.

This concludes section 7 consultation on this action. As required in 50 CFR § 402.16, reinitiation of consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operation causing such take must cease pending reinitiation.

If you have any questions or concerns about this consultation or the consultation process in general, please feel free to email Jacqueline Flores at jacqueline_flores@fws.gov or contact her at (671) 989-6744.

Sincerely,

David Tessler
Acting Field Supervisor

cc:
Wildlife Supervisor, CNMI, Department of Land and Natural Resources
Kevin Brindock, Joint Region Marianas

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Appendix 1

Evaluation of Requirements for Reinitiation of Formal Consultation for Planned Divert Activities and Exercises on Saipan

The U.S. Pacific Air Forces (PACAF) and U.S. Fish and Wildlife Service (USFWS) completed consultation as required by Section 7 of the Endangered Species Act (ESA) in June 2013 for planned divert activities and exercises at the Saipan International Airport (GSN). Since June 2013, PACAF has modified their plans for activities on Saipan, and has therefore considered whether consultation should be re-initiated for their planned activities. As summarized in this paper, and based on the requirements in 50 CFR 402.16, re-initiation of consultation is not required for activities now planned to occur on Saipan. This paper also identifies the conservation measures specified in the 2013 Biological Opinion (BO) that are applicable to activities currently proposed on Saipan. This analysis was based on the alternative or combination of activities currently being considered in the Revised Draft Environmental Impact Statement that would have the greatest effect on listed species (e.g., the largest facility footprints, the maximum number of flight events).

2013 Consultation – PACAF prepared a Biological Assessment (BA) and requested formal consultation in September 2012 to consider effects to the endangered nightingale reed-warblers from planned activities and exercises for the Divert proposed project on Saipan. Planned activities considered in the BA (and subsequently in the 2013 BO) included the following.

- Disturbance of up to 59 acres at GSN and 4 acres at the Port of Saipan, including the clearing of 11.0 acres of tangantangan forest at GSN.
- Training activities at GSN for up to eight weeks per year and involving:
    - Joint fighter, cargo, and tanker aircraft, not to exceed 24 fighters, or 12 cargo/tanker aircraft, or a mix of those aircraft.
    - Up to 700 personnel participating in an exercise.
    - On-site, temporary billeting of personnel during some exercises.
    - Up to about 72 takeoffs and landings of military aircraft per day during exercises, totaling up to about 1,920 per year.
- Emergency and other unplanned divert landings of military aircraft.

PACAF concluded that the proposed activities would not affect Mariana fruit bats and Micronesian megapodes, and that those activities may affect, but would not be likely to adversely affect Mariana common moorhens, Mariana swiftlets, and nesting green sea turtles. They also concluded that the project is likely to adversely affect the nightingale reed-warbler.

The BA and BO considered the following effects to nightingale reed-warblers.

- Habitat loss, fragmentation, and degradation, leading to the destruction of one nightingale reed-warbler territory from clearing of 6.4 acres of habitat for the east parking ramp.
- Indirect effects to other nightingale reed-warbler territories from increased noise during construction.
- Increased noise from aircraft overflights, possibly causing:
    - Habitat loss or degradation, harassment, increased energetic costs, abandonment of territories or other adverse modifications of behavior, nest abandonment, decreased ability to communicate, and adverse physiological effects from the operation of joint fighter aircraft. Up to 13 nightingale reed-warbler pairs could be affected.
    - No adverse effects from the operation of KC-135 and similar aircraft.
- Increased risk of the introduction and spread of non-native invasive species during construction and implementation.

Current Planned Activities at Saipan – Based on public and agency input into the Draft EIS for divert activities and exercises, the USAF removed numerous elements from their planned activities on Saipan including:

- Runway extension
- Navigational aids
- Aircraft hanger
- Temporary munitions storage
- Arm/disarm pad
- Tent billeting (lodging)
- Fighter aircraft operations.

PACAF currently is planning to implement the following activities at Saipan that could affect listed species (**Table 1**).

- Disturbance of up to 31 acres at GSN and 4 acres at the Port of Saipan, including the clearing of 6.6 acres of tangantangan forest.
- Training activities at GSN for up to eight weeks per year involving:
  - Operation of KC-135 tankers or similar aircraft, but no fighter aircraft, from GSN.
  - Up to 265 personnel participating in an exercise (but no onsite billeting/tent lodging).
  - A typical exercise of 2 to 4 KC-135 aircraft, with each aircraft taking off and landing twice per day.
  - About 720 tanker operations per year. (An operation is considered one take-off, or one landing).
- Emergency and other unplanned divert landings of military aircraft.

These activities will have the following effects on nightingale reed-warblers, which would be similar to or less than those considered during the completed consultation.

1. Loss of habitat from clearing of 6.4 acres of tangantangan forest. The east parking ramp would not be constructed and the territory there would not be directly affected.
2. Indirect effects to nightingale reed-warbler territories from increased noise during construction.
3. Noise from aircraft overflights, leading to:
   - No adverse effects from the operation of KC-135 and similar aircraft
4. Increased risk of the introduction and spread of non-native invasive species during construction and implementation.

Table 1. Comparison of Previously Planned and Currently Planned Divert Activities and Exercises on Saipan.

	2013 Planned Activities	Current Planned Activities
Total acres to be disturbed	**59**	**31**
Acres of tangantangan	**11.0**	**≤6.6**[1]
Fighter aircraft	**Yes**	**No**
Maximum number of personnel per exercise	**700**	**265**
Number of aircraft per day	**12–24**	**2–4**
Maximum of operations per day	**72**	**16**
Operations per year	**1,920**	**720**
Emergency landings	**Yes**	**Yes**

[1] Amount of acreage to be disturbed would be less under hybrid modified alternative discussed at 21 Aug 15 meeting.

Requirements for Reinitiation of Consultation – The implementing regulations for Section 7 of the ESA at 50 CFR 402.16 identify four conditions that would require reinitiation of formal consultation.

1. Exceed the amount of taking – The project has not been implemented and no take has occurred.

2. New information is available that identifies effects of the action not previously considered – No new information is available about potential effects.

3. Modification of the action that would cause an effect that was not previously considered – Planned activities will cause the same types of effects as considered in the 2013 BO, but those effects will be of a lesser magnitude.

4. A new species is listed or critical habitat is designated – Six species that could occur on Saipan have been proposed for listing since completion of consultation in 2013. The USFWS has confirmed that none of these species would occur in the tangantangan forest or disturbed/ developed areas that would be used for planned activities GSN (letter from R. Rounds, USFWS, to W. Grannis, AFCEC, 22 January 2015); thus, there will be no adverse effects to those species.

50 CFR 402.16 Reinitiation of formal consultation.

Reinitiation of formal consultation is required and shall be requested by the Federal agency or by the Service, where discretionary Federal involvement or control over the action has been retained or is authorized by law and:

(a) If the amount or extent of taking specified in the incidental take statement is exceeded:

(b) If new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered:

(c) If the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in the biological opinion; or

(d) (d) If a new species is listed or critical habitat designated that may be affected by the identified action.

Conclusion – Based on this analysis, it is concluded that none of the four requirements in 50 CFR 402.16 are applicable; therefore, PACAF does not need to reinitiate formal consultation for planned divert activities and exercises on Saipan.

Conservation Measures – Table 2 lists the conservation measures that PACAF plans to implement to comply with the requirements of the BO if planned divert activities and exercises are conducted on Saipan. These are the same measures identified in the BO, with the following clarifications:

- No credit will be purchased from the Saipan Upland Mitigation Bank for construction of the east parking apron, as that facility will not be constructed. All other effects during construction would be similar to or less than those considered in the BO, and in accordance with that document, implementing those other construction activities do not require the purchase of a credit to compensate for direct or indirect effects to nightingale reed-warblers or their habitat.

- No credits will be purchased for the loss of nightingale reed-warbler territories caused by noise from operating fighter aircraft. PACAF now plans to operate only KC-135 aircraft, which (as concluded in the BO) would not result in adverse effects to nightingale reed-warblers.

TABLE 2. SAIPAN NATURAL RESOURCE MITIGATION MEASURES DEFINED IN SEC 7 CONSULT

NO.	MITIGATION MEASURES FROM DIVERT BIOLOGICAL OPINION, SAIPAN	SOURCE OF REQUIREMENT	DUE	Modified Saipan Alternative	COMMENTS/CONSIDERATIONS
1	Purchase credit in SUMBA prior to construction of Eastern Parking Ramp	Conservation measure considered part of project description	prior to construction of east parking apron	Not Applicable	East Parking Ramp is no longer part of the proposed action.
2	Clearing vegetation only during Oct-Dec or Apr-Jun	Conservation measure considered part of project description	Construction	Applicable	
3	No laydown yard or temp construction area within nightingale reed warbler habitat or 50 meter buffer zone around reed-warbler territories.	Conservation measure considered part of project description	Construction	Applicable	
4	When possible, the use of very noisy (greater than 60 decibels A-weighted (dBA)) heavy machinery should be limited to the non-active or non-peak breeding seasons or temporary noise barriers or buffer zones should be installed to protect nightingale reed-warblers using buffer zones or areas of connectivity	Conservation measure considered part of project description	Construction	Applicable	
5	Adequate plastic construction fencing will be placed and maintained around any habitat that is to be avoided (including buffer areas and adjacent parcels) to prevent impacts to habitat from construction equipment and personnel.	Conservation measure considered part of project description	Construction	Applicable	
6	All on-site construction personnel will receive instructions regarding the presence of listed species and the importance of avoiding and minimizing impacts to these species and their habitat.	Conservation measure considered part of project description	Construction	Applicable	
7	All on-site personnel will receive instruction regarding the BTS and what to do immediately in case of a sighting.	Conservation measure considered part of project description	Construction	Applicable	
8	The USAF will ensure that no unauthorized take of nightingale reed-warbler or destruction of their habitat occurs. The USAF will have the authority to stop all activities that may result in such take or destruction until appropriate coiTective measures have been completed. The USAF will report immediately any unauthorized impacts to the Service and CNMI DFW.	Conservation measure considered part of project description	Construction/ Implementation	Applicable	
9	Litter control (see BO for details)	Conservation measure considered part of project description	Construction	Applicable	
10	Reporting to USFWS within 30 days of construction implementation to document implementation of any fencing, buffer zones, and minimization measures.	Conservation measure considered part of project description	Within 30 days of construction start	Applicable	
11	Pay SUMBA for 17 Nightingale Reed Warbler Territories if using Fighters	Conservation measure considered part of project description	Implementation Phase: prior to flying fighters	Not applicable	No fighters will be used during Divert exercises and activities.
12	Develop Hazard Analysis and Critical Control Point (HACCP) plans for construction and coordinate development with the Service	Conservation measure considered part of project description	prior to construction activities	Applicable	
13	Brown Tree Snake Inspections for 100% of outgoing vessels from Guam to Saipan (see BO for details). Will be performed with trained quarantine officers and dog detection teams	Conservation measure considered part of project description	Construction/ Implementation	Applicable	Inspection is already in place and this is a normal course of action.
14	Avoid routing flights through Guam for exercises	Conservation measure considered part of project description	Implementation Phase	Applicable	
15	100% redundant inspections after discussions with appropriate stakeholders. Redundant inspections include inspections on Guam and at the receiving jurisdiction for administrative and logistical movements that do not require a tactical approach to complete the training requirements.... in the event that there is inadequate inspection coverage the USAF will coordinate with the USDA-WS to provide additional canine inspection teams that will augment quarantine and inspection protocols at the receiving ports.	Conservation measure considered part of project description	Construction/ Implementation	Applicable	
16	Establish Snake-Free Quarantine Areas for cargo traveling from Guam to CNMI and other brown treesnake-free areas (see BO for details)	Conservation measure considered part of project description	Construction/ Implementation	Applicable	The existing quarantine area at Saipan Port may suffice for shipments. If HACCP determines it is insufficient, temporary barriers may be necessary. JRM is developing a standard design using shade cloth with stakes. At the airport, the temporary barriers are what is recommended by USFWS.

TABLE 2. SAIPAN NATURAL RESOURCE MITIGATION MEASURES DEFINED IN SEC 7 CONSULT

NO.	MITIGATION MEASURES FROM DIVERT BIOLOGICAL OPINION, SAIPAN	SOURCE OF REQUIREMENT	DUE	Modified Saipan Alternative	COMMENTS/CONSIDERATIONS
17	The USAF, in conjunction with the Service and JRM, will develop procedures and protocols specific to Divert training events that will support a rapid response action in the event of a brown treesnake sighting resulting from Divert activities. USAF will agree on the type and amount of logisitical support in advance of a training event and will provide agreed-to support for a rapid response resulting from Divert activities (see BO for details)	Conservation measure considered part of project description	Construction/ Implementation	Applicable	
18	The USAF, working in collaboration with the Service, and USDA-WS, will decide how best to implement the Brown Treesnake Control Plan (BTS TWG 2009, 37 pp.) relevant to Divert activities. The USAF and Service must mutually agree on the Brown Treesnake Control Plan implementation.	Conservation measure considered part of project description	Construction/ Implementation	Applicable	
19	The USAF will provide invasive species awareness training for all military and contractor personnel prior to all training activities.	Conservation measure considered part of project description	Construction/ Implementation	Applicable	
20	USAF will coordinate with the Service, U.S. DOA, CNMI DLNR and JRM on planning for training activities on Saipan. The USAF, along with cooperating agencies, will identify the inspection and interdiction requirements for the Divert training, including the number of trained quarantine officers and dog detection teams required. The USAF will coordinate and consult with the Service on the inspection and interdiction requirements identified by the USAF, and the Service must concur with these requirements prior to the implementation of the exercise or training activity. The USAF, along with the cooperating agencies, will develop plans to ensure that inspection personnel are available and that all requirements can be met, and will identify the support that the USAF will need to provide for the inspections... if adequate resources, such as trained inspectors and dog teams, are not available during training activities, training will not occur until resources are available.	Conservation measure considered part of project description	Implementation	Applicable	
21	Troop self-inspections IAW DoD Instruction 5090.IOA and the 2005 Brown Treesnake Control and Interdiction Plan.	Conservation measure considered part of project description	Implementation	Applicable	
22	Perform pathway risk analysis for each training action	Conservation measure considered part of project description	Implementation	Applicable	
23	Once completed, any portions of the Micronesia Biosecurity Plan determined to be applicable to Divert construction and training activities, will be implemented when such procedures do not unduly interfere with military training.	Conservation measure considered part of project description	Construction/ Implementation	Applicable	The Micronesia Biosecurity Plan is now final as the "Regional Biosecurity Plan for Micronesia and Hawaii." Determination on what is applicable has not yet been made.
24	Monitor and report take as specified in Incidental Take Statement	Incidental Take Statement	Construction/ Implementation	Applicable	During construction the monitor and report must be by the environmental monitor. After construction, the BOS contract must take this over.
25	One nightingale reed-warbler territory will be cleared for construction of the east parking apron resulting in harm of up to two adults and up to four juveniles.	Incidental Take Statement	Construction	Not applicable	Only applicable if east parking ramp were constructed. This ramp is not part of the proposed action for the revised project.
26	Four nightingale reed-warbler territories could be abandoned due to habitat degradation from repeated and loud noise from fighter jet training resulting in harassment of up to eight adults and up to sixteen eggs, chicks, or juveniles.	Incidental Take Statement	Implementation	Not applicable	
27	Thirteen nightingale reed-warbler territories will suffer habitat degradation from noise disturbance from fighter jet training resulting in periodic, but rare, harassment of up to twenty-six adults.	Incidental Take Statement	Implementation	Not applicable	
28	The USAF shall minimize the potential for harassment, harm, or mortality of nightingale reed-warblers	Reasonable and Prudent Measures	Construction/ Implementation	Applicable	
29	To the extent practicable, consistent with national security and contingency requirements, and military safety and security requirements, the USAF will notify the Service on an annual basis of upcoming Divert training events at GSN including timing and description of the joint military exercises.	Terms and Conditions	Implementation	Applicable	

TABLE 2. SAIPAN NATURAL RESOURCE MITIGATION MEASURES DEFINED IN SEC 7 CONSULT

NO.	MITIGATION MEASURES FROM DIVERT BIOLOGICAL OPINION, SAIPAN	SOURCE OF REQUIREMENT	DUE	Modified Saipan Alternative	COMMENTS/CONSIDERATIONS
30	Annual report to USFWS	Terms and Conditions	1 Dec, beginning in 2014	Applicable	Report was provided to Service at end of 2014; reports will continue and will contain details required per terms and conditions as project is approved and proceeds.
31	The USAF will convene an annual coordination meeting or conference call prior to 28 February of each year, starting in 2015, to discuss findings within the compliance report and adapt avoidance, minimization, and conservation measures to further reduce incidental take.	Terms and Conditions	prior to 28 Feb each year, starting in 2015		Not done in 2015 as project was on ice at that time. Recommend we agree it will not be done until the ROD that selects location is signed and design/construction activity begins.
32	Monitoring of fighter noise effects on NRW for fighters only	Conservation Recommendation	Implementation	Not applicable	
33	Conservation Recommendation: rat/cat control measures	Conservation Recommendation	Construction/ Implementation	Applicable	

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F1K NMFS, BO and Conference Report for U.S. Military Mariana Islands Training and Testing Activities, NMFS promulgation of regulations and issuance of a letter of authorization pursuant to the MMPA for the U.S. Navy to "take" marine mammals incidental to Mariana Islands Training and Testing activities from August 2015 through August 2020 (June 2015)

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National Marine Fisheries Service
Endangered Species Act Section 7 Consultation
Biological Opinion and Conference Report

Agencies:	United States Navy[1] National Marine Fisheries Service
Activities Considered:	U.S. Military Mariana Islands Training and Testing Activities; and The National Marine Fisheries Services' promulgation of regulations and issuance of a letter of authorization pursuant to the Marine Mammal Protection Act for the U.S. Navy to "take" marine mammals incidental to Mariana Islands Training and Testing activities from August 2015 through August 2020
Consultation Conducted by:	Endangered Species Act Interagency Cooperation Division of the Office of Protected Resources, National Marine Fisheries Service
Approved by:	Donna S. Wieting Director, Office of Protected Resources
Date:	JUN 12 2015
PCTS Tracking Number:	FPR-2014-9070

This document is the National Marine Fisheries Service (NMFS) Office of Protected Resources biological opinion (Opinion). The consulting agency for these proposals is NMFS Office of Protected Resources - Endangered Species Act Interagency Cooperation Division. This opinion has been prepared in accordance with section 7 of the Endangered Species Act of 1973, as

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[1] The Navy is the executive agent for Mariana Islands Training and Testing (MITT) activites which include all Navy, US Air Force (USAF), and US Coast Guard (USCG) activities as outlined in the MITT Environmental Impact Statement/Overseas Environmental Impact Statement (EIS/OEIS). This Biological Opinion (BO) supports Navy, USAF, and USCG actions.

amended (16 U.S.C. 1531 et seq.). The Public Consultation Tracking System number for this consultation is FPR-2015-9111.

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List of Acronyms

A-A	Air-to-Air	DoD	Department of Defense
A-G	Air-to-Ground	DoN	Department of Navy
A-S	Air-to-Surface	DVLA	Distributed vertical line array
AAW	Anti-Air Warfare	EA	Environmental Assessment
ACM	Air Combat Maneuvering	EER	Extended Echo Ranging
AMW	Amphibious Warfare	EEZ	Exclusive Economic Zone
ASUW	Anti-Surface Warfare	EIS	Environmental Impact Statement
ASW	Anti-Submarine Warfare	EOD	Explosive Ordnance Disposal
ATC	air traffic control	ESA	Endangered Species Act
BE	Biological Evaluation	EXTORP	Running Torpedo Exercise
BO	Biological Opinion	°F	Degrees Fahrenheit
BOMBEX	Bombing Exercise	ft	Feet
CSG	Carrier Strike Group	ft^2	Square Feet
CV	Coefficient of Variation	GUNEX	Gun Exercise
dB	Decibel		
DICASS	Directional Command Activated Sonobuoy System		

IEER	Improved Extended Echo Ranging
kHz	Kilohertz
km	Kilometer
lb	Pound
LOA	Letter of Authorization
m	Meter
m^2	Square Meter
MFA	Mid-Frequency Active
min	Minute
MIW	Mine Warfare
MMPA	Marine Mammal Protection Act
ms	Millisecond
NEPA	National Environmental Policy Act
NEPM	Non-explosive Practice Munitions
NEW	Net Explosive Weight
nm	nautical miles
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NUWC	Naval Undersea Warfare Center
OEIS	Overseas Environmental Impact Statement
pH	Alkalinity
PTS	Permanent Threshold Shift
RDT&E	Research, Development, Test and Evaluation
S-A	Surface-to-Air
S-S	Surface-to-Surface
SAR	Search and Rescue
SINKEX	Sinking Exercise
Sonar	Sound Navigation And Ranging
SPAWAR	Space and Naval Warfare Systems
STW	Strike Warfare
SUA	Special-Use Airspace
TORPEX	Torpedo Exercise
TRACKEX	Tracking Exercise
TTS	Temporary Threshold Shift
UNDET	Underwater Detonation
USW	Undersea Warfare

1 INTRODUCTION

Section 7(a)(2) of the Endangered Species Act of 1973, as amended (ESA; 16 U.S.C. 1536(a)(2)) requires each Federal agency to insure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of critical habitat of such species. When a Federal agency's action "may affect" a protected species, that agency is required to consult formally with the National Marine Fisheries Service (NMFS) or the U.S. Fish and Wildlife Service, depending upon the endangered species, threatened species, or designated critical habitat that may be affected by the action (50 CFR § 402.14(a)). Federal agencies are exempt from this general requirement if they have concluded that an action "may affect, but is not likely to adversely affect" endangered species, threatened species, or designated critical habitat and NMFS or the U.S. Fish and Wildlife Service concurs with that conclusion (50 CFR § 402.14(b)).

In this biological opinion (Opinion), the action agencies are the U.S. Department of Defense (DoD) and U.S. Coast Guard (USCG) (since the Navy is the lead action agency for this consultation, these agencies are collectively referred to as the "Navy" throughout this Opinion), which undertakes military training and testing activities and NMFS's Office of Protected Resources, Permits and Conservation Division, which is (1) promulgating regulations under the Marine Mammal Protection Act (MMPA) governing the U.S. Navy's "take" of marine mammals incidental to those military readiness activities which will be in effect from August 2015 through August 2020 and (2) proposing a Letter of Authorization (LOA) pursuant to the regulations that authorizes the U.S. Navy to "take" marine mammals incidental to those military readiness activities through August 2020. The consulting agency for these proposals is NMFS's Office of Protected Resources, Endangered Species Act (ESA) Interagency Cooperation Division.

This biological opinion was prepared by NMFS's Endangered Species Act Interagency Cooperation Division in accordance with section 7(b) of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531, et seq.), and implementing regulations at 50 CFR § 402. This document is NMFS's final biological opinion (Opinion) on the anticipated effects of these actions on endangered and threatened species and critical habitat that has been designated for those species, and supercedes previous biological opinions on Mariana Islands training described in more detail below, which is incorporated by reference.

This biological opinion is based on information provided in the March 2014 U.S. Navy request for ESA consultation package which included the September 2013 Mariana Islands Training and Testing Draft Environmental Impact Statement/Overseas Environmental Impact Statement (DEIS/OEIS); the Biological Evaluation; the Mariana Islands Training and Testing Endangered Species Act Section 7 Consultation Supplemental Information; NMFS Permits Division's 28 January 2015 request for Section 7 consultation under the ESA; and the proposed Federal regulations under the MMPA specific to the proposed activities (78 FR 7050). We also considered later versions of the Final EIS/OEIS and other supplemental information as they were made available to us. Also considered were the draft or final recovery plans for the endangered

or threatened species that are considered in this document, and publications that we identified, gathered, and examined from the public scientific literature.

The Navy proposes to conduct training and testing activities within the Mariana Islands Training and Testing (MITT) Study Area. Military training and testing activities have been ongoing in the same general geographic area for several decades. Ongoing activities that are analyzed in previous section 7 consultations are assessed in this Opinion as part of the *Environmental Baseline* in the Action Area.

1.1 Consultation History

- On March 7, 2014, the U.S. Navy requested section 7 formal consultation based on their determination that MITT activities may affect and are likely to adversely affect humpback whale (*Megaptera novaeangliae*), sei whale (*Balaenoptera borealis*), fin whale (*Balaenoptera physalus*), blue whale (*Balaenoptera musclus*), sperm whale (*Physeter macrocephalus*), green sea turtle (*Chelonia mydas*), hawksbill sea turtle (*Eretmochelys imbricata*), Olive ridley sea turtle (*Lepidochelys olivacea*), loggerhead sea turtle (*Caretta caretta*), leatherback sea turtle (*Dermochelys coriacea*), and conference on the proposed listing of 43 species of coral.

- On April 16, 2014, we responded to the U.S. Navy's 7 March 2014 request indicating that we had received sufficient information to initiate formal consultation. We also determined that NMFS Permits and Conservation Division's proposed action of promulgating a rule in accordance with the MMPA and subsequently issuing a LOA authorizing take of marine mammals incidental to U.S. Navy MITT activities are inter-dependent and interrelated to the U.S. Navy's proposed action and therefore must be included in the consultation. Due to the complexity of the proposed action and extent of species potentially affected, we proposed an extended consultation timeline with a final opinion issued no later than April 2015.

- On August 19, 2014, the U.S. Navy provided supplemental information to the biological evaluation provided on 7 March. The U.S. Navy determined that the Indo-West Pacific DPS of scalloped hammerhead shark is present in the MITT Study Area and upon their review of the pertinent biology literature combined with consideration of proposed Navy training and testing activities in MITT, reached a "may affect" determination for the Indo-West Pacific DPS of scalloped hammerhead shark.

- On September 22, 2014, the U.S. Navy's Pacific Fleet provided a minor change to the action consisting of a reduction from the originally-proposed 20 pound (lb) charges/net explosive weight (NEW) to be used in underwater detonations (UNDETS) to the currently-used 10 lb charge NEW in Apra Harbor, Guam and to request that the biological opinion cover the five listed species of coral found in the MITT study area (*Acropora globiceps*, *Acropora retusa*, *Acropora tenella*, *Pavona diffluens* and *Seriatopora aculeata*) in place of the previous request for conference opinion covering forty-three species of corals that were proposed for listing.

- On October 14, 2014, NMFS provided the draft Opinion along with questions to the Navy. NMFS received responses to questions on 6 November 2014 and comments on the draft Opinion on 10 November 2014.

- On December 5, 2014, the U.S. Pacific Fleet released a naval message to all subordinate commands, requiring mitigation for all hammerhead sharks prior to underwater detonations in the same manner employed for marine mammals and sea turtles.

- On April 7, 2015, NMFS and the Navy decided to include analyses for the proposed endangered Central-West Pacific DPS of green sea turtles, resulting in this Biological/Conference Opinion.

- On April 15, 2015, NMFS provided the final draft Opinion to the Navy and NMFS's Permits and Conservation Division for review.

- On April 30, 2015, NMFS reveived comments on the draft Opinon from the Navy.

- On May 1, 2015, the Navy provided supplemental information on the effects of training and testing activities on corals in Apra Harbor, Guam.

- On May 5, 2015, NMFS and the Navy held a teleconference to discuss alternate approaches to the coral risk analysis. The Navy also provided supplemental information on coral sightings around Guam and Farallon De Medinilla.

- On May 12, 2015, the Navy provided supplemental information on the impacts of munitions at Farrallon De Medinilla including estimates of seafloor impacted by munitions.

2 DESCRIPTION OF THE ACTION

"Action" means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by Federal agencies. Interrelated actions are those that are part of a larger action and depend on the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration. This opinion addresses three interdependent actions as proposed by the U.S. Navy and NMFS's Permits Division.

This opinion addresses three interdependent actions as proposed by the U.S. Navy and NMFS's Permits Division: (1) the U.S. Navy's proposed military training and testing activities (i.e., readiness activities) conducted in the MITT Study Area; (2) NMFS's Permits Division's proposal to promulgate regulations pursuant to the MMPA governing the U.S. Navy's "take" of marine mammals incidental to the Navy's military readiness activities from August 2015 through August 2020; and (3) NMFS's Permits Division's proposal to issue an LOA pursuant to the regulations that authorize the U.S. Navy to "take" marine mammals incidental to military readiness activities in the MITT Study Area through August 2020.

The purpose of the activities the U.S. Navy conducts in the MITT Study Area is to meet the requirements of the U.S. Navy's Fleet Response Training Plan and allow Navy personnel to remain proficient in anti-submarine warfare and mine warfare skills (i.e., military readiness activities). The purpose of the MMPA regulations and the Permits and Conservation Division's LOA is to allow the U.S. Navy to "take" marine mammals incidental to military readiness activities in the MITT Study Area conducted through August 2020 in a manner that is consistent with the requirements of the MMPA and implementing regulations.

NMFS recognizes that while Navy training and testing requirements change over time in response to global or geopolitical events and other factors, the general types of activities addressed by this consultation are expected to continue into the reasonably foreseeable future, along with the associated impacts. Therefore, as part of our effects analysis, we assumed that the activities proposed for the remainder of the five year period of the MMPA Rule would continue into the reasonably foreseeable future at levels similar to that assessed in this Opinion and described in the 2015 MITT FEIS/OEIS and MMPA rule.

The tempo of training within the MITT Study Area is subject to variation within the scope of the activities described in the Navy's MITT FEIS/OEIS and this Opinion. Annual variation in the number of training events and quantities of authorized sonar systems and explosive training could occur. Given the inherent uncertainty and potential variation within the training spectrum due to unforeseen world events, the Navy stated that it cannot predict exact annual system use for the period.

Notwithstanding this analysis, however, NMFS would fully take into account all of the best available science and any change in the status of the species when and if the Navy applies for a new MMPA incidental take authorization upon expiration of the five-year regulations considered in this opinion. The Navy would also need to initiate a new ESA consultation at that time.
The Navy, U.S. Air Force, U.S. Marine Corps, and U.S. Coast Guard routinely train in the Action Area in preparation for national defense missions. Typical training and testing activities and exercises covered in this Opinion are briefly described in the following sections. Each military training activity described meets a requirement that can be traced ultimately to requirements set forth by the National Command Authority.

The Navy and other services have been conducting military readiness activities in the Action Area for decades. The tempo and types of training and testing activities have fluctuated because of the introduction of new technologies, the evolving nature of international events, advances in warfighting doctrine and procedures, and changes in force structure (organization of ships, weapons, and military personnel). Such developments influence changes in the frequency, duration, intensity, and location of required training and testing activities. The Navy categorizes training and testing activities into functional warfare areas called primary mission areas. Most training and testing activities analyzed in this Opinion fall into the following eight primary mission areas:

- Anti-air warfare
- Amphibious warfare
- Strike warfare
- Anti-surface warfare
- Anti-submarine warfare
- Electronic warfare
- Mine warfare
- Naval special warfare

Not all activities can be categorized in one of these areas. The research and acquisition community (i.e., testing community) also categorizes some, but not all, of its testing activities under these primary mission areas. Testing activities analyzed in this Opinion are categorized into the following areas:

- Life Cycle Activities
- Shipboard Protection Systems and Swimmer Defense Testing
- New Ship Construction
- Naval Research

U.S. Navy proposed training and testing activities and annual activity levels are summarized in this opinion. Specific details regarding each mission area can be found in the *Mariana Islands Training and Testing Final Environmental Impact Statement/Overseas Environmental Impact Statement (FEIS/OEIS)*, May 2015.

Also, NMFS' Permits Division proposes to issue five-year regulations and a LOA to the U.S. Navy, pursuant to section 101(a)(5)(A) of the Marine Mammal Protection Act of 1972, as amended (MMPA; 16 U.S.C. 1361 *et seq.*), for taking marine mammals incidental to conducting training and testing activities in the MITT Study Area. The MMPA regulations would be effective from August 2015 to August 2020.

2.1 Mariana Islands Training Activities

The following sections describe the training activities occurring in the MITT study area.

2.1.1 Anti-Air Warfare (AAW)

The mission of anti-air warfare is to destroy or reduce enemy air and missile threats (including unmanned airborne threats) and serves two purposes: to protect U.S. forces from attacks from the air and to gain air superiority. Anti-air warfare also includes providing U.S. forces with adequate attack warnings, while denying hostile forces the ability to gather intelligence about U.S. forces. Table 1 provides summaries of training activities in support of AAW.

Aircraft conduct anti-air warfare through radar search, detection, identification, and engagement of airborne threats-generally by firing anti-air missiles or cannon fire. Surface ships conduct anti-air warfare through an array of modern anti-aircraft weapon systems such as aircraft detecting radar, naval guns linked to radar-directed fire-control systems, surface-to-air missile systems, and radar-controlled cannons for close-in point defense.

Table 1. Typical Anti-Air Warfare Training Exercises

Activity Name	Activity Description
Anti-Air Warfare (AAW)	
Gunnery Exercise (Surface-to-Air) (GUNEX [S-A]) – Large-caliber	Surface ship crews defend against threat aircraft or missiles with guns.
Gunnery Exercise (Surface-to-Air) (GUNEX [S-A]) – Medium-caliber	Surface ship crews defend against threat aircraft or missiles with guns.
Missile Exercise (Surface-to-Air) (MISSILEX [S-A])	Surface ship crews defend against threat missiles and aircraft with missiles.

2.1.2 Amphibious Warfare (AMW)

The mission of amphibious warfare is to project military power from the sea to the shore through the use of naval firepower and Marine Corps landing forces. It is used to attack a threat located on land by a military force embarked on ships. Amphibious warfare operations include small unit reconnaissance or raid missions to large-scale amphibious operations involving multiple ships and aircraft combined into a strike group. Table 2 provides summaries of training activities in support of AMW.

Amphibious warfare training ranges from individual, crew, and small unit events to large task force exercises. Individual and crew training include amphibious vehicles and naval gunfire support training. Small-unit training operations include shore assaults, boat raids, airfield or port seizures, and reconnaissance. Large-scale amphibious exercises involve ship-to-shore maneuver, naval fire support, such as shore bombardment, and air strike and close air support training.

Table 2. Typical Amphibious Warfare Training Exercises

Activity Name	Activity Description
Amphibious Warfare (AMW)	
Naval Surface Fire Support Exercise-Land Based Target (FIREX [Land])	Surface ship crews use large-caliber guns to fire on land-based targets in support of forces ashore.
Amphibious Rehearsal, No Landing	Amphibious shipping, landing craft, and elements of the Marine Air Ground Task Force rehearse amphibious landing operations without conducting an actual landing on shore.
Amphibious Assault	Forces move ashore from ships at sea for the immediate execution of inland objectives.
Amphibious Raid	Small unit forces move swiftly from ships at sea for a specific short-term mission. Raids are quick operations with as few Marines as possible.
Unmanned Aerial Vehicles Ops (UAV OPS)	Military units employ unmanned aerial vehicles to launch, operate, and gather intelligence for specified amphibious missions.

2.1.3 Strike Warfare (STW)

The mission of strike warfare is to conduct offensive attacks on land-based targets, such as refineries, power plants, bridges, major roadways, and ground forces to reduce the enemy's ability to wage war. Strike warfare employs weapons by manned and unmanned air, surface, submarine, and naval special warfare assets in support of extending dominance over enemy territory (power projection). Table 3 provides summaries of training activities in support of STW.

Strike warfare includes training of fixed wing attack aircraft pilots and aircrews in the delivery of precision-guided munitions, non-guided munitions, rockets, and other ordnance, including the high-speed anti-radiation missile, against land-based targets in all conditions. Not all strike mission training events involve dropping ordnance and instead the event is simulated with video footage obtained by onboard sensors.

Table 3. Typical Strike Warfare Training Exercises

Activity Name	Activity Description
Strike Warfare (STW)	
Combat Search and Rescue (CSAR)	CSAR units use helicopters, night vision and identification systems, and insertion and extraction techniques under hostile conditions to locate, rescue, and extract personnel.

2.1.4 Anti-Surface Warfare (ASUW)

The mission of anti-surface warfare is to defend against enemy ships or boats. In the conduct of anti-surface warfare, aircraft use cannons, air-launched cruise missiles or other precision guided munitions; ships employ torpedoes, naval guns, and surface-to-surface missiles; and submarines attack surface ships using torpedoes or submarine-launched, anti-ship cruise missiles. Table 4 provides summaries of training activities in support of ASUW.

Anti-surface warfare training includes surface-to-surface gunnery and missile exercises, air-to-surface gunnery and missile exercises, and submarine missile or torpedo launch events.

Table 4. Typical Anti-Surface Warfare Training Exercises

Activity Name	Activity Description
Anti-Surface Warfare (ASUW)	
Gunnery Exercise (Air-to-Surface) – Small-caliber	Fixed-wing and helicopter aircrews, including embarked personnel, use small-caliber guns to engage surface targets.
Gunnery Exercise (Air-to-Surface) – Medium-caliber	Fixed-wing and helicopter aircrews, including embarked personnel, use medium-caliber guns to engage surface targets.
Missile Exercise (Air-to-Surface) – Rocket (MISSILEX [A-S] – Rocket)	Fixed-wing and helicopter aircrews fire precision-guided and unguided rockets against surface targets.

Activity Name	Activity Description
Missile Exercise (Air-to-Surface) – Missile (MISSILEX [A-S] – Missile)	Fixed-wing and helicopter aircrews fire precision-guided missiles against surface targets.
Laser Targeting (at sea)	Fixed-winged, helicopter, and ship crews illuminate enemy targets with lasers.
Bombing Exercise (Air-to-Surface) (BOMBEX [A-S])	Fixed-wing aircrews deliver bombs against surface targets.
Torpedo Exercise (Submarine-to-Surface)	Submarine attacks a surface target using exercise or live-fire torpedoes.
Missile Exercise (Surface-to-Surface) (MISSILEX [S-S])	Surface ship crews defend against threat missiles and other surface ships with missiles.
Gunnery Exercise Surface-to-Surface (Ship) – Large-caliber (GUNEX-S-S [Ship])	Ship crews engage surface targets with ship's large-caliber guns.
Gunnery Exercise Surface-to-Surface (Ship) – Small- and Medium-caliber (GUNEX-S-S [Ship])	Ship crews engage surface targets with ship's small- and medium-caliber guns.
Sinking Exercise (SINKEX)	Aircraft, ship, and submarine crews deliver ordnance on a seaborne target, usually a deactivated ship, which is deliberately sunk using multiple weapon systems.
Gunnery Exercise Surface-to-Surface (Boat) (GUNEX-S-S [Boat])	Small boat crews engage surface targets with small- and medium-caliber weapons.
Maritime Security Operations (MSO)	Helicopter and surface ship crews conduct a suite of Maritime Security Operations (e.g., Vessel Search, Board, and Seizure; Maritime Interdiction Operations; Force Protection; and Anti-Piracy Operation).

2.1.5 Anti-Submarine Warfare (ASW)

The mission of anti-submarine warfare is to locate, neutralize, and defeat hostile submarine threats to surface forces. Anti-submarine warfare is based on the principle of a layered defense of surveillance and attack aircraft, ships, and submarines all searching for hostile submarines. These forces operate together or independently to gain early warning and detection, and to localize, track, target, and attack hostile submarine threats. Table 5 provides summaries of training activities in support of ASW.

Anti-submarine warfare training addresses basic skills such as detection and classification of submarines, and distinguishing between sounds made by enemy submarines and those of friendly submarines, ships, and marine life. More advanced, integrated anti-submarine warfare training exercises are conducted in coordinated, at-sea training events involving submarines, ships, fixed wing aircraft, and helicopters. This training integrates the full spectrum of anti-submarine

warfare from detecting and tracking a submarine to attacking a target using either exercise torpedoes or simulated weapons.

Table 5. Typical Anti-Submarine Warfare Training Exercises

Activity Name	Activity Description
Anti-Submarine Warfare (ASW)	
Tracking Exercise/Torpedo Exercise – Helicopter (TRACKEX/TORPEX – Helo)	Helicopter crews search, track, and detect submarines. Exercise torpedoes may be used during this event.
Tracking Exercise – Maritime Patrol Aircraft Extended Echo Ranging Sonobuoys	Maritime patrol aircraft crews search, detect and track submarines using explosive source sonobuoys or multistatic active coherent system.
Tracking Exercise/Torpedo Exercise – Maritime Patrol Aircraft (TRACKEX/TORPEX – MPA)	Maritime patrol aircraft crews search, detect, and track submarines. Recoverable air launched torpedoes may be employed against submarine targets.
Tracking Exercise/Torpedo Exercise – Surface (TRACKEX/TORPEX – Surface)	Surface ship crews search, track, and detect submarines. Exercise torpedoes may be used during this event.
Tracking Exercise/Torpedo Exercise – Submarine (TRACKEX/TORPEX – Sub)	Submarine crews search, detect, and track submarines and surface ships. Exercise torpedoes may be used during this event.

2.1.6 Electronic Warfare (EW)

The mission of electronic warfare is to degrade the enemy's ability to use their electronic systems, such as communication systems and radar, in order to confuse or deny them the ability to defend their forces and assets. Electronic warfare is also used to recognize an emerging threat and counter an enemy's attempt to degrade the electronic capabilities of the Navy. Table 6 provides summaries of training activities in support of EW.

Typical electronic warfare activities include threat avoidance training, signals analysis for intelligence purposes, and use of airborne and surface electronic jamming devices to defeat tracking and communications systems.

Table 6. Typical Electronic Warfare Training Exercises

Activity Name	Activity Description
Electronic Warfare (EW)	
Electronic Warfare Operations (EW OPS)	Aircraft, surface ship, and submarine crews attempt to control portions of the electromagnetic spectrum used by enemy systems to degrade or deny the enemy's ability to take defensive actions.
Counter Targeting – Flare Exercise (FLAREX) – Aircraft	Fixed-winged aircraft and helicopters crews defend against an attack by deploying flares to disrupt threat infrared (IR) missile guidance systems.

Activity Name	Activity Description
Counter Targeting Chaff Exercise (CHAFFEX) – Ship	Surface ships defend against an attack by deploying chaff, a radar reflective material, which disrupt threat targeting and missile guidance radars.
Counter Targeting Chaff Exercise (CHAFFEX) – Aircraft	Fixed-winged aircraft and helicopter crews defend against an attack by deploying chaff, a radar reflective material, which disrupt threat targeting and missile guidance radars.

2.1.7 Mine Warfare (MIW)

The mission of mine warfare is to detect, and avoid or neutralize mines to protect Navy ships and submarines and to maintain free access to ports and shipping lanes. Mine warfare also includes offensive mine laying to gain control of, or deny the enemy access to sea space. Naval mines can be laid by ships (including purpose-built minelayers), submarines, or aircraft. Table 7 provides summaries of training activities in support of MIW.

Mine warfare neutralization (destruction) training includes exercises in which ships, aircraft, submarines, or underwater vehicles search for mines. Personnel train to destroy or disable mines by attaching and detonating underwater explosives to the mine. Other neutralization techniques involve impacting the mine with a bullet-like projectile or intentionally triggering the mine to detonate.

Table 7. Typical Mine Warfare Exercises

Activity Name	Activity Description
Mine Warfare (MIW)	
Civilian Port Defense	Naval mine warfare activities conducted at various ports and harbors, in support of maritime homeland defense/security.
Mine Laying	Fixed-winged aircraft and vessel crews drop/launch non explosive mine shapes.
Mine Neutralization – Explosive Ordnance Disposal (EOD)	Personnel disable threat mines. Explosive charges may be used.
Limpet Mine Neutralization System/Shock Wave Generator	Navy divers place a small charge on a simulated underwater mine.
Submarine Mine Exercise	Submarine crews practice detecting mines in a designated area.
Airborne Mine Countermeasure (MCM) – Mine Detection	Helicopter aircrews detect mines using towed and laser mine detection systems (e.g., AN/AQS-20, Airborne Laser Mine Detection System).
Mine Countermeasure Exercise – Towed Sonar	Surface ship crews detect and avoid mines while navigating restricted areas or channels using towed active sonar.
Mine Countermeasure Exercise – Surface (SMCMEX)	Mine countermeasure ship crews detect, locate, identify, and avoid mines while navigating restricted areas or channels using active sonar.
Mine Neutralization – Remotely Operated Vehicle Sonar	Helicopter aircrews disable mines using remotely operated underwater vehicles.

Activity Name	Activity Description
Mine Countermeasure (MCM) – Towed Mine Neutralization	Ship crews and helicopter aircrews tow systems (e.g., Organic and Surface Influence Sweep, MK 104/105) through the water that are designed to disable and/or trigger mines.

2.1.8 Naval Special Warfare

The mission of naval special warfare is to conduct unconventional warfare, direct action, combat terrorism, special reconnaissance, security assistance, counter-drug operations, and recovery of personnel from hostile situations. Naval special warfare operations are highly specialized and require continual and intense training. Table 8 provides summaries of training activities in support of NSW.

Naval special warfare units utilize a combination of specialized training, equipment, and tactics, including insertion and extraction operations using parachutes, submerged vehicles, rubber boats, and helicopters; boat-to-shore and boat-to-boat gunnery; underwater demolition training; reconnaissance; and small arms training.

Table 8. Typical Naval Special Warfare Exercises

Activity Name	Activity Description
Naval Special Warfare (NSW)	
Personnel Insertion/Extraction	Military personnel train for covert insertion and extraction into target areas using helicopters, fixed-wing aircraft (insertion only), small boats, and submersibles.
Direct Action (Tactical Air Control Party [TACP]/Joint Tactical Air Control)	Military personnel train for controlling of combat support aircraft; providing target designation, airspace de-confliction, and terminal control for Close Air Support. Teams also train in use of small arms and mortars.
Underwater Demolition Qualification/Certification	Navy divers conduct training and certification in placing underwater demolition charges.
Intelligence, Surveillance, Reconnaissance (ISR)	Special Warfare units train to collect and report battlefield intelligence.
Underwater Survey	Navy divers train in survey of underwater conditions and features in preparation for insertion, extraction, or intelligence, surveillance and reconnaissance activities.

2.1.9 Major Training and Other Training Activities

Major training exercises provide multi-Service and Joint participation in realistic maritime and expeditionary training that is designed to replicate the types of events and challenges that could be faced during real-world contingency operations. Major training exercises also include providing training to submarine, ship, aircraft, and special warfare forces in mission tactics, techniques, and procedures. Table 9 provides summaries of Major Training and Other Training Activities.

Table 9. Major Training and Other Training Activities

Activity Name	Activity Description
Major Training Activities	
Joint Expeditionary Exercise	A 10-day at-sea and ashore exercise which brings different branches of the United States (U.S.) military together in a joint environment that includes planning and execution efforts as well as military training activities at sea, in the air, and ashore. More than 8,000 personnel may participate and could include the combined assets of a Carrier Strike Group and Expeditionary Strike Group, Marine Expeditionary Units, Army Infantry Units, and Air Force aircraft.
Joint Multi-Strike Group Exercise	A 10-day at-sea and ashore exercise in which up to three Carrier Strike Groups integrated with U.S. Air Force and U.S. Marine Corps forces would conduct at-sea training and STW exercises simultaneously.
Marine Air Ground Task Force Exercise (Amphibious) – Battalion	A 10-day at-sea and shore exercise which conducts over the horizon, ship to objective maneuver for the elements of the Expeditionary Strike Group and the Amphibious Marine Air Ground Task Force. The exercise utilizes all elements of the Marine Air Ground Task Force (Amphibious), conducting training activities ashore with logistic support of the Expeditionary Strike Group and conducting amphibious landings.
Special Purpose Marine Air Ground Task Force Exercise	A 10-day at-sea and ashore exercise similar to Marine Air Ground Task Force (Amphibious) – Battalion, but task organized to conduct a specific mission (e.g., Humanitarian Assistance, Disaster Relief, Non-combatant Evacuation Operations).
Other Training Activities	
Surface Ship Sonar Maintenance	In-port and at-sea maintenance of sonar systems.
Submarine Sonar Maintenance	In-port and at-sea maintenance of sonar systems.
Small Boat Attack	Small boats or personal watercraft conduct attack activities on units afloat.
Submarine Navigation	Submarine crews locate underwater objects and ships while transiting out of port.
Search and Rescue at Sea	United States Coast Guard and military personnel train with ships, fixed wing and rotary aircraft to locate and rescue missing personnel and vessels at sea.
Precision Anchoring	Releasing of anchors in designated locations.

2.2 Mariana Islands Testing Activities

The Navy's research and acquisition community engages in a broad spectrum of testing activities in support of the fleet. These activities include, but are not limited to, basic and applied scientific research and technology development; testing, evaluation, and maintenance of systems (e.g., missiles, radar, and sonar), and platforms (e.g., surface ships, submarines, and aircraft); and acquisition of systems and platforms to support Navy missions and give a technological edge over adversaries.

The individual commands within the research and acquisition community included in this Biological Opinion are Naval Air Systems Command, Naval Sea Systems Command, the Office of Naval Research, and the Naval Research Laboratory.

The Navy operates in an ever-changing strategic, tactical, and funding and time-constrained environment. Testing activities occur in response to emerging science or fleet operational needs. For example, future Navy experiments to develop a better understanding of ocean currents may be designed based on advancements made by non-government researchers not yet published in the scientific literature. Similarly, future but yet unknown Navy operations within a specific geographic area may require development of modified Navy assets to address local conditions. Such modifications must be tested in the field to ensure they meet fleet needs and requirements.

Some testing activities are similar to training activities conducted by the fleet. For example, both the fleet and the research and acquisition community fire torpedoes. While the firing of a torpedo might look identical to an observer, the difference is in the purpose of the firing. The fleet might fire the torpedo to practice the procedures for such a firing, whereas the research and acquisition community might be assessing a new torpedo guidance technology or to ensure that the torpedo meets performance specifications and operational requirements. These differences may result in different analysis and potential mitigations for the activity.

2.2.1 Naval Air Systems Command Testing Activities

Naval Air Systems Command testing activities generally fall in the primary mission areas used by the fleets. Naval Air Systems Command activities include, but are not limited to, the testing of new aircraft platforms, weapons, and systems before those platforms, weapons and systems are delivered to the fleet. In addition to the testing of new platforms, weapons, and systems, Naval Air Systems Command also conducts lot acceptance testing of weapons and systems, such as sonobuoys.

The majority of testing and development activities (Table 10) conducted by Naval Air Systems Command are similar to fleet training activities, and many platforms (e.g., Maritime Patrol Aircraft) and systems (e.g., sonobuoys) currently being tested are already being used by the fleet or will ultimately be integrated into fleet training activities. However, some testing and development may be conducted in different locations and in a different manner than the fleet and therefore, though the potential environmental effects may be the same, the analysis for those activities may differ. Training with systems and platforms delivered to the fleet within the timeframe of this document are analyzed in the training sections of the MITT EIS/OEIS.

Table 10. Typical NAVAIR Testing Activities

Testing Event	Description	Weapons/Rounds/ Sound Source
Anti-Surface Warfare (ASUW)		
Air-to-Surface Missile Test	This event is similar to the training event missile exercise (air-to-surface). Test may involve both fixed wing and rotary wing aircraft launching missiles at surface maritime targets to evaluate the weapons system or as part of another systems integration test.	Explosive missiles

Testing Event	Description	Weapons/Rounds/ Sound Source
Anti-Submarine Warfare (ASW)		
Anti-Submarine Warfare Torpedo Test	This event is similar to the training event torpedo exercise. The Test evaluates anti-submarine warfare systems onboard rotary wing and fixed wing aircraft and the ability to search for, detect, classify, localize, and track a submarine or similar target. Some tests from fixed-wing aircraft will involve releasing torpedoes and sonobuoys from high altitudes (approximately 25,000 feet [ft.]).	Exercise (Non-explosive) torpedoes
Anti-Submarine Warfare Tracking Test – Maritime Patrol Aircraft (Sonobuoy)	This event is similar to the training event ASW TRACKEX-Maritime Patrol Aircraft (MPA). The test evaluates the sensors and systems used by maritime patrol aircraft to detect and track submarines and to ensure that aircraft systems used to deploy the tracking systems perform to specifications and meet operational requirements.	DICASS active sonobuoys, IEER sonobuoys (2 detonations per IEER buoy), High Duty Cycle sonobuoys, various Signal Underwater Sound (SUS) devices, MAC sonobuoys
Electronic Warfare (EW)		
Flare Test	Flare tests evaluate newly developed or enhanced flares, flare dispensing equipment, or modified aircraft systems against flare deployment. Tests may also train pilots and aircrew in the use of newly developed or modified flare deployment systems. Flare tests are often conducted with other test events, and are not typically conducted as standalone tests.	Chaff and flares are expended

2.2.2 Naval Sea Systems Command Testing Activities

Naval Sea Systems Command testing activities are aligned with its mission of new ship construction, life cycle support, and weapon systems development. Each major category of Naval Sea Systems Command activities is described below:

2.2.2.1 New Ship Construction Activities

Ship construction activities include testing of ship systems, and developmental and operational test and evaluation programs for new technologies and systems. At-sea testing of systems aboard a ship may include sonar, acoustic countermeasures, radars, and radio equipment. At-sea test firing of shipboard weapon systems, including guns, torpedoes, and missiles, are also conducted. Table 11 provides summaries of testing activities in support of ship construction and maintenance.

Table 11. Typical New Ship Construction Activities

Activity Name	Activity Description
New Ship Construction	
Anti-Submarine Warfare Mission Package Testing	Ships and their supporting platforms (e.g., helicopters, unmanned aerial systems) detect, localize, and prosecute submarines.
Anti-Surface Warfare Mission Package Testing	Ships and their supporting platforms (e.g., helicopters, unmanned aerial vehicles) detect, localize, and prosecute surface vessels.
Mine Countermeasure Mission Package Testing	Ships conduct mine countermeasure operations.

2.2.2.2 Life Cycle Activities

Testing activities (Table 12) are conducted throughout the life of a Navy ship to verify performance and mission capabilities. Sonar systems testing occurs pierside during maintenance, repair, and overhaul availabilities, and at sea immediately following most major overhaul periods. Radar cross signature testing of surface ships is conducted on new vessels and periodically throughout a ship's life to measure how detectable the ship is to radar. Additionally, electromagnetic measurements of off-board electromagnetic signature are conducted for submarines, ships, and surface crafts periodically.

Table 12. Typical Life Cycle Activities in the Study Area

Activity Name	Activity Description
Life Cycle Activities	
Ship Signature Testing	Tests ship and submarine radars, electromagnetic, or acoustic signatures.

2.2.3 Other Naval Sea System Command Testing Activities

Numerous test activities and technical evaluations, in support of Naval Sea Systems Command's systems development mission, often occur in conjunction with fleet activities within the MITT Study Area. Tests within this category include, but are not limited to anti-submarine warfare and mine warfare tests using torpedoes, sonobuoys, and mine detection and neutralization systems. Pierside, swimmer detection systems will also be tested.

Unique Naval Sea Systems Command planned testing includes a kinetic energy weapon for Navy ships, which uses electromagnetic energy to propel a projectile at a surface, air, or ground target.

Table 13. Other Naval Sea System Command Testing Activities.

Activity Name	Activity Description
Anti-Surface Warfare (ASUW)/Anti-Submarine Warfare (ASW) Testing	
Kinetic Energy Weapon Testing	A kinetic energy weapon uses stored electromagnetic energy released in a burst to accelerate a projectile. Projectiles used for testing are either non-explosive or in-air explosive munitions.
Torpedo Testing	Air, surface, or submarine crews employ live/exercise torpedoes against submarines or surface vessels.
Countermeasure Testing	Various systems (e.g., towed arrays and defense systems) are employed to detect, localize, and track incoming weapons.
At-sea Sonar Testing	At-sea testing to ensure systems are fully functional in an open ocean environment.
Shipboard Protection Systems and Swimmer Defense Testing	
Pierside Integrated Swimmer Defense	Swimmer defense testing ensures that systems can effectively detect, characterize, verify, and engage swimmer/diver threats in harbor environments.

2.2.4 Office of Naval Research and Naval Research Laboratory Testing Activities

As the Navy's Science and Technology provider, Office of Naval Research and the Naval Research Laboratory provide technology solutions for Navy and Marine Corps needs. The Office of Naval Research's missions, defined by law, are to plan, foster, and encourage scientific research in recognition of its paramount importance as related to the maintenance of future naval power, and the preservation of national security. Further, the Office of Naval Research manages the Navy's basic, applied, and advanced research to foster transition from science and technology to higher levels of research, development, test and evaluation. The Ocean Battlespace Sensing Department explores science and technology in the areas of oceanographic and meteorological observations, modeling, and prediction in the battlespace environment; submarine detection and classification (anti-submarine warfare); and mine warfare applications for detecting and neutralizing mines in both the ocean and littoral environment. The Office of Naval Research activities include: research, development, test, and evaluation activities; surface processes acoustic communications experiments; shallow water acoustic communications experiments; sediment acoustics experiments; shallow water acoustic propagation experiments; and long range acoustic propagation experiments. Office of Naval Research testing is shown in Table 14.

Table 14. Typical Office of Naval Research Testing Activity in the Study Area

Activity Name	Activity Description
Office of Naval Research	
North Pacific Acoustic Lab Philippine Sea 2018–19 Experiment (Deep Water)	The experiment area encompasses international waters. The initial experiment was completed in May of 2011; an acoustic tomography array, a distributed vertical line array (DVLA), and moorings were deployed in the deep-water environment of the northwestern Philippine Sea. The acoustic tomography array and DVLA have remained in situ at the experiment site since that time, collecting oceanographic and acoustic data used to study deep-water propagation and to characterize the temperature and velocity structure in this oceanographically complex and highly dynamic region. In addition, data will be collected during two periods of intensive experimental at-sea operations in May and July of 2018. During fall 2018, data will be collected passively by remotely sensing seagliders. Research vessels, acoustic test sources, side scan sonar, ocean gliders, the existing moored acoustic tomographic array and distributed vertical line array, and other oceanographic data collection equipment will be used to collect information on the ocean environment. The final phases of the experiment will be completed during March through May 2019. The resulting analyses will aid in developing a more complete understanding of deep water sound propagation and the temperature-velocity profile of the water column in this part of the world.

2.3 Sonar, Ordnance, Targets, and Other Systems Used in Training and Testing

The Navy uses a variety of sensors, platforms, weapons, and other devices to meet its mission. Training and testing with these systems may introduce acoustic (sound) energy into the environment. This section describes and organizes sonar systems, ordnance, munitions, targets, and other systems to facilitate understanding of the activities in which these systems are used. Underwater sound is described as one of two types for the purposes of the Navy's application: impulsive and non-impulsive. Underwater detonations of explosives and other percussive events are impulsive sounds. Sonar and similar sound producing systems are categorized as non-impulsive sound sources.

2.3.1 Sonar and Other Non-impulsive Sources

Modern sonar technology includes a variety of sonar sensor and processing systems. The simplest active sonar emits sound waves, or "pings," sent out in multiple directions and the sound waves then reflect off of the target object in multiple directions. The sonar source calculates the time it takes for the reflected sound waves to return; this calculation determines the distance to the target object. More sophisticated active sonar systems emit a ping and then rapidly scan or listen to the sound waves in a specific area. This provides both distance to the target and directional information. Even more advanced sonar systems use multiple receivers to listen to echoes from several directions simultaneously and provide efficient detection of both direction and distance. The Navy rarely uses active sonar continuously throughout the listed activities. When sonar is in use, the pings occur at intervals, referred to as a duty cycle, and the signals themselves are very short in duration. Even when the Navy is "operating continuously" while conducting ASW training, the sonar sends out a ping nominally once every 50 seconds, it

does not ping continuously when it is in operation. Therefore, even when operating continuously sonar signals are only actively transmitting 2% of the time. The Navy utilizes sonar systems and other acoustic sensors in support of a variety of mission requirements. Primary uses include the detection of and defense against submarines (anti-submarine warfare) and mines (mine warfare); safe navigation and effective communications; use of unmanned undersea vehicles; and oceanographic surveys.

2.3.2 Ordnance and Munitions

Most ordnance and munitions used during training and testing events fall into three basic categories: projectiles (such as gun rounds), missiles (including rockets), and bombs. Ordnance can be further defined by their net explosive weight, which considers the type and quantity of the explosive substance without the packaging, casings, bullets, etc. Net explosive weight (NEW) is the trinitrotoluene (TNT) equivalent of energetic material, which is the standard measure of strength of bombs and other explosives. For example, a 12.7-centimeter (cm) shell fired from a Navy gun is analyzed at about 9.5 pounds (lb) (4.3 kilograms (kg)) of NEW. The Navy also uses non-explosive ordnance in place of high explosive ordnance in many training and testing events. Non-explosive ordnance munitions look and perform similarly to high explosive ordnance, but lack the main explosive charge.

2.3.3 Defense Countermeasures

Naval forces depend on effective defensive countermeasures to protect themselves against missile and torpedo attack. Defensive countermeasures are devices designed to confuse, distract, and confound precision guided munitions. Defensive countermeasures analyzed in this opinion include acoustic countermeasures, which are used by surface ships and submarines to defend against torpedo attack. Acoustic countermeasures are either released from ships and submarines, or towed at a distance behind the ship.

2.3.4 Mine Warfare Systems

The Navy divides mine warfare systems into two categories: mine detection and mine neutralization. Mine detection systems are used to locate, classify, and map suspected mines, on the surface, in the water column, or on the sea floor. The Navy analyzed the following mine detection systems for potential impacts to marine mammals:

- Towed or hull-mounted mine detection systems. These detection systems use acoustic and laser or video sensors to locate and classify suspect mines. Fixed and rotary wing platforms, ships, and unmanned vehicles are used for towed systems, which can rapidly assess large areas.

- Unmanned/remotely operated vehicles. These vehicles use acoustic and video or lasers to locate and classify mines and provide unique capabilities in nearshore littoral areas, surf zones, ports, and channels.

- Marine mammal systems. The Navy deploys trained Atlantic bottlenose dolphins (*Tursiops truncatus*) and California sea lions (*Zalopus californianus*) for integrated training involving two primary mission areas: to find objects such as inert mine shapes, and to detect swimmers or other intruders around Navy facilities such as piers. These systems also include one or more motorized small boats and several crew members for

each trained marine mammal. When not engaged in training, Navy marine mammals are housed in temporary enclosures either on land or aboard ships.

2.3.5 Mine Neutralization Systems

Mine neutralization systems disrupt, disable, or detonate mines to clear ports and shipping lanes, as well as littoral, surf, and beach areas in support of naval amphibious operations. The Navy analyzed the following mine neutralization systems for potential impacts to marine mammals:

- Towed influence mine sweep systems. These systems use towed equipment that mimic a particular ship's magnetic and acoustic signature triggering the mine and causing it to explode.

- Unmanned/remotely operated mine neutralization systems. Surface ships and helicopters operate these systems, which place explosive charges near or directly against mines to destroy the mine.

- Airborne projectile-based mine clearance systems. These systems neutralize mines by firing a small or medium-caliber non-explosive, supercavitating projectile from a hovering helicopter.

- Diver emplaced explosive charges. Operating from small craft, divers put explosive charges near or on mines to destroy the mine or disrupt its ability to function.

2.4 Proposed Training Activity Levels

The following table provides a summary of training activities (as described in Section 2.1 above) including tempo and quantities of inert and live munitions that the Navy plans to expend during training that were analyzed by the U.S. Navy. Munitions that contain explosives are shaded grey in the table to highlight activities that might have greater potential for impact to listed species.

Table 15. Training Activities Ocurring in the Action Area

Range Activity	No. of Activities (per year)	Ordnance (Number per year)	Location
Anti-Air Warfare			
Air Combat Maneuver (ACM)	4,800	None	Study Area > 12 nm from land: SUA
Air Defense Exercise (ADEX)	100	None	Study Area > 12 nm from land: SUA
Air Intercept Control (AIC)	4,800	None	Study Area > 12 nm from land: SUA
Gunnery Exercise (Air-to-Air) – Medium-caliber (GUNEX [A-A]) Medium-caliber	36	9,000 rounds	Study Area SUA > 12 nm from land
Missile Exercise (Air-to-Air) (MISSILEX [A-A])	18	36 explosive missiles	Study Area SUA > 12 nm from land
Gunnery Exercise (Surface-to-Air) – Large-caliber (GUNEX [S-A]) – Large-caliber	5	40 rounds	Study Area SUA > 12 nm from land

Range Activity	No. of Activities (per year)	Ordnance (Number per year)	Location
Gunnery Exercise (Surface-to-Air) – Medium-caliber (GUNEX [S-A]) – Medium-caliber	12	24,000 rounds	Study Area SUA > 12 nm from land
Missile Exercise (Surface-to-Air) (MISSILEX [S-A])	15	15 explosive missiles	Study Area SUA > 12 nm from land
Strike Warfare (STW)			
Combat Search and Rescue	80	None	MIRC
Bombing Exercise (Air-to-Ground) (BOMBEX [A-G])*	2,300	2,670 NEPM 6,242 explosive rounds	FDM
Gunnery Exercise (Air-to-Ground) (GUNEX [A-G])*	96	24,000 small-caliber rounds 94,150 medium-caliber rounds 17,350 explosive med.-caliber rounds 200 explosive large-caliber rounds	FDM
Missile Exercise (MISSILEX)*	85	2,000 explosive rockets 85 explosive missiles	FDM
Amphibious Warfare (AMW)			
Amphibious Rehearsal, No Landing – Marine Air Ground Task Force	12	None	Study Area and Nearshore
Amphibious Assault	6	Blanks; Simunitions	MIRC; Tinian; Guam
Amphibious Raid	6	Blanks; Simunitions	MIRC; Tinian; Guam; Rota
Anti-Surface Warfare (ASUW)			
Gunnery Exercise (Air-to-Surface) – Small-caliber (GUNEX [A-S]) – Small-caliber	242	48,040 rounds	Study Area SUA > 12 nm from land
Gunnery Exercise (Air-to-Surface) – Medium-caliber (GUNEX [A-S]) – Medium-caliber	295	36,650 (7,150 explosive)	Study Area SUA > 12 nm from land; Transit Corridor
Missile Exercise (Air-to-Surface) – Rocket (MISSILEX [A-S] – Rocket)	3	114 rockets (114 explosive)	Study Area SUA > 12 nm from land
Missile Exercise (Air-to-Surface) (MISSILEX [A-S])	20	20 explosive missiles	Study Area SUA > 12 nm from land
Laser Targeting (at sea)	600	None	Study Area SUA > 12 nm from land
Bombing Exercise (Air-to-Surface) (BOMBEX [A-S])	37	368 NEPM 184 explosive	Study Area > 50 nm from land

Range Activity	No. of Activities (per year)		Ordnance (Number per year)	Location
Torpedo Exercise (Submarine-to-Surface)	5		10 EXTORP	Study Area > 3 nm from land
Missile Exercise (Surface-to-Surface) (MISSILEX [S-S])	12		12 Missiles explosive	Study Area > 50 nm from land
Gunnery Exercise (Surface-to-Surface) Ship – Large-caliber (GUNEX [S-S] – Ship) Large-caliber	140		5,698 rounds (500 explosive)	Study Area SUA > 12 nm from land; Transit Corridor
Gunnery Exercise (Surface-to-Surface) Ship – Small- and Medium-caliber (GUNEX [S-S] – Ship) Small- and Medium-caliber	100		21,900 rounds (900 explosive)	Study Area SUA > 12 nm from land; Transit Corridor
Sinking Exercise (SINKEX) Representative ordnance. Actual ordnance used will vary (typically less than shown).	2		28 explosive Bombs 42 explosive Missiles 800 explosive Large-caliber rounds 2 MK-48 explosive 4 explosive Demolitions	Study Area > 50 nm from land and > 1,000 fathoms depth
Gunnery Exercise (Surface-to-Surface) Boat – Small and Medium-caliber (GUNEX [S-S] – Boat	Medium-caliber	10	2,100 (100 explosive)	Study Area SUA > 12 nm from land; Transit Corridor
	Small-caliber	40	36,000 rounds	Study Area > 3 nm from land; Transit Corridor
Maritime Security Operations (MSO)	40		200 G911 anti-swimmer grenade	Study Area; MIRC
Anti-Submarine Warfare (ASW)				
Tracking Exercise – Helicopter (TRACKEX – Helo)	62		None/ REXTORP	Study Area > 3 nm from land; Transit Corridor
Torpedo Exercise – Helicopter (TORPEX – Helo)	4		4 EXTORP	Study Area > 3 nm from land
Tracking Exercise – Maritime Patrol Advanced Extended Echo Ranging Sonobuoys	11		None	Study Area > 3 nm from land
Tracking Exercise – Maritime Patrol Aircraft (TRACKEX – Maritime Patrol Aircraft)	34		None/ REXTORP	Study Area > 3 nm from land
Torpedo Exercise – Maritime Patrol Aircraft (TORPEX – Maritime Patrol Aircraft)	4		4 EXTORP	Study Area > 3 nm from land
Tracking Exercise – Surface (TRACKEX – Surface)	CG/DDG-92 FFG-30 LCS-10		None/ REXTORP	Study Area > 3 nm from land

Range Activity	No. of Activities (per year)	Ordnance (Number per year)	Location
Torpedo Exercise – Surface (TORPEX – Surface)	3	3 EXTORP	Study Area > 3 nm from land
Tracking Exercise – Submarine (TRACKEX – Sub)	12	None	Study Area > 3 nm from land; Transit Corridor
Torpedo Exercise – Submarine (TORPEX – Sub)	10	40 MK-48 EXTORP	Study Area > 3 nm from land
Major Training Activities			
Joint Expeditionary Exercise	1	Note 1	Study Area; MIRC
Joint Multi-Strike Group Exercise	1	Note 1	Study Area; MIRC
Marine Air Ground Task Force Exercise (Amphibious) – Battalion	4	Note 1	Study Area to nearshore; MIRC; Tinian; Guam; Rota; Saipan; FDM
Special Purpose Marine Air Ground Task Force Exercise	2	Note 1	Study Area to nearshore; MIRC; Tinian; Guam; Rota; Saipan
Electronic Warfare (EW)			
Electronic Warfare Operations (EW Ops)	480	None	Study Area
Counter Targeting Flare Exercise (FLAREX) – Aircraft	3,200	25,600 cartridges	Study Area > 12 nm from land
Counter Targeting Chaff Exercise (CHAFFEX) – Ship	40	240 cartridges	Study Area > 12 nm from land
Counter Targeting Chaff Exercise (CHAFFEX) – Aircraft	3,200	25,600 cartridges	Study Area > 12 nm from land
Mine Warfare (MIW)			
Civilian Port Defense	1	Note 1	Mariana littorals; MIRC; Inner and Outer Apra Harbor
Mine Laying	4	480 mine shapes	MIRC Warning Areas
Mine Neutralization – Explosive Ordnance Disposal (EOD)	20	20 explosive charges	MIRC mine neutralization sites at Piti and Outer Apra Harbor site are 10 lb. NEW maximum and 20 lb NEW maximum at Agat Bay Mine Neutralization Site
Limpet Mine Neutralization System/Shock Wave Generator	40	40 charges	Mariana littorals; Inner and Outer Apra Harbor
Submarine Mine Exercise	16	n/a	Study Area; nearshore
Airborne Mine Countermeasure – Mine Detection	4	n/a	Study Area; nearshore

Range Activity	No. of Activities (per year)	Ordnance (Number per year)	Location
Mine Countermeasure Exercise – Towed Sonar (AQS-20, LCS)	4	n/a	Study Area
Mine Countermeasure Exercise – Surface (SMCMEX) Sonar (SQQ-32, MCM)	4	n/a	Study Area
Mine Neutralization – Remotely Operated Vehicle Sonar (ASQ-235 [AQS-20], SLQ-48)	4	4 explosive neutralizers	Study Area
Mine Countermeasure – Towed Mine Detection	4	n/a	Study Area
Naval Special Warfare (NSW)			
Personnel Insertion/ Extraction	240	None	MIRC; Guam; Tinian; Rota
Underwater Demolition Qualification/ Certification	30	30 explosive charges	MIRC underwater demolition sites, 20 lb. NEW maximum charge (except Piti 10 lb. NEW maximum)
Other			
Surface Ship Sonar Maintenance	42	None	Study Area > 3 nm from land; Inner Apra Harbor; Transit Corridor
Submarine Sonar Maintenance	48	None	Study Area > 3 nm from land; Inner Apra Harbor; Transit Corridor
Small Boat Attack	6	2,100 small-caliber rounds	Study Area > 3 nm from land
	12	4,000 blank rounds	Study Area
Submarine Navigation	8	None	Apra Harbor and Mariana littorals
Search and Rescue At Sea	40	None	Study Area
Precision Anchoring	18	None	Apra Harbor; Mariana Islands anchorages

Notes:
(1) Exercise is composed of various activities accounted for elsewhere within Table
(2) Discussed as an embedded training activity to CHAFFEX/FLAREX in MIRC EIS/OEIS Appendix D (Air Quality Calculations and Record of Non-Applicability).
(3) CHAFF = Chaff Exercise, EIS = Environmental Impact Statement, EOD = Explosive Ordnance Disposal, EXTORP = Exercise Torpedo, FDM = Farallon de Medinilla, FLAREX = Flare Exercise, lb. = pounds, LCS = Littoral Combat Ship, MIRC = Mariana Islands Range Complex, mm = millimeters, n/a = Not Applicable, NEPM = Non-explosive Practice Munitions, NEW = Net Explosive Weight, nm = nautical miles, OEIS = Overseas Environmental Impact Statement, REXTORP = Recoverable Exercise Torpedo, SUA = Special Use Airspace
*** Ordnance are dropped on land (FDM) but are included in this table as a very small percentage may miss or richochet and end up in the water.**

2.5 Proposed Testing Activity Levels / Naval Air Systems Command

The following table provides a summary of testing activities including tempo and quantities of inert and live munitions that the Naval Air Systems Command plans to expend during testing that were analyzed by the U.S. Navy. Munitions containing explosives are shaded grey in the table to highlight activities that may have greater potential for impacts to listed resources than inert materials.

Table 16. Proposed Naval Air Systems Command Testing Activities

Range Activity	Action		
	No. of activities (per year)	Ordnance (Number per year)	Location
Anti-Surface Warfare (ASUW)			
Air-to-Surface Missile Test	8	8 harpoon missiles (4 explosive)	Action Area > 50 nm from land
Anti-Submarine Warfare (ASW)			
Anti-Submarine Warfare Tracking Test – Maritime Patrol Aircraft (Sonobuoys)	188	240 IEER/MAC 553 SUS	Action Area > 3 nm from land
Anti-Submarine Warfare Torpedo Test	40	40 EXTORP	Action Area > 3 nm from land
Broad Area Maritime Surveillance (BAMS) Testing – MQ-4C Triton	10	None	Action Area
Electronic Warfare (EW)			
Flare Test	10	None	Action Area > 3 nm from land

Notes: EIS = Environmental Impact Statement, EXTORP = Exercise Torpedo, IEER = Improved Extended Echo Ranging, MAC = Multi-static Active Coherent, nm = nautical miles, OEIS = Overseas Environmental Impact Statement, SUS = Signal Underwater Sound

2.6 Proposed Testing Activity Levels - Naval Sea Systems Command

The following table provides a summary of testing activities including tempo and quantities of inert and live munitions that the Naval Sea Systems Command plans to expend during testing that were analyzed by the U.S. Navy. Munitions containing explosives are shaded grey in the table to highlight activities that may have greater potential for impacts to listed resources than inert materials.

Table 17. Proposed Naval Sea Systems Command Testing Activities

Range Activity	Action			
	No. of activities (per year)		Ordnance (Number per year)	Location
Life Cycle Activities				
Ship Signature Testing	17		None	Action Area
Anti-Surface Warfare (ASUW)/Anti-Submarine Warfare (ASW) Testing				
Kinetic Energy Weapon Testing	50		2,000 projectiles	MIRC > 12 nm from land
	1 event total		5,000 projectiles	
Torpedo Testing	2		20 torpedoes (8 explosive)	MIRC > 3 nm from land
Countermeasure Testing	2		56 torpedoes	Action Area
At-Sea Sonar Testing	20		None	Action Area
New Ship Construction				
ASW Mission Package Testing	33		None	Action Area
MCM Mission Package Testing	32		48 neutralizers (24 explosive)	Action Area
ASUW Mission Package Testing	Gun Testing – Small-caliber	4	2,000 rounds	Action Area; Warning Area > 12 nm from land

Range Activity	Action			
	No. of activities (per year)		Ordnance (Number per year)	Location
	Gun Testing – Medium-caliber (30 mm)	4	4,080 rounds (2,040 explosive)	
	Gun Testing – Large-caliber (57 mm)	4	5,600 rounds (3,920 in-air explosive)	
	Missile/ Rocket Testing	4	32 missiles/ rockets (16 explosive)	

Notes: IEER = Improved Extended Echo Ranging, MCM = Mine Countermeasure, MIRC = Mariana Islands Range Complex, mm = millimeters, nm = nautical miles

2.7 Office of Naval Research and Naval Research Laboratory Testing Activities

As the Department of the Navy's Science and Technology provider, Office of Naval Research and Naval Research Laboratory provide technology solutions for Navy and Marine Corps needs. The Office of Naval Research's mission, defined by law, is to plan, foster, and encourage scientific research in recognition of its paramount importance as related to the maintenance of future naval power, and the preservation of national security.

Further, Office of Naval Research manages the Navy's basic, applied, and advanced research to foster transition from science and technology to higher levels of research, development, test, and evaluation. The Ocean Battlespace Sensing Department explores science and technology in the areas of oceanographic and meteorological observations, modeling, and prediction in the battlespace environment; submarine detection and classification (anti-submarine warfare); and mine warfare applications for detecting and neutralizing mines in both the ocean and littoral environment. The Office of Naval Research events include research, development, test, and evaluation activities; surface processes acoustic communications experiments; shallow and deep water acoustic communications experiments; sediment acoustics experiments; shallow and deep water acoustic propagation experiments; and long-range acoustic propagation experiments.

Table 18. Proposed Naval Research Activities

Office of Naval Research	Action		
	No. of activities (per year)	Ordnance (Number per year)	Location
North Pacific Acoustic Lab Phillipine Sea 2018-19 Experiment (Deep Water)	1	n/a	Action Area

2.8 U.S. Navy Proposed Mitigation

This section summarizes the Navy's mitigation measures, that were developed in close coordination with NMFS' Office of Protected Resources based on previous consultations and lessons-learned from employment during Phase I (2010 to 2015) training and testing activities. Table 19 provides a summary of the Navy's proposed mitigation measures. These measures are

also described in NMFS' proposed final rule in this opinion. The measures presented in the table are discussed in greater detail in the Final EIS/OEIS, May 2015.

Table 19. Summary of the U.S. Navy's Proposed Mitigation

Activity Category or Mitigation Area	Recommended Lookout Procedural Measure	Recommended Mitigation Zone and Protection Focus
Specialized Training	Lookouts will complete the Introduction to the U.S. Navy Afloat Environmental Compliance Training Series and the U.S. Navy Marine Species Awareness Training or civilian equivalent.	The mitigation zones observed by Lookouts are specified for each Mitigation Zone Procedural Measure below.
Low-Frequency and Hull-Mounted Mid-Frequency Active Sonar during Anti-Submarine Warfare and Mine Warfare	2 Lookouts (general) 1 Lookout (minimally manned, moored, or anchored)	Sources that can be powered down: 1,000 yd. (914 m) and 500 yd. (457 m) power downs and 200 yd. (183 m) shutdown for marine mammals (hull-mounted mid-frequency and low-frequency) and sea turtles (low-frequency only). Sources that cannot be powered down: 200 yd. (183 m) shutdown for marine mammals and sea turtles.
High-Frequency and Non-Hull Mounted Mid-Frequency Active Sonar	1 Lookout	200 yd. (183 m) for marine mammals (high-frequency and mid-frequency), sea turtles (bins MF8, MF9, MF10, and MF12 only)
Improved Extended Echo Ranging Sonobuoys	1 Lookout	600 yd. (549 m) for marine mammals and sea turtles Passive acoustic monitoring conducted with Navy assets participating in the activity.
Explosive Sonobuoys using >0.5–2.5 lb. NEW	1 Lookout	350 yd. (320 m) for marine mammals and sea turtles Passive acoustic monitoring conducted with Navy assets participating in the activity.
Anti-Swimmer Grenades	1 Lookout	200 yd. (183 m) for marine mammals and sea turtles
Mine Countermeasures and Mine Neutralization using Positive Control Firing Devices	General: 1 or 2 Lookouts (NEW dependent) Diver-placed: 2 Lookouts	NEW dependent for marine mammals, sea turtles, and hammerhead sharks
Mine Neutralization Activities Using Diver-Placed Time-Delay Firing Devices	4 Lookouts	Up to 10-minute time-delay using up to 20 lb. NEW: 1,000 yd. (914 m) for marine mammals, sea turtles, and hammerhead sharks.
Explosive and Non-Explosive Gunnery Exercises – Small- and Medium-Caliber Using a Surface Target	1 Lookout	200 yd. (183 m) for marine mammals and sea turtles

Activity Category or Mitigation Area	Recommended Lookout Procedural Measure	Recommended Mitigation Zone and Protection Focus
Explosive and Non-Explosive Gunnery Exercises – Large-Caliber Using a Surface Target	1 Lookout	Explosive: 600 yd. (549 m) for marine mammals and sea turtles Non-Explosive: 200 yd. (183 m) for marine mammals and sea turtles Both: 70 yd. (64 m) within 30 degrees on either side of the gun target line on the firing side for marine mammals and sea turtles Both: 350 yd. (320 m) for surveyed shallow coral reefs
Non-Explosive Missile Exercises and Explosive Missile Exercises (Including Rockets) up to 250 lb. NEW using a Surface Target	1 Lookout	900 yd. (823 m) for marine mammals and sea turtles 350 yd. (320 m) for surveyed shallow coral reefs
Explosive Missile Exercises (Including Rockets) from > 250 to 500 lb. NEW using a Surface Target	1 Lookout	2,000 yd. (1.8 km) for marine mammals and sea turtles 350 yd. (320 m) for surveyed shallow coral reefs
Bombing Exercises, Explosive and Non-Explosive	1 Lookout	Explosive: 2,500 yd. (2.3 km) for marine mammals and sea turtles Non-Explosive: 1,000 yd. (914 m) for marine mammals and sea turtles Both: 350 yd. (320 m) for surveyed shallow coral reefs
Torpedo (Explosive) Testing	1 Lookout	2,100 yd. (1.9 km) for marine mammals and sea turtles and jellyfish aggregations Passive acoustic monitoring conducted with Navy assets participating in the activity.
Sinking Exercises	2 Lookouts	2.5 nm for marine mammals and sea turtles and jellyfish aggregations. Passive acoustic monitoring conducted with Navy assets participating in the activity.
Vessel Movements	1 Lookout	500 yd. (457 m) for whales 200 yd. (183 m) for all other marine mammals (except bow riding dolphins)
Towed In-Water Device Use	1 Lookout	250 yd. (229 m) for marine mammals

Activity Category or Mitigation Area	Recommended Lookout Procedural Measure	Recommended Mitigation Zone and Protection Focus
Precision Anchoring	No Lookouts in addition to standard personnel standing watch	Avoidance of precision anchoring within the anchor swing diameter of shallow coral reefs, live hardbottom, artificial reefs, and shipwrecks Except at existing anchorages as well as at near-shore training areas around Guam and in Apra Harbor, the Navy will not conduct precision anchoring activities within the anchor swing diameter of surveyed shallow coral reefs, live hardbottom, artificial reefs, and shipwrecks.
Shallow Coral Reefs, Hardbottom Habitat, Artificial Reefs, and Shipwrecks	No Lookouts in addition to standard personnel standing watch	Except at existing anchorages as well as at near-shore training areas around Guam and in Apra Harbor, the Navy will not conduct precision anchoring within the anchor swing diameter, or explosive mine countermeasure and neutralization activities within 350 yd. (320 m) of surveyed shallow coral reefs, live hardbottom, artificial reefs, and shipwrecks. No explosive or non-explosive small-, medium-, and large-caliber gunnery exercises using a surface target, explosive or non-explosive missile exercises using a surface target, explosive and non-explosive bombing exercises, or at-sea explosive testing within 350 yd. (320 m) of surveyed shallow coral reefs

2.9 NMFS' Promulgation of Regulations Pursuant to the Marine Mammal Protection Act (MMPA)

On April 17, 2013, NMFS' Permits Division received an application from the U.S. Navy requesting regulations and a LOA for the take of 26 species of marine mammals incidental to Navy training and testing activities to be conducted in the MITT Study Area over 5 years. The Navy is requesting regulations that would establish a process for authorizing take, via a five-year LOA, of marine mammals for training and testing activities proposed to be conducted from August 2015 through August 2020.

The regulations establish a framework under the MMPA whereby the Navy may obtain authorization to "take" marine mammals only if the "take" occurs within the MITT Study Area incidental to the Navy's testing and training activities. The framework includes the following: (1) specific activity and geographical region where "take" make occur, (2) dates when "take" may occur, (3) permissible methods of taking, (4) prohibitions on taking of marine mammals, (5) mitigation required, (6) monitoring and reporting requirements, (7) how LOAs may be applied for, (8) specifics of LOAs, and (9) renewals and modifications of LOAs and adaptive management processes.

In order to promulgate the Final Rule, NMFS must determine that the incidental taking of marine mammals will have a negligible impact on the species or stock(s) and will not have an unmitigable adverse impact on the availability of the species or stock(s) for subsistence uses (where relevant). NMFS has defined negligible impact in 50 CFR 216.103 as "an impact resulting from the specified activity that cannot be reasonably expected to, and is not reasonably likely to, adversely affect the species or stock through effects on annual rates of recruitment or survival."

NMFS Permits Division determined that the Navy's proposed action (summarized above) would result in the take of ESA-listed species and that such take would be in the form of exposure to sound or pressure waves in the water and interactions with vessels. The specific activity and geographic region where take may occur, the dates when take may occur, and permissible method of taking that will be set by the proposed regulations are all consistent with the Navy's action described previously in this Opinion so they will not be reiterated here. The estimated take of ESA-listed marine mammals is presented in Table 20. NMFS Permits Division's proposed final rule is based on the information contained in the revised LOA application.

Marine mammals present in the Study Area may be exposed to sound from active sonar and underwater detonations. The Navy requested MMPA authorization to take individuals of ESA-listed, marine mammal species by Level B harassment.

Table 20. Species Specific Take Requests from Modeling Estimates of Impulse and Non-Impulse Source Effects for All Training and Testing Activities Pursuant to the MMPA

Species	Annually			Total Over the five-year MMPA Rule		
	Level B	Level A	Mortality	Level B	Level A	Mortality
Humpback Whale	860	0	0	4,300	0	0
Blue whale	28	0	0	140	0	0
Fin Whale	28	0	0	140	0	0
Sei Whale	319	0	0	1,595	0	0

Species	Annually			Total Over the five-year MMPA Rule		
	Level B	Level A	Mortality	Level B	Level A	Mortality
Sperm Whale	506	0	0	2,530	0	0

There are five marine mammal species under NMFS' jurisdiction included in the Navy's incidental take authorization request that are listed as threatened or endangered under the ESA with confirmed or possible occurrence in the Study Area. They are: blue whale, humpback whale, fin whale, sei whale, and sperm whale. We are consulting with NMFS' Permits Division pursuant to section 7 of the ESA, on the issuance of a rule and LOA under section 101(a)(5)(A) of the MMPA for MITT activities. We have also determined that NMFS Permit Division's actions are interdependent with MITT. Therefore, both actions are assessed in this Opinion. The proposed MMPA rule will amend 50 CFR §218. The proposed rule provides a five-year framework for authorizations including descriptions of the specified activity and specified geographical region (Sec. 218.80), effective dates and definitions (Sec. 218.81), permissible methods of taking (Sec. 218.82), prohibitions (Sec. 218.83), mitigation (Sec. 218.84), requirements for monitoring and reporting (Sec. 218.85), and procedures for applications for letters of authorization (Sec. 218.86), issuance of letters of authorization (Sec. 218.87), and Renewals and Modifications of Letters of Authorization and Adaptive Management (Sec. 218.88).

We provide excerpts from the proposed rule, including excerpts of the description of the activity (anticipated levels of activities), and permissible methods of taking and mitigation for the five-year period. Statements in the proposed rule regarding ESA-listed species are emphzised in bold.

2.9.1 PART 218—REGULATIONS GOVERNING THE TAKING AND IMPORTING OF MARINE MAMMALS

1. The authority citation for part 218 continues to read as follow: Authority: 16 U.S.C. 1361 et seq.

2. Subpart J is added to part 218 to read as follows:

2.9.1.1 Subpart J – Taking and Importing Marine Mammals; U.S. Navy's Mariana Islands Training and Testing (MITT)

§ 218.90 Specified activity and specified geographical region.
(a) Regulations in this subpart apply only to the U.S. Navy for the taking of marine mammals that occurs in the area outlined in paragraph (b) of this section and that occurs incidental to the activities described in paragraph (c) of this section.

(b) The taking of marine mammals by the Navy is only authorized if it occurs within the MITT Study Area, which includes the MIRC and areas to the north and west. The Study Area includes established ranges, operating areas, warning areas, and special use airspace in the region of the Mariana Islands that are part of the MIRC, its surrounding seas, and a transit corridor to the

Hawaii Range Complex. The Study Area also includes Navy pierside locations where sonar maintenance and testing may occur.

(c) The taking of marine mammals by the Navy is only authorized if it occurs incidental to the following activities within the designated amounts of use:

(1) Non-impulsive Sources Used During Training and Testing:
- (i) Low-frequency (LF) Source Classes:
  - (A) LF4 – an average of 123 hours per year.
  - (B) LF5 – an average of 11 hours per year.
  - (C) LF6 – an average of 40 hours per year.
- (ii) Mid-frequency (MF) Source Classes:
  - (A) MF1 – an average of 1,872 hours per year.
  - (B) MF2 – an average of 625 hours per year.
  - (C) MF3 – an average of 192 hours per year.
  - (D) MF4 – an average of 214 hours per year.
  - (E) MF5 – an average of 2,588 items per year.
  - (F) MF6 – an average of 33 items per year.
  - (G) MF8 – an average of 123 hours per year.
  - (H) MF9 – an average of 47 hours per year.
  - (I) MF10 – an average of 231 hours per year.
  - (J) MF11 – an average of 324 hours per year.
  - (K) MF12 – an average of 656 hours per year.
- (iii) High-frequency (HF) and Very High-frequency (VHF) Source Classes:
  - (A) HF1 – an average of 113 hours per year.
  - (B) HF4 – an average of 1,060 hours per year.
  - (C) HF5 – an average of 336 hours per year.
  - (D) HF6 – an average of 1,173 hours per year.
- (iv) Anti-Submarine Warfare (ASW) Source Classes:
  - (A) ASW1 – an average of 144 hours per year.
  - (B) ASW2 – an average of 660 items per year.
  - (C) ASW3 – an average of 3,935 hours per year.
  - (D) ASW4 – an average of 32 items per year.
- (v) Torpedoes (TORP) Source Classes:
  - (A) TORP1 – an average of 115 items per year.
  - (B) TORP2 – an average of 62 items per year.
- (vi) Acoustic Modems (M):
  - (A) M3 – an average of 112 hours per year.
  - (B) [Reserved]
- (vii) Swimmer Detection Sonar (SD):
  - (A) SD1 – an average 2,341 hours per year.

(2) Impulsive Source Detonations During Training and Testing:
- (i) Explosive Classes:
  - (A) E1 (0.1 to 0.25 lb NEW) – an average of 10,140 detonations per year.
  - (B) E2 (0.26 to 0.5 lb NEW) – an average of 106 detonations per year.
  - (C) E3 (>0.5 to 2.5 lb NEW) – an average of 932 detonations per year.
  - (D) E4 (>2.5 to 5 lb NEW) – an average of 420 detonations per year.

(E) E5 (>5 to 10 lb NEW) – an average of 684 detonations per year.
(F) E6 (>10 to 20 lb NEW) – an average of 76 detonations per year.
(G) E8 (>60 to 100 lb NEW) – an average of 16 detonations per year.
(H) E9 (>100 to 250 lb NEW) – an average of 4 detonations per year.
(I) E10 (>250 to 500 lb NEW) – an average of 12 detonations per year.
(J) E11 (>500 to 650 lb NEW) – an average of 6 detonations per year.
(K) E12 (>650 to 2,000 lb NEW) – an average of 184 detonations per year.

(ii) [Reserved]

2.9.1.2 § 218.91 Effective dates and definitions.

(a) Regulations are effective [INSERT DATE OF FILING] through [INSERT DATE FIVE YEARS AFTER DATE OF FILING].

(b) The following definitions are utilized in these regulations:

(1) *Uncommon Stranding Event (USE)* – A stranding event that takes place within an OPAREA where a Major Training Exercise (MTE) occurs and involves any one of the following:

(i) Two or more individuals of any cetacean species (not including mother/calf pairs), unless of species of concern listed in paragraph (b)(1)(ii) of this section found dead or live on shore within a 2-day period and occurring within 30 miles of one another.

(ii) A single individual or mother/calf pair of any of the following marine mammals of concern: beaked whale of any species, *Kogia* spp., Risso's dolphin, melon-headed whale, humpback whale, sperm whale, blue whale, fin whale, or sei whale.

(iii) A group of two or more cetaceans of any species exhibiting indicators of distress.

(2) *Shutdown* – The cessation of active sonar operation or detonation of explosives within 14 nautical miles of any live, in the water, animal involved in a USE.

2.9.1.3 § 218.92 Permissible methods of taking.

(a) Under a Letter of Authorization (LOA) issued pursuant to § 218.97, the Holder of the Letter of Authorization may incidentally, but not intentionally, take marine mammals within the area described in § 218.90, provided the activity is in compliance with all terms, conditions, and requirements of these regulations and the appropriate LOA.

(b) The activities identified in § 218.90(c) must be conducted in a manner that minimizes, to the greatest extent practicable, any adverse impacts on marine mammals and their habitat.

(c) The incidental take of marine mammals under the activities identified in § 218.90(c) is limited to the following species, by the identified method of take:

(1) Level B Harassment for all Training and Testing Activities:

(i) Mysticetes:

(A) Blue whale (*Balaenoptera musculus*) – 140 (an average of 28 annually)

(B) Bryde's whale (*Balaenoptera edeni*) – 1,990 (an average of 398 annually)

(C) Fin whale (*Balaenoptera physalus*) - 140 (an average of 28 annually)

(D) Humpback whale (*Megaptera novaeangliae*) – 4,300 (an average of 860 annually)

(E) Minke whale (*Balaenoptera acutorostrata*) – 505 (an average of 101 annually)

(F) Sei whale (*Balaenoptera borealis*) - 1,595 (an average of 319 annually)

(G) Omura's whale (*Balaenoptera omurai*) - 515 (an average of 103 annually)

(ii) Odontocetes:

(A) Blainville's beaked whale (*Mesoplodon densirostris*) – 22,130 (an average of 4,426 annually)

(B) Bottlenose dolphin (*Tursiops truncatus*) – 3,705 (an average of 741 annually)

(C) Cuvier's beaked whale (*Ziphius cavirostris*) – 112,705 (an average of 22,541 annually)

(D) Dwarf sperm whale (*Kogia sima*) – 71,085 (an average of 14,217 annually)

(E) False killer whale (*Pseudorca crassidens*) – 2,775 (an average of 555 annually)

(F) Fraser's dolphin (*Lagenodelphis hosei*) – 12,860 (an average of 2,572 annually)

(G) Gingko-toothed beaked whale (*Mesoplodon ginkgodens*) – 19,485 (an average of 3,897 annually)

(H) Killer whale (*Orcinus orca*) – 420 (an average of 84 annually)

(I) Longman's beaked whale (*Indopacetus pacificus*) – 9,620 (an average of 1,924 annually)

(J) Melon-headed whale (*Peponocephala electra*) – 10,425 (an average of 2,085 annually)

(K) Pantropical spotted dolphin (*Stenella attenuata*) – 64,055 (an average of 12,811 annually)

(L) Pygmy killer whale (*Feresa attenuata*) – 525 (an average of 105 annually)

(M) Pygmy sperm whale (*Kogia breviceps*) – 27,895 (an average of 5,579 annually)

(N) Risso's dolphin (*Grampus griseus*) – 2,525 (an average of 505 annually)

(O) Rough-toothed dolphin (*Steno bredanensis*) – 9,095 (an average of 1,819 annually)

(P) Short-finned pilot whale (Globicephala macrorhynchus) – 9,075 (an average of 1,815 annually)

(Q) Sperm whale (*Physeter macrocephalus*) – 2,530 (an average of 506 annually)

(R) Spinner dolphin (*Stenella longirostris*) – 2,945 (an average of 589 annually)

(S) Striped dolphin (*Stenella coerulealba*) – 16,490 (an average of 3,298 annually)

(2) Level A Harassment for all Training and Testing Activities:

(i) Odontocetes:

(A) Dwarf sperm whale (*Kogia sima*) – 205 (an average of 41 annually)

(B) Pygmy sperm whale (*Kogia breviceps*) – 75 (an average of 15 annually)

2.9.1.4 § 218.93 Prohibitions.

Notwithstanding takings contemplated in § 218.92 and authorized by an LOA issued under §§ 216.106 and 218.97 of this chapter, no person in connection with the activities described in § 218.90 may:

(a) Take any marine mammal not specified in § 218.92(c);

(b) Take any marine mammal specified in § 218. 92(c) other than by incidental take as specified in § 218.92(c);

(c) Take a marine mammal specified in § 218.92(c) if such taking results in more than a negligible impact on the species or stocks of such marine mammal; or

(d) Violate, or fail to comply with, the terms, conditions, and requirements of these regulations or an LOA issued under §§ 216.106 and 218.97.

2.9.1.5 § 218.94 Mitigation.

(a) When conducting training and testing activities, as identified in § 218.90, the mitigation measures contained in the LOA issued under §§ 216.106 and 218.97 of this chapter must be implemented. These mitigation measures include, but are not limited to:

(1) *Lookouts* – The following are protective measures concerning the use of lookouts.

(i) Lookouts positioned on surface ships will be dedicated solely to diligent observation of the air and surface of the water. Their observation objectives will include, but are not limited to, detecting the presence of biological resources and

recreational or fishing boats, observing mitigation zones, and monitoring for vessel and personnel safety concerns.

(ii) Lookouts positioned in aircraft or on boats will, to the maximum extent practicable and consistent with aircraft and boat safety and training and testing requirements, comply with the observation objectives described above in § 218.94 (a)(1)(i).

(iii) Lookout measures for non-impulse sound:

(A) With the exception of vessels less than 65 ft (20 m) in length and ships that are minimally manned, ships using low-frequency or hull-mounted mid-frequency active sonar sources associated with anti-submarine warfare and mine warfare activities at sea will have two lookouts at the forward position. For the purposes of this rule, low-frequency active sonar does not include surface towed array surveillance system low-frequency active sonar.

(B) While using low-frequency or hull-mounted mid-frequency active sonar sources associated with anti-submarine warfare and mine warfare activities at sea, ships less than 65 ft (20 m) in length and ships that are minimally manned will have one lookout at the forward position of the vessel due to space and manning restrictions.

(C) Ships conducting active sonar activities while moored or at anchor (including pierside testing or maintenance) will maintain one lookout.

(D) Surface ships or aircraft conducting high-frequency or non-hull mounted mid-frequency active sonar activities associated with anti-submarine warfare and mine warfare activities at sea will have one lookout.

(iv) Lookout measures for explosives and impulse sound:

(A) Aircraft conducting IEER sonobuoy activities and explosive sonobuoy exercises will have one lookout.

(B) Surface vessels conducting anti-swimmer grenade activities will have one lookout.

(C) During general mine countermeasure and neutralization activities using up to a 20-lb net explosive weight detonation (bin E6 and below), vessels greater than 200 ft (61 m) will have two lookouts, while vessels less than 200 ft (61 m) or aircraft will have one lookout.

(D) Mine neutralization activities involving positive control diver-placed charges using up to a 20-lb net explosive weight detonation will have two

lookouts. The divers placing the charges on mines will report all marine mammal sightings to their supporting small boat or Range Safety Officer.

(E) When mine neutralization activities using diver-placed charges with up to a 20-lb net explosive weight detonation are conducted with a time-delay firing device, four lookouts will be used. Two lookouts will be positioned in each of two small rigid hull inflatable boats. When aircraft are used, the pilot or member of the aircrew will serve as an additional lookout. The divers placing the charges on mines will report all marine mammal sightings to their supporting small boat or Range Safety Officer.

(F) Surface vessels or aircraft conducting small- or medium-caliber gunnery exercises against a surface target will have one lookout.

(G) Aircraft conducting missile exercises (including rockets) against surface targets will have one lookout.

(H) Aircraft conducting bombing exercises will have one lookout.

(I) During explosive torpedo testing, one lookout will be used and positioned in an aircraft.

(J) During sinking exercises, two lookouts will be used. One lookout will be positioned in an aircraft and one on a surface vessel.

(K) Surface vessels conducting explosive and non-explosive large-caliber gunnery exercises will have one lookout.

(v) Lookout measures for physical strike and disturbance:

(A) While underway, surface ships will have at least one lookout.

(B) During activities using towed in-water devices, that are towed from a manned platform, one lookout will be used.

(C) Non-explosive small-, medium-, and large-caliber gunnery exercises using a surface target will have one lookout.

(D) Non-explosive bombing exercises will have one lookout.

(E) Aircraft conducting non-explosive missile exercises against a surface target will have one lookout.

(2) *Mitigation Zones* – The following are protective measures concerning the implementation of mitigation zones.

(i) Mitigation zones will be measured as the radius from a source and represent a distance to be monitored.

(ii) Visual detections of marine mammals within a mitigation zone will be communicated immediately to a watch station for information dissemination and appropriate action.

(iii) Mitigation zones for non-impulse sound:

(A) When marine mammals are visually detected, the Navy shall ensure that low-frequency and hull-mounted mid-frequency active sonar transmission levels are limited to at least 6 dB below normal operating levels (for sources that can be powered down during the activity) if any visually detected marine mammals are within 1,000 yd (914 m) of the source (i.e., the bow).

(B) The Navy shall ensure that low-frequency and hull-mounted mid-frequency active sonar transmissions are limited to at least 10 dB below the equipment's normal operating level (for sources that can be powered down during the activity) if any detected marine mammals are sighted within 500 yd (457 m) of the source.

(C) The Navy shall ensure that low-frequency and hull-mounted mid-frequency active sonar transmissions (for sources that can be turned off during the activity) are ceased if any visually detected marine mammals are within 200 yd (183 m) of the sonar dome. Active transmission will recommence if any one of the following conditions is met: (1) the animal is observed exiting the mitigation zone; (2) the animal is thought to have exited the mitigation zone based on a determination of its course and speed and the relative motion between the animal and the source; (3) the mitigation zone has been clear from any additional sightings for a period of 30 minutes; (4) the ship has transited more than 2,000 yd. (1.8 kilometers [km]) beyond the location of the last sighting; or (5) the ship concludes that dolphins are deliberately closing in on the ship to ride the ship's bow wave (and there are no other marine mammal sightings within the mitigation zone).

(D) If the source is not able to be powered down during the activity (e.g., low-frequency sources within bins LF4 and LF5), mitigation will involve ceasing active transmission if a marine mammal is sighted within 200 yd. (183 m). Active transmission will recommence if any one of the following conditions is met: (1) the animal is observed existing the mitigation zone; (2) the animal is thought to have exited the mitigation zone based on a determination of its course and speed and the relative motion between the animal and the source; (3) the mitigation zone has been clear from any additional sightings for a period of 30 minutes; or (4) the ship has transited more than 400 yd. (366 m) beyond the location of the last sighting.

(E) With the exception of activities involving platforms operating at high altitudes, when marine mammals are visually detected, the Navy shall

ensure that high-frequency and non-hull-mounted mid-frequency active sonar transmission (for sources that can be turned off during the activity) is ceased if any visually detected marine mammals are within 200 yd (183 m) of the source. Active transmission will recommence if any one of the following conditions is met: (1) the animal is observed exiting the mitigation zone, (2) the animal is thought to have exited the mitigation zone based on a determination of its course and speed and the relative motion between the animal and the source, (3) the mitigation zone has been clear from any additional sightings for a period of 10 minutes for an aircraft-deployed source, (4) the mitigation zone has been clear from any additional sightings for a period of 30 minutes for a vessel-deployed source, (5) the vessel or aircraft has repositioned itself more than 400 yd. (366 m) away from the location of the last sighting, or (6) the vessel concludes that dolphins are deliberately closing in to ride the vessel's bow wave (and there are no other marine mammal sightings within the mitigation zone).

(iv) Mitigation zones for explosive and impulse sound:

(A) A mitigation zone with a radius of 600 yd (549 m) shall be established for IEER sonobuoys (bin E4). Mitigation would include pre-exercise aerial observation and passive acoustic monitoring, which would begin 30 minutes before the first source/receiver pair detonation and continue throughout the duration of the exercise. The pre-exercise aerial observation would include the time it takes to deploy the sonobuoy pattern (deployment is conducted by aircraft dropping sonobuoys in the water). Explosive detonations would cease if a marine mammal is sighted within the mitigation zone. Detonations would recommence if any one of the following conditions is met: (1) the animal is observed exiting the mitigation zone, (2) the animal is thought to have exited the mitigation zone based on its course and speed and the relative motion between the animal and the source, or (3) the mitigation zone has been clear from any additional sightings for a period of 30 minutes.

Passive acoustic monitoring would be conducted with Navy assets, such as sonobuoys, already participating in the activity. These assets would only detect vocalizing marine mammals within the frequency bands monitored by Navy personnel. Passive acoustic detections would not provide range or bearing to detected animals, and therefore cannot provide locations of these animals. Passive acoustic detections would be reported to lookouts posted in aircraft and on vessels in order to increase vigilance of their visual observation.

(B) A mitigation zone with a radius of 350 yd (320 m) shall be established for explosive sonobuoys using 0.5-2.5 lb net explosive weight (bin E3). Mitigation would include pre-exercise aerial monitoring during deployment of the field of sonobuoy pairs (typically up to 20 minutes) and

continuing throughout the duration of the exercise within a mitigation zone of 350 yd (320 m) around an explosive sonobuoy. Explosive detonations would cease if a marine mammal is sighted within the mitigation zone. Detonations would recommence if any one of the following conditions is met: (1) the animal is observed exiting the mitigation zone, (2) the animal is thought to have exited the mitigation zone based on its course and speed and the relative motion between the animal and the source, or (3) the mitigation zone has been clear from any additional sightings for a period of 10 minutes.

Passive acoustic monitoring would also be conducted with Navy assets, such as sonobuoys, already participating in the activity. These assets would only detect vocalizing marine mammals within the frequency bands monitored by Navy personnel. Passive acoustic detections would not provide range or bearing to detected animals, and therefore cannot provide locations of these animals. Passive acoustic detections would be reported to lookouts posted in aircraft in order to increase vigilance of their visual observation.

(C) A mitigation zone with a radius of 200 yd (183 m) shall be established for anti-swimmer grenades (bin E2). Mitigation would include visual observation from a small boat immediately before and during the exercise within a mitigation zone of 200 yd (183 m) around an anti-swimmer grenade. Explosive detonations would cease if a marine mammal is sighted within the mitigation zone. Detonations would recommence if any one of the following conditions is met: (1) the animal is observed exiting the mitigation zone, (2) the animal is thought to have exited the mitigation zone based on its course and speed and the relative motion between the animal and the source, (3) the mitigation zone has been clear from any additional sightings for a period of 30 minutes, or (4) the activity has been repositioned more than 400 yd (366 m) away from the location of the last sighting.

(D) A mitigation zone ranging from 350 yd (320 m) to 800 yd (732 m), dependent on charge size and if the activity involves the use of diver-placed charges, shall be established for mine countermeasure and neutralization activities using positive control firing devices. Mitigation zone distances are specified for charge size in Table 7 of the preamble.

During general mine countermeasure and neutralization activities, mitigation would include visual observation from one or more small boats or aircraft beginning 30 minutes before, during, and 30 minutes after (when helicopters are not involved in the activity) or 10 minutes before, during, and 10 minutes after (when helicopters are involved in the activity) the completion of the exercise within the mitigation zones around the detonation site.

For activities involving diver-placed charges, visual observation would be conducted by either two small boats, or one small boat in combination with one helicopter. Boats would position themselves near the mid-point of the mitigation zone radius (but always outside the detonation plume radius and human safety zone) and travel in a circular pattern around the detonation location. When using two boats, each boat would be positioned on opposite sides of the detonation location, separated by 180 degrees. If used, helicopters would travel in a circular pattern around the detonation location.

For both general and diver-placed positive control mine countermeasure and neutralization activities, explosive detonations will cease if a marine mammal is sighted within the mitigation zone. Detonations will recommence if any one of the following conditions is met: (1) the animal is observed exiting the mitigation zone, (2) the animal is thought to have exited the mitigation zone based on a determination of its course and speed and the relative motion between the animal and the source, (3) the mitigation zone has been clear from any additional sightings for a period of 30 minutes, when helicopters are not involved in the activity or (4) the mitigation zone has been clear from any additional sightings for a period of 10 minutes when helicopters are involved in the activity.

(E) A mitigation zone with a radius of 1,000 yd (914 m) shall be established for mine countermeasure and neutralization activities using diver-placed time-delay firing devices (bin E6). Mine neutralization activities involving diver-placed charges would not include time-delay longer than 10 minutes. Mitigation would include visual observation from small boats or aircraft commencing 30 minutes before, during, and until 30 minutes after the completion of the exercise within a mitigation zone of 1,000 yd (914 m) around the detonation site. During activities using time-delay firing devices involving up to a 20 lb net explosive weight charge, visual observation will take place using two small boats. Fuse initiation would recommence if any one of the following conditions is met: (1) the animal is observed exiting the mitigation zone, (2) the animal is thought to have exited the mitigation zone based on its course and speed and the relative motion between the animal and the source, or (3) the mitigation zone has been clear from any additional sightings for a period of 30 minutes.

Survey boats would position themselves near the mid-point of the mitigation zone radius (but always outside the detonation plume radius/human safety zone) and travel in a circular pattern around the detonation location. One lookout from each boat would look inward toward the detonation site and the other lookout would look outward away from the detonation site. When using two small boats, each boat would be positioned on opposite sides of the detonation location, separated by 180

degrees. If available for use, helicopters would travel in a circular pattern around the detonation location.

(F) A mitigation zone with a radius of 200 yd (183 m) shall be established for small- and medium-caliber gunnery exercises with a surface target (bin E2). Mitigation would include visual observation from a vessel or aircraft immediately before and during the exercise within a mitigation zone of 200 yd (183 m) around the intended impact location. Vessels would observe the mitigation zone from the firing position. When aircraft are firing, the aircrew would maintain visual watch of the mitigation zone during the activity. Firing would cease if a marine mammal is sighted within the mitigation zone. Firing would recommence if any one of the following conditions is met: (1) the animal is observed exiting the mitigation zone, (2) the animal is thought to have exited the mitigation zone based on its course and speed and the relative motion between the animal and the source, (3) the mitigation zone has been clear from any additional sightings for a period of 10 minutes for a firing aircraft, (4) the mitigation zone has been clear from any additional sightings for a period of 30 minutes for a firing vessel, or (5) the intended target location has been repositioned more than 400 yd (366 m) away from the location of the last sighting.

(G) A mitigation zone with a radius of 600 yd (549 m) shall be established for large-caliber gunnery exercises with a surface target (bin E5). Mitigation would include visual observation from a ship immediately before and during the exercise within a mitigation zone of 600 yd (549 m) around the intended impact location. Ships would observe the mitigation zone from the firing position. Firing would cease if a marine mammal is sighted within the mitigation zone. Firing would recommence if any one of the following conditions is met: (1) the animal is observed exiting the mitigation zone, (2) the animal is thought to have exited the mitigation zone based on its course and speed and the relative motion between the animal and the source, or (3) the mitigation zone has been clear from any additional sightings for a period of 30 minutes.

(H) A mitigation zone with a radius of 900 yd (823 m) around the deployed target shall be established for missile exercises involving aircraft firing up to 250 lb net explosive weight using and a surface target (bin E9). When aircraft are firing, mitigation would include visual observation by the aircrew or supporting aircraft prior to commencement of the activity within a mitigation zone of 900 yd (823 m) around the deployed target. Firing would recommence if any one of the following conditions is met: (1) the animal is observed exiting the mitigation zone, (2) the animal is thought to have exited the mitigation zone based on its course and speed and the relative motion between the animal and the source, or (3) the mitigation zone has been clear from any additional sightings for a period of 10 minutes or 30 minutes (depending on aircraft type).

(I) A mitigation zone with a radius of 2,000 yd (1.8 km) shall be established for missile exercises involving aircraft firing >250 to 500 lb net explosive weight using and a surface target (bin E10). When aircraft are firing, mitigation would include visual observation by the aircrew prior to commencement of the activity within a mitigation zone of 2,000 yd (1.8 km) around the intended impact location. Firing would cease if a marine mammal is sighted within the mitigation zone. Firing would recommence if any one of the following conditions is met: (1) the animal is observed exiting the mitigation zone, (2) the animal is thought to have exited the mitigation zone based on its course and speed and the relative motion between the animal and the source, or (3) the mitigation zone has been clear from any additional sightings for a period of 10 minutes or 30 minutes (depending on aircraft type).

(J) A mitigation zone with a radius of 2,500 yd (2.3 km) shall be established for bombing exercises (bin E12). Mitigation would include visual observation from the aircraft immediately before the exercise and during target approach within a mitigation zone of 2,500 yd (2.3 km) around the intended impact location. Bombing would cease if a marine mammal is sighted within the mitigation zone. Bombing would recommence if any one of the following conditions is met: (1) the animal is observed exiting the mitigation zone, (2) the animal is thought to have exited the mitigation zone based on its course and speed and the relative motion between the animal and the source, or (3) the mitigation zone has been clear from any additional sightings for a period of 10 minutes.

(K) A mitigation zone with a radius of 2,100 yd (1.9 km) shall be established for torpedo (explosive) testing (except for aircraft operating at high altitudes) (bin E11). Mitigation would include visual observation by aircraft immediately before, during, and after the exercise within a mitigation zone of 2,100 yd (1.9 km) around the intended impact location. Firing would cease if a marine mammal is sighted within the mitigation zone. Firing would recommence if any one of the following conditions is met: (1) the animal is observed exiting the mitigation zone, (2) the animal is thought to have exited the mitigation zone based on its course and speed and the relative motion between the animal and the source, or (3) the mitigation zone has been clear from any additional sightings for a period of 10 minutes or 30 minutes (depending on aircraft type).

In addition to visual observation, passive acoustic monitoring would be conducted with Navy assets, such as passive ships sonar systems or sonobuoys, already participating in the activity. Passive acoustic observation would be accomplished through the use of remote acoustic sensors or expendable sonobuoys, or via passive acoustic sensors on submarines when they participate in the proposed action. These assets would only detect vocalizing marine mammals within the frequency bands monitored by Navy personnel. Passive acoustic detections would not

provide range or bearing to detected animals, and therefore cannot provide locations of these animals. Passive acoustic detections would be reported to the lookout posted in the aircraft in order to increase vigilance of the visual observation and to the person in control of the activity for their consideration in determining when the mitigation zone is free of visible marine mammals.

(L) A mitigation zone with a radius of 2.5 nautical miles around the target ship hulk shall be established for sinking exercises (bin E12). Mitigation would include aerial observation beginning 90 minutes before the first firing, visual observations from vessels throughout the duration of the exercise, and both aerial and vessel observation immediately after any planned or unplanned breaks in weapons firing of longer than 2 hours. Prior to conducting the exercise, the Navy would review remotely sensed sea surface temperature and sea surface height maps to aid in deciding where to release the target ship hulk.

The Navy would also monitor using passive acoustics during the exercise. Passive acoustic monitoring would be conducted with Navy assets, such as passive ships sonar systems or sonobuoys, already participating in the activity. These assets would only detect vocalizing marine mammals within the frequency bands monitored by Navy personnel. Passive acoustic detections would not provide range or bearing to detected animals, and therefore cannot provide locations of these animals. Passive acoustic detections would be reported to lookouts posted in aircraft and on vessels in order to increase vigilance of their visual observation. Lookouts will also increase observation vigilance before the use of torpedoes or unguided ordnance with a net explosive weight of 500 lb or greater, or if the Beaufort sea state is a 4 or above.

The exercise would cease if a marine mammal is sighted within the mitigation zone. The exercise would recommence if any one of the following conditions is met: (1) the animal is observed exiting the mitigation zone, (2) the animal is thought to have exited the mitigation zone based on its course and speed and the relative motion between the animal and the source, or (3) the mitigation zone has been clear from any additional sightings for a period of 30 minutes. Upon sinking the vessel, the Navy would conduct post-exercise visual observation of the mitigation zone for 2 hours (or until sunset, whichever comes first).

(M) A mitigation zone with a radius of 70 yd (64 m) within 30 degrees on either side of the gun target line on the firing side of the vessel for explosive and non-explosive large-caliber gunnery exercises conducted from a ship. Firing would cease if a marine mammal is sighted within the mitigation zone. Firing would recommence if any one of the following conditions is met: (1) the animal is observed exiting the mitigation zone, (2) the animal is thought to have exited the mitigation zone based on its

course and speed and the relative motion between the animal and the source, (3) the mitigation zone has been clear from any additional sightings for a period of 30 minutes, or (4) the vessel has repositioned itself more than 140 yd (128 m) away from the location of the last sighting.

(v) Mitigation zones for vessels and in-water devices:

(A) A mitigation zone of 500 yd (457 m) for observed whales and 200 yd (183 m) for all other marine mammals (except bow riding dolphins) shall be established for all vessel movement, providing it is safe to do so.

(B) A mitigation zone of 250 yd (229 m) shall be established for all towed in-water devices that are towed from a manned platform, providing it is safe to do so.

(vi) Mitigation zones for non-explosive practice munitions:

(A) A mitigation zone of 200 yd (183 m) shall be established for non-explosive small-, medium-, and large-caliber gunnery exercises using a surface target. Mitigation would include visual observation immediately before and during the exercise within a mitigation zone of 200 m around the intended impact location. Firing would cease if a marine mammal is visually detected within the mitigation zone. Firing would recommence if any one of the following conditions are met: (1) the animal is observed exiting the mitigation zone, (2) the animal is thought to have exited the mitigation zone based on its course and speed and the relative motion between the animal and the source, (3) the mitigation zone has been clear from any additional sightings for a period of 10 minutes for a firing aircraft, (4) the mitigation zone has been clear from any additional sightings for a period of 30 minutes for a firing vessel, or (5) the intended target location has been repositioned more than 400 yd (366 m) away from the location of the last sighting and the animal's estimated course direction.

(B) A mitigation zone of 1,000 yd (914 m) shall be established for non-explosive bombing exercises. Mitigation would include visual observation from the aircraft immediately before the exercise and during target approach within a mitigation zone of 1000 yd (914 m) around the intended impact location. Bombing would cease if a marine mammal is visually detected within the mitigation zone. Bombing would recommence if any one of the following conditions are met: (1) the animal is observed exiting the mitigation zone, (2) the animal is thought to have exited the mitigation zone based on its course and speed and the relative motion between the animal and the source, or (3) the mitigation zone has been clear from any additional sightings for a period of 10 minutes.

(C) When aircraft are firing, a mitigation zone of 900 yd (823 m) around the deployed target shall be established for non-explosive missile exercises (including rockets) using a surface target. Firing would cease if a marine mammal is visually detected within the mitigation zone. Firing would recommence if any one of the following conditions are met: (1) the animal is observed exiting the mitigation zone, (2) the animal is thought to have exited the mitigation zone based on its course and speed and the relative motion between the animal and the source, or (3) the mitigation zone has been clear from any additional sightings for a period of 10 minutes or 30 minutes (depending on aircraft type).

(3) Stranding Response Plan:

(i) The Navy shall abide by the letter of the "Stranding Response Plan for Major Navy Training Exercises in the MITT Study Area," to include the following measures:

(A) Shutdown Procedures – When an Uncommon Stranding Event (USE - defined in § 218.91) occurs during a Major Training Exercise (MTE) in the MITT Study Area, the Navy shall implement the procedures described below.

(*1*) The Navy shall implement a shutdown (as defined § 218.91) when advised by a NMFS Office of Protected Resources Headquarters Senior Official designated in the MITT Study Area Stranding Communication Protocol that a USE involving live animals has been identified and that at least one live animal is located in the water. NMFS and the Navy will maintain a dialogue, as needed, regarding the identification of the USE and the potential need to implement shutdown procedures.

(*2*) Any shutdown in a given area shall remain in effect in that area until NMFS advises the Navy that the subject(s) of the USE at that area die or are euthanized, or that all live animals involved in the USE at that area have left the area (either of their own volition or herded).

(*3*) If the Navy finds an injured or dead animal floating at sea during an MTE, the Navy shall notify NMFS immediately or as soon as operational security considerations allow. The Navy shall provide NMFS with species or description of the animal(s), the condition of the animal(s), including carcass condition if the animal(s) is/are dead, location, time of first discovery, observed behavior (if alive), and photo or video (if available). Based on the information provided, NFMS will determine if, and advise the Navy whether a modified shutdown is appropriate on a case-by-case basis.

(*4*) In the event, following a USE, that qualified individuals are attempting to herd animals back out to the open ocean and animals are not willing to leave, or animals are seen repeatedly heading for the open ocean but turning back to shore, NMFS and the Navy shall coordinate (including an investigation of other potential anthropogenic stressors in the area) to determine if the proximity of mid-frequency active sonar training activities or explosive detonations, though farther than 14 nautical miles from the distressed animal(s), is likely contributing to the animals' refusal to return to the open water. If so, NMFS and the Navy will further coordinate to determine what measures are necessary to improve the probability that the animals will return to open water and implement those measures as appropriate.

(*5*) Within 72 hours of NMFS notifying the Navy of the presence of a USE, the Navy shall provide available information to NMFS (per the MITT Study Area Communication Protocol) regarding the location, number and types of acoustic/explosive sources, direction and speed of units using mid-frequency active sonar, and marine mammal sightings information associated with training activities occurring within 80 nautical miles (148 km) and 72 hours prior to the USE event. Information not initially available regarding the 80-nautical miles (148-km), 72-hour period prior to the event will be provided as soon as it becomes available. The Navy will provide NMFS investigative teams with additional relevant unclassified information as requested, if available.

2.9.1.6 § 218.95 Requirements for monitoring and reporting.

(a) As outlined in the MITT Study Area Stranding Communication Plan, the Holder of the Authorization must notify NMFS immediately (or as soon as operational security considerations allow) if the specified activity identified in § 218.90 is thought to have resulted in the mortality or injury of any marine mammals, or in any take of marine mammals not identified in § 218.91.

(b) The Holder of the LOA must conduct all monitoring and required reporting under the LOA, including abiding by the MITT Monitoring Project Description.

(c) General Notification of Injured or Dead Marine Mammals – Navy personnel shall ensure that NMFS (regional stranding coordinator) is notified immediately (or as soon as operational security considerations allow) if an injured or dead marine mammal is found during or shortly after, and in the vicinity of, an Navy training or testing activity utilizing mid- or high-frequency active sonar, or underwater explosive detonations. The Navy shall provide NMFS with species or description of the animal(s), the condition of the animal(s) (including carcass condition if the animal is dead), location, time of first discovery, observed behaviors (if alive), and photo or video (if available). The Navy shall consult the Stranding Response Plan to obtain more specific reporting requirements for specific circumstances.

(d) Annual MITT Monitoring Program Report – (1) The Navy shall submit an annual report describing the implementation and results of the MITT Monitoring Program, described in § 218.95. Data standards will be consistent to the extent appropriate across range complexes and study areas to allow for comparison in different geographic locations. Although additional information will be gathered, the protected species observers collecting marine mammal data pursuant to the MITT Monitoring Program shall, at a minimum, provide the same marine mammal observation data required in § 218.95. (2) As an alternative, the Navy may submit a multi-range complex annual monitoring plan report to fulfill this requirement. Such a report would describe progress of knowledge made with respect to monitoring plan study questions across multiple Navy ranges associated with the ICMP. Similar study questions shall be treated together so that progress on each topic shall be summarized across all Navy ranges. The report need not include analyses and content that does not provide direct assessment of cumulative progress on the monitoring plan study questions. The report shall be submitted either 90 days after the calendar year, or 90 days after the conclusion of the monitoring year date to be determined by the Adaptive Management process.

(e) Sonar Exercise Notification – The Navy shall submit to NMFS (specific contact information to be provided in the LOA) either an electronic (preferably) or verbal report within 15 calendar days after the completion of any major exercise indicating:

(i) Location of the exercise.
(ii) Beginning and end dates of the exercise.
(iii) Type of exercise.

(f) Annual MITT Exercise and Testing Report – The Navy shall submit preliminary reports detailing the status of authorized sound sources within 21 days after the end of the annual authorization cycle. The Navy shall submit a detailed report 3 months after the anniversary of the date of issuance of the LOA. The detailed annual report shall contain information on Major Training Exercises (MTE), Sinking Exercise (SINKEX) events, and a summary of sound sources used, as described below. The analysis in the detailed report will be based on the accumulation of data from the current year's report and data collected from previous reports. The detailed report shall contain information identified in § 218.95 (e)(1-5).

(1) Major Training Exercises/SINKEX:

(i) This section shall contain the reporting requirements for Coordinated and Strike Group exercises and SINKEX. Coordinated and Strike Group Major Training Exercises include:
(A) Joint Multi-Strike Group Exercise (Valiant Shield).
(B) Joint Expeditionary Exercise
(ii) Exercise information for each MTE:
(A) Exercise designator.
(B) Date that exercise began and ended.
(C) Location (operating area).
(D) Number of items or hours (per the LOA) of each sound source bin (impulsive and non-impulsive) used in the exercise.
(E) Number and types of vessels, aircraft, etc., participating in exercise.

(F) Individual marine mammal sighting info for each sighting when mitigation occurred during each MTE:

(*1*) Date/time/location of sighting.

(*2*) Species (if not possible, indication of whale/dolphin).

(*3*) Number of individuals.

(*4*) Initial detection sensor.

(*5*) Indication of specific type of platform the observation was made from (including, for example, what type of surface vessel or testing platform).

(*6*) Length of time observers maintained visual contact with marine mammal(s).

(*7*) Sea state.

(*8*) Visibility.

(*9*) Sound source in use at the time of sighting.

(*10*) Indication of whether animal is <200 yd, 200 to 500 yd, 500 to 1,000 yd, 1,000 to 2,000 yd, or >2,000 yd from sound source.

(*11*) Mitigation Implementation – Whether operation of sonar sensor was delayed, or sonar was powered or shut down, and how long the delay was; or whether navigation was changed or delayed.

(*12*) If source in use is a hull-mounted sonar, relative bearing of animal from ship, and estimation of animal's motion relative to ship (opening, closing, parallel).

(*13*) Observed behavior – Watchstanders shall report, in plain language and without trying to categorize in any way, the observed behavior of the animal(s) (such as animal closing to bow ride, paralleling course/speed, floating on surface and not swimming, etc.) and if any calves present.

(iii) An evaluation (based on data gathered during all of the MTEs) of the effectiveness of mitigation measures designed to minimize the received level to which marine mammals may be exposed. This evaluation shall identify the specific observations that support any conclusions the Navy reaches about the effectiveness of the mitigation.

(iv) Exercise information for each SINKEX:

(A) List of the vessels and aircraft involved in the SINKEX.

(B) Location (operating area).

(C) Chronological list of events with times, including time of sunrise and sunset, start and stop time of all marine species surveys that occur before, during, and after the SINKEX, and ordnance used.

(D) Visibility and/or weather conditions, wind speed, cloud cover, etc. throughout exercise if it changes.

(E) Aircraft used in the surveys, flight altitude, and flight speed and the area covered by each of the surveys, given in coordinates, map, or square miles.

(F) Passive acoustic monitoring details (number of sonobuoys, area, detections of biologic activity, etc.).

(G) Individual marine mammal sighting info for each sighting that required mitigation to be implemented:

(*1*) Date/time/location of sighting.

(*2*) Species (if not possible, indication of whale/dolphin).

(*3*) Number of individuals.

(*4*) Initial detection sensor.

(*5*) Indication of specific type of platform the observation was made from (including, for example, what type of surface vessel or platform).

(*6*) Length of time observers maintained visual contact with marine mammal(s).

(*7*) Sea state.

(*8*) Visibility.

(*9*) Indication of whether animal is <200 yd, 200-500 yd, 500-1,000 yd, 1,000-2,000 yd, or >2,000 yd from the target.

(*10*) Mitigation implementation – Whether the SINKEX was stopped or delayed and length of delay.

(*11*) Observed behavior – Watchstanders shall report, in plain language and without trying to categorize in any way, the observed behavior of the animals (such as animal closing to bow ride, paralleling course/speed, floating on surface and not swimming, etc.), and if any calves present.

(H) List of the ordnance used throughout the SINEKX and net explosive weight (NEW) of each weapon and the combined NEW.

(2) Summary of Sources Used.

(i) This section shall include the following information summarized from the authorized sound sources used in all training and testing events:

(A) Total annual or quantity (per the LOA) of each bin of sonar or other non-impulsive source;

(B) Total annual expended/detonated rounds (missiles, bombs, etc.) for each explosive bin; and

(C) Improved Extended Echo-Ranging System (IEER)/sonobuoy summary, including:

(*1*) Total expended/detonated rounds (buoys).

(*2*) Total number of self-scuttled IEER rounds.

(3) Geographic Information Presentation – The reports shall present an annual (and seasonal, where practical) depiction of training exercises and testing bin usage geographically across the Study Area.

(4) 5-year Close-out Exercise and Testing Report – This report will be included as part of the 2020 annual exercise or testing report. This report will provide the annual totals for each sound source bin with a comparison to the annual allowance and the 5-year total for each sound source bin with a comparison to the 5-year allowance. Additionally, if there were any changes to the sound source

allowance, this report will include a discussion of why the change was made and include the analysis to support how the change did or did not result in a change in the FEIS and final rule determinations. The report will be submitted 3 months after the expiration of the rule. NMFS will submit comments on the draft close-out report, if any, within 3 months of receipt. The report will be considered final after the Navy has addressed NMFS' comments, or 3 months after the submittal of the draft if NMFS does not provide comments.

2.10 NMFS' Issuance of Letters of Authorization (LOA) Pursuant to the MMPA Regulations

Subsequent to promulgation of the MMPA Rule, NMFS' Permits Division proposes to issue an LOA for Navy training and testing activities for the five year period (August 2015 through August 2020). Once issued, the LOA will set forth:

(1) Permissible methods of incidental taking;

(2) Means of effecting the least practicable adverse impact on the species, its habitat, and on the availability of the species for subsistence uses (i.e., mitigation); and

(3) Requirements for mitigation, monitoring and reporting.

Issuance of the LOA is dependent on a on a determination that the total number of marine mammals taken by the activity as a whole will have no more than a negligible impact on the affected species or stock of marine mammals. Incidental take of marine mammals that will be authorized by the LOA is also provided in the MMPA Rule and thus may not exceed the levels published in the Rule and assessed in this Opinion. Mitigation requirements are the same as those described in the MMPA rule as provided in the previous section and as assessed in this Opinion. Any unforeseen changes in the incidental take authorization above what is authorized in the MMPA Rule and LOA, would require amending the Rule and reinitiation of section 7 consultation pursuant to the ESA.

Section 7(b)(4)(C) of the ESA provides that if an endangered or threatened marine mammal is involved, the taking must first be authorized by Section 101(a)(5) of the MMPA. Accordingly, the terms of this incidental take statement and the exemption from Section 9 prohibitions of the ESA become effective only upon the issuance of MMPA authorization (i.e, five year regulations and LOA) to take the marine mammals in this Opinon. Absent such authorization, the incidental take statement is inoperative for marine mammals. The incidental take statement for sea turtles, fish, corals, and other non-marine mammal species will take effect immediately upon issuance of the LOA.

2.11 Interrelated and Interdependent Activities

Interrelated actions are those that are part of a larger action and depend on the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration. NMFS determined that there are no interrelated and interdependent actions outside the scope of this consultation.

2.12 Action Area

Action Area means all areas affected directly, or indirectly, by the Federal action, and not just the immediate area involved in the action (50 CFR 402.02). The Action Area encompasses the MITT Study Area, transit corridor and area outsides of the study area where direct and indirect effects of stressors from Navy training and testing activities could be experienced.

2.12.1 MITT Action Area

The MITT Action Area is composed of the established ranges (at-sea ranges and land based training areas on Guam and CNMI), operating areas, and special use airspace in the region of the Mariana Islands that are part of the Mariana Islands Range Complex (MIRC) and its surrounding seas, and includes a transit corridor.[2] The MITT Action Area does not include the territorial waters of Palau or Micronesia. The transit corridor is outside the geographic boundaries of the MIRC and is a direct route across the high seas for Navy ships in transit between the MIRC and the HRC. The Proposed Action also includes pierside sonar maintenance and testing alongside Navy piers located in Inner Apra Harbor. The MITT Action Area is depicted in Figure 1.

[2] Vessel transit corridors are the routes typically used by Navy ships to traverse from one area to another. The route depicted in Figure 1 is a direct route between the MIRC and the HRC, making it a quick and fuel-efficient transit. The depicted transit corridor is notional and may not represent actual routes used. Actual routes navigated are based on a number of factors including, but not limited to, weather and training; however, the corridor represents the environment potentially impacted by the Proposed Action.

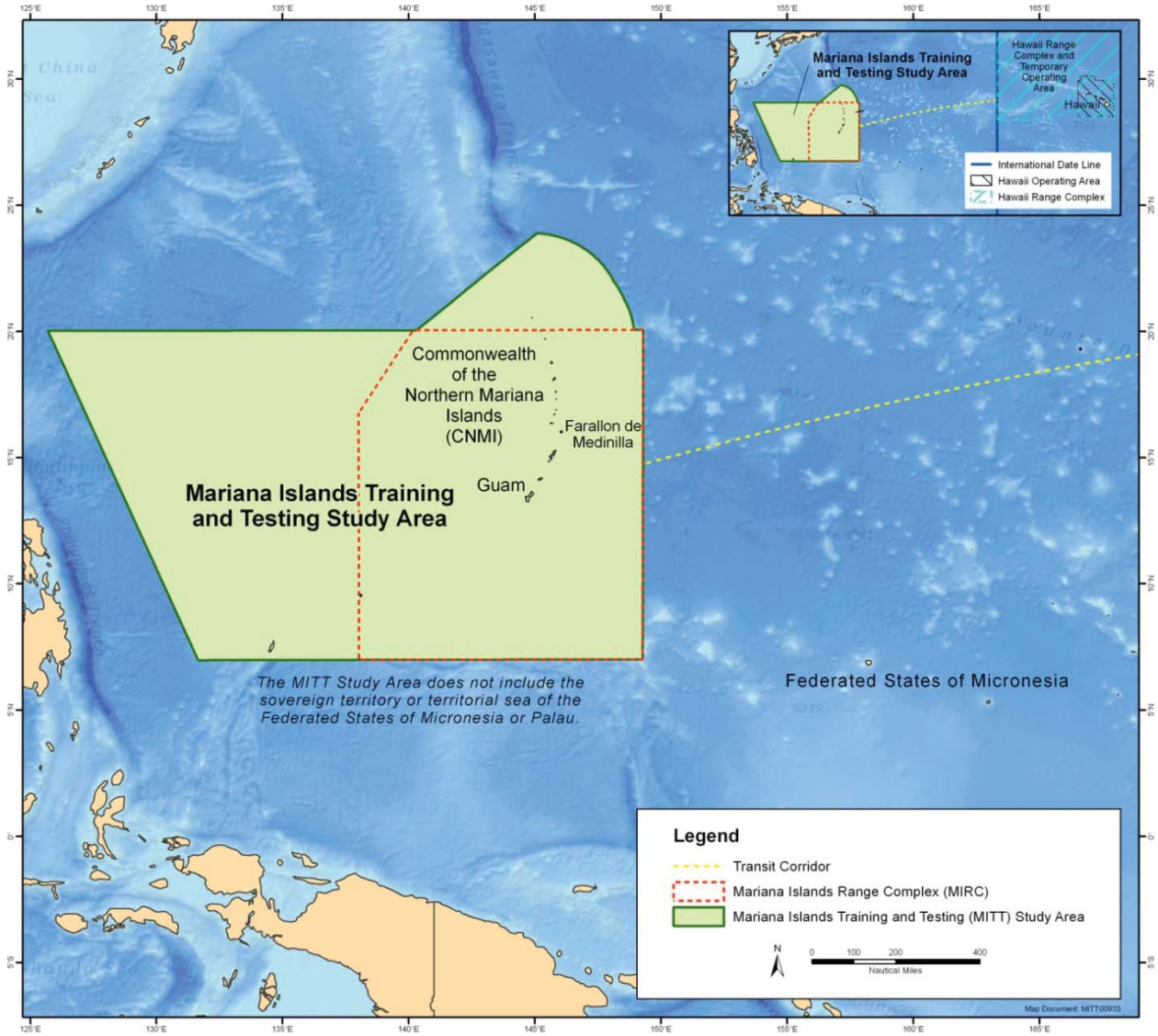

Figure 1.Mariana Islands Action Area with the Mariana Islands Range Complex and notional transit corridor

A range complex is a designated set of specifically bounded geographic areas that encompasses a water component (above and below the surface) and airspace, and may encompass a land component where training and testing of military platforms, tactics, munitions, explosives, and electronic warfare systems occurs. Range complexes include established ocean operating areas and special use airspace, which may be further divided to provide better control of the area and activities for safety reasons.

The MITT Action Area includes the MIRC land training areas and at-sea operating areas that were previously addressed in the MIRC EIS/OEIS (May 2010) with modifications to the special use air space that were addressed in the MIRC Airspace Environmental Assessment (EA)/Overseas EA (OEA) (U.S. Department of the Navy 2013), and the seaward extension of the northern and western edges of the MIRC study area, the transit corridor, and Navy pierside locations in the Apra Harbor Naval Complex.

2.12.2 Mariana Islands Range Complex

The MIRC includes land training areas, ocean surface and subsurface areas, and special use airspace. These areas extend from the waters south of Guam to north of Pagan (CNMI), and from the Pacific Ocean east of the Mariana Islands to the Philippine Sea to the west, encompassing 501,873 square nautical miles (nm^2) of open ocean.

2.12.2.1 Special Use Airspace and Air Traffic Controlled Assigned Airspace

The MIRC is anticipated to include approximately 70,000 nm^2 of special use airspace and ATCAA (once Federal Aviation Administration [FAA] rule-making and non-rule making airspace changes are complete[3]). As depicted in Figure 2 and Figure 3, this airspace is almost entirely over the ocean (except ATCAA 6 and W-13A) and includes warning areas, ATCAAs, and restricted areas.

[3] The MIRC Airspace EA/OEA tiered off from the MIRC EIS/OEIS; the Navy analyzed the potential impacts of redesignating ATCAAs in the MITT Study Area with Warning Areas and expanding the special use airspace around FDM. In that EA/OEA, no new training or testing events were proposed. The EA/OEA concluded that no significant impacts to the environment would occur as a result of the airspace redesignation and expansion. The FAA has rule-making and non-rule making authority for the airspace redesignation and expansion, and the MIRC Airspace EA/OEA supported the FAA in its rule-making and non-rule making process to establish special use airspace.

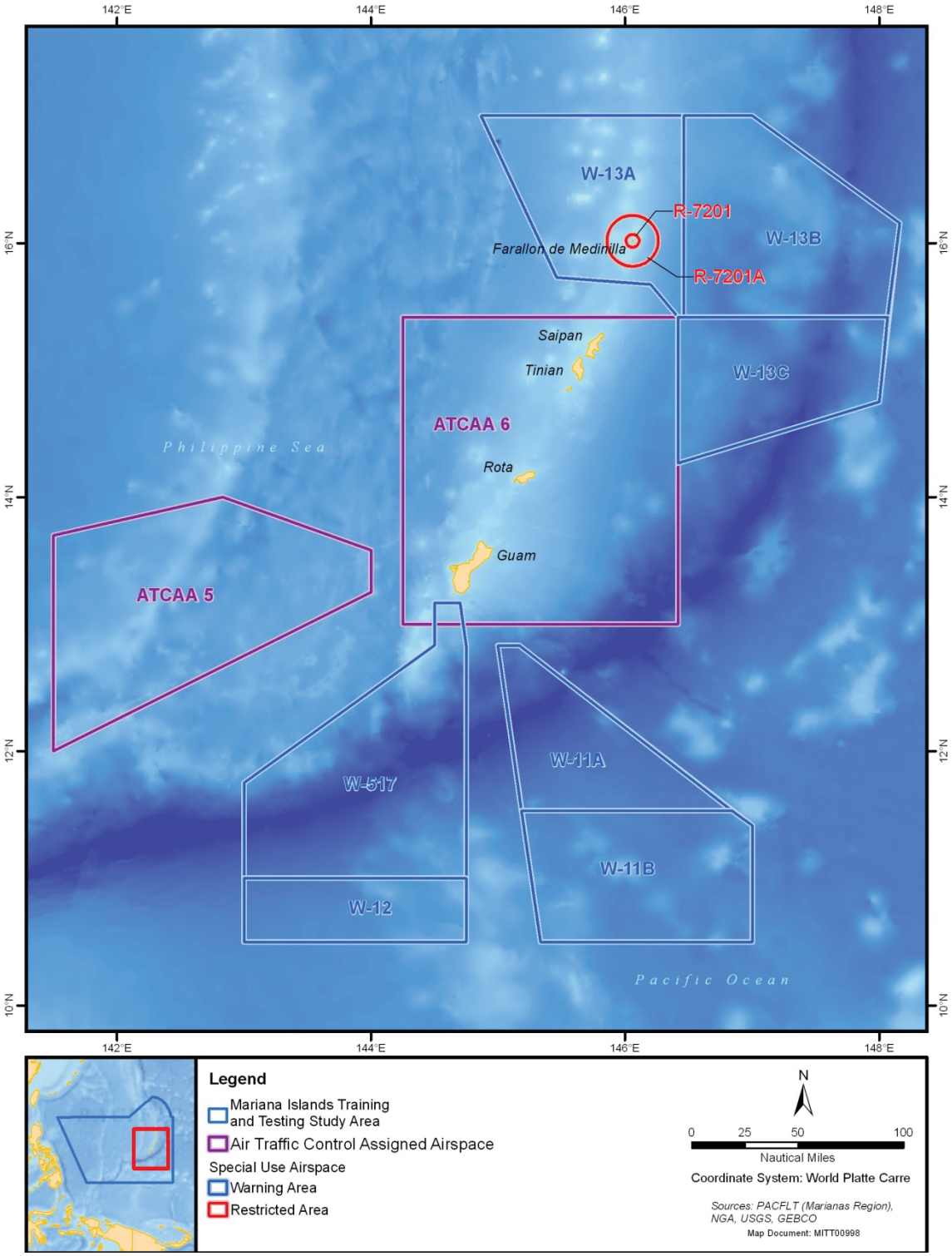

Figure 2.Mariana Islands Range Complex Airspace

Warning Area (W)-517 and W-12 include approximately 11,769 nm^2 of special use airspace; W-11 (A/B) is approximately 10,467 nm^2 of special use airspace, and W-13 (A/B/C) is approximately 13,752 nm^2 of special use airspace.

The ATCAAs of the MIRC account for more than 28,750 nm^2 of airspace and includes ATCAA 5 and ATCAA 6. (Figure 2)

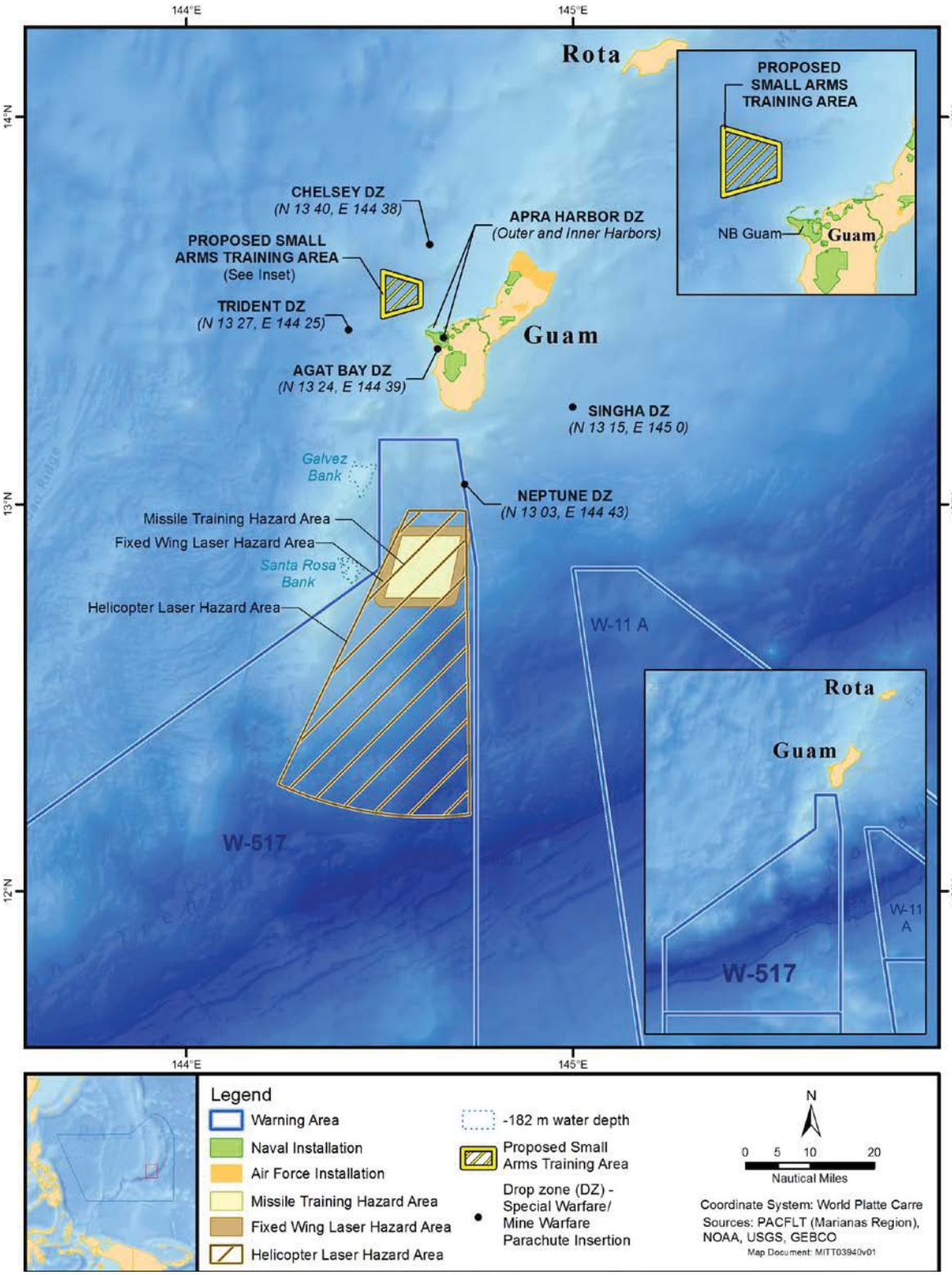

Figure 3.Mariana Islands Range Complex Airspace and Warning Area 517

The restricted area airspace over or near land areas within the MIRC makes up 452 nm^2 of special use airspace and includes restricted areas (R)-7201 and R-7201A which extends in a 12 nm radius around Farallon de Medinilla (FDM) (Figure 4).

2.12.2.2 Sea and Undersea Space

The MIRC includes the sea and undersea space from the ocean surface to the ocean floor. The MIRC includes designated sea and undersea space training sites to include designated drop zones, underwater demolition and floating mine exclusion zones, danger zones associated with live fire ranges, and training areas associated with military controlled beaches, harbors, and littoral areas.

W-517 (Figure 3) is special use airspace where the sea space underneath is also restricted from public access during hazardous training and testing events. Portions of the Marianas Trench Marine National Monument, established in January 2009 by Presidential Proclamation under the authority of the Antiquities Act (16 U.S. Code §§431–433), lie within the MIRC. The prohibitions required by the Proclamation do not apply to activities and exercises of the Armed Forces (including those carried out by the U.S. Coast Guard).

The MIRC Airspace EA/OEA proposed and analyzed a Danger Zone around FDM. The Army Corps of Engineers has rule-making authority for Danger Zone establishment. The pending Danger Zone rule for FDM extends out 12 nm from a center point on FDM and over a range hazard area of approximately 452 nm^2 (Figure 2 and Figure 4).

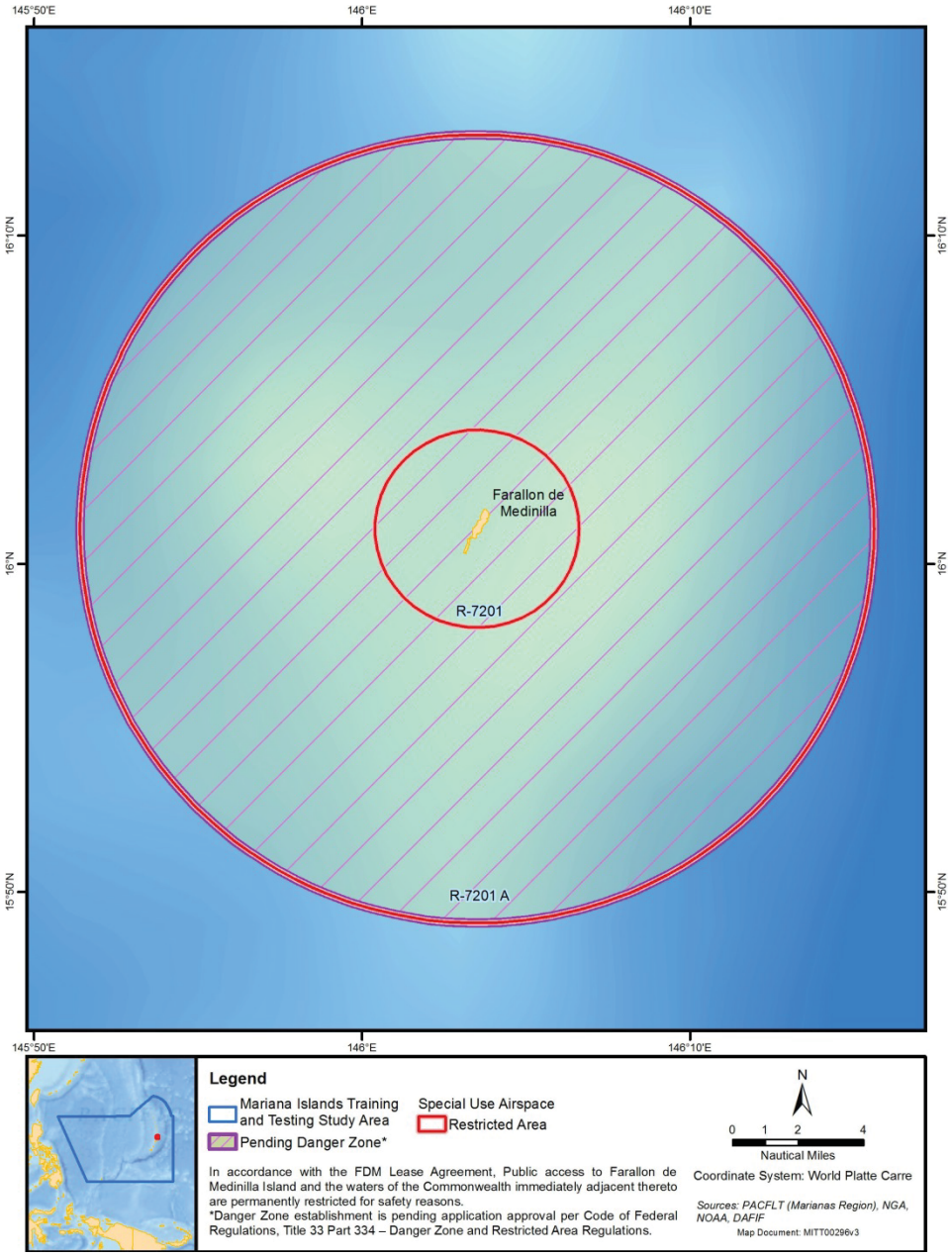

Figure 4. Farallon de Medinilla Restricted Area 7201, 7201A, and Danger Zone

2.12.2.3 Land

Commander Joint Region Marianas provides executive level installation management support to all DoD components and tenants through assigned regional installations on Guam and the Commonwealth of the Northern Mariana Islands in support of training and testing in the Marianas, including coordination with Northern Mariana Islands Commonwealth Port Authority for logistic and operational support of DoD aircraft and vessels; acts as the interface between the Navy and the civilian community; ensures compliance with all environmental laws and regulations, safety procedures, and equal opportunity policy; and performs other functions and tasks as assigned. While land based activities are not part of this consultation, a description of installations on Guam and the CNMI are provided for informational purposes only.

2.12.2.4 Guam

The Navy has control of approximately 28 square miles (mi.^{2}) (72.5 square kilometers [km^2]) of land in noncontiguous properties on Guam. There are five Navy annexes: Main Base (which includes Apra Harbor Naval Complex and Main Base/Polaris Point) (Figure 5), Naval Base Guam Munitions Site (Figure 6); Hospital Annex/Nimitz Hill, Naval Base Guam Telecommunications Site (Figure 7), and Naval Base Guam Barrigada (Figure 8).

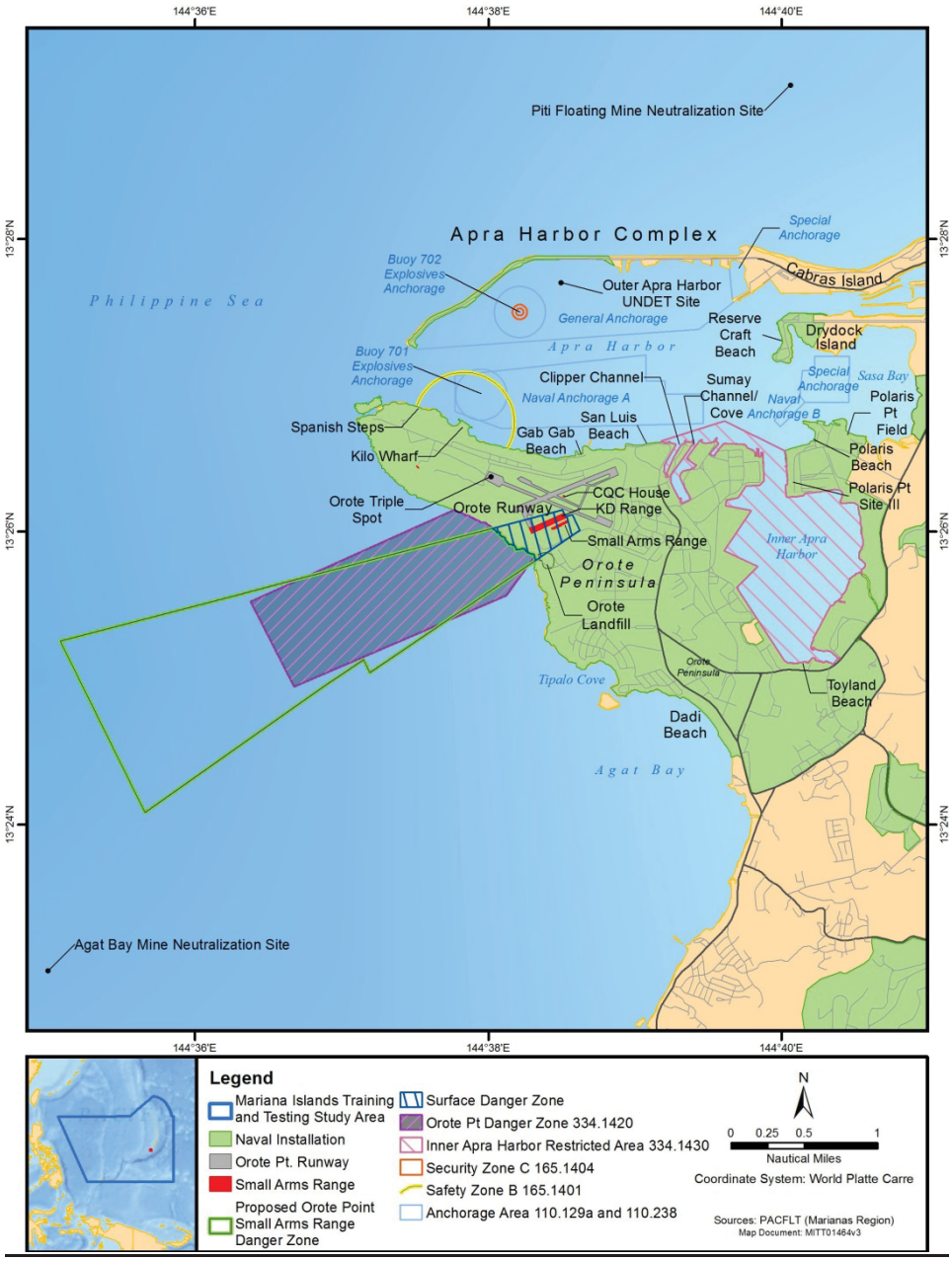

Figure 5. Apra Harbor Naval Complex (Main Base) and Main Base/Polaris Point

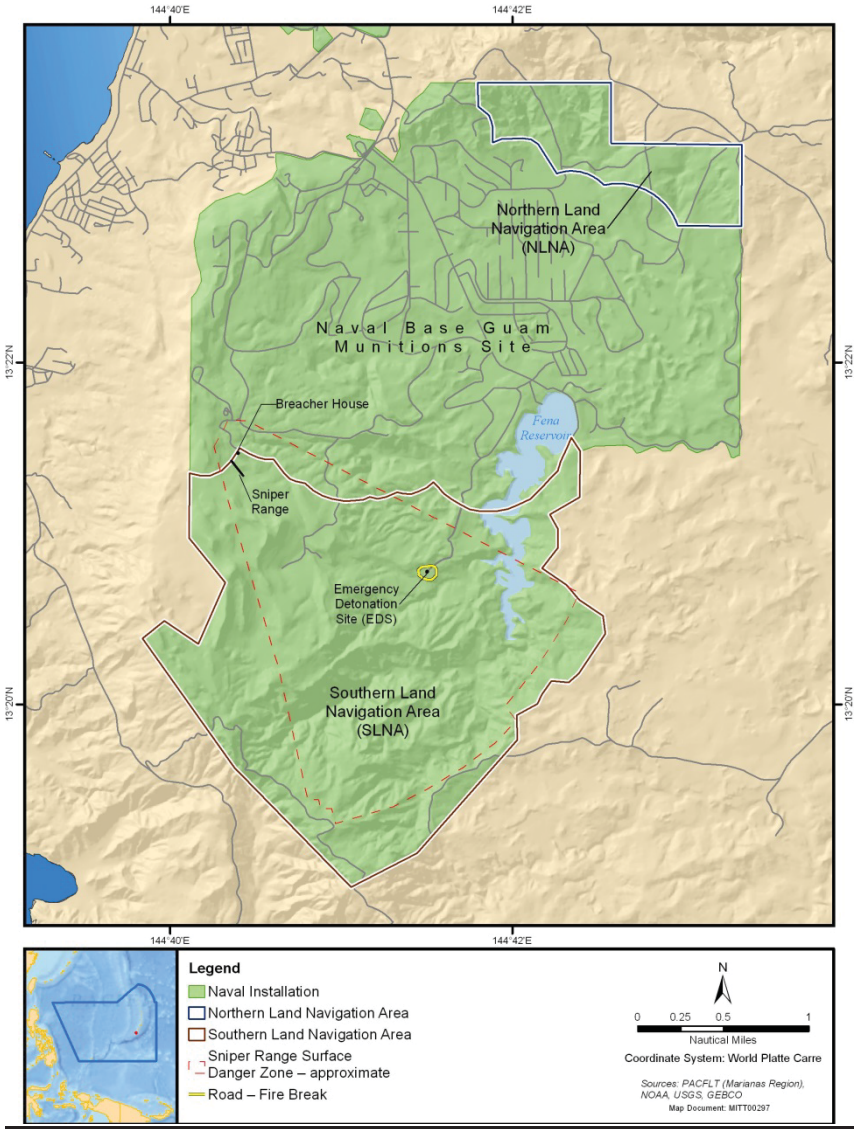

Figure 6. Naval Base Guam Munitions Site

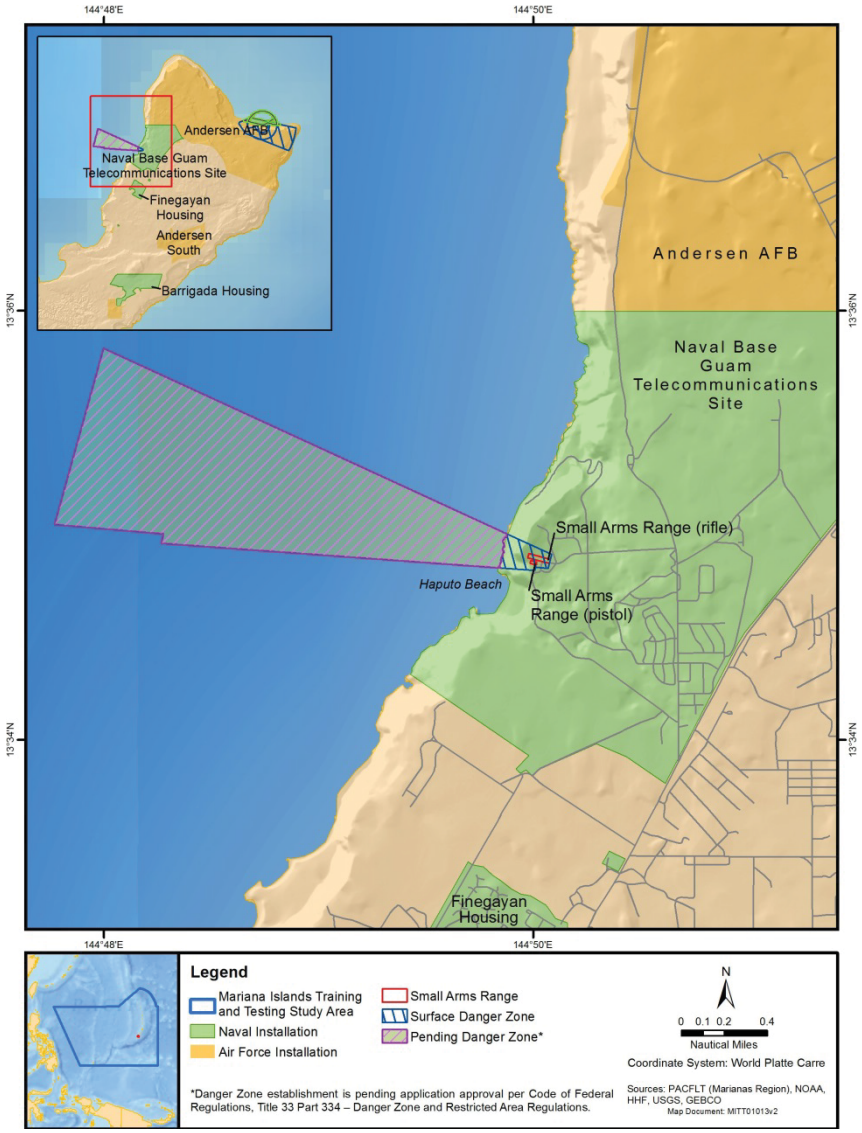

Figure 7. Naval Base Guam Telecommunications Site

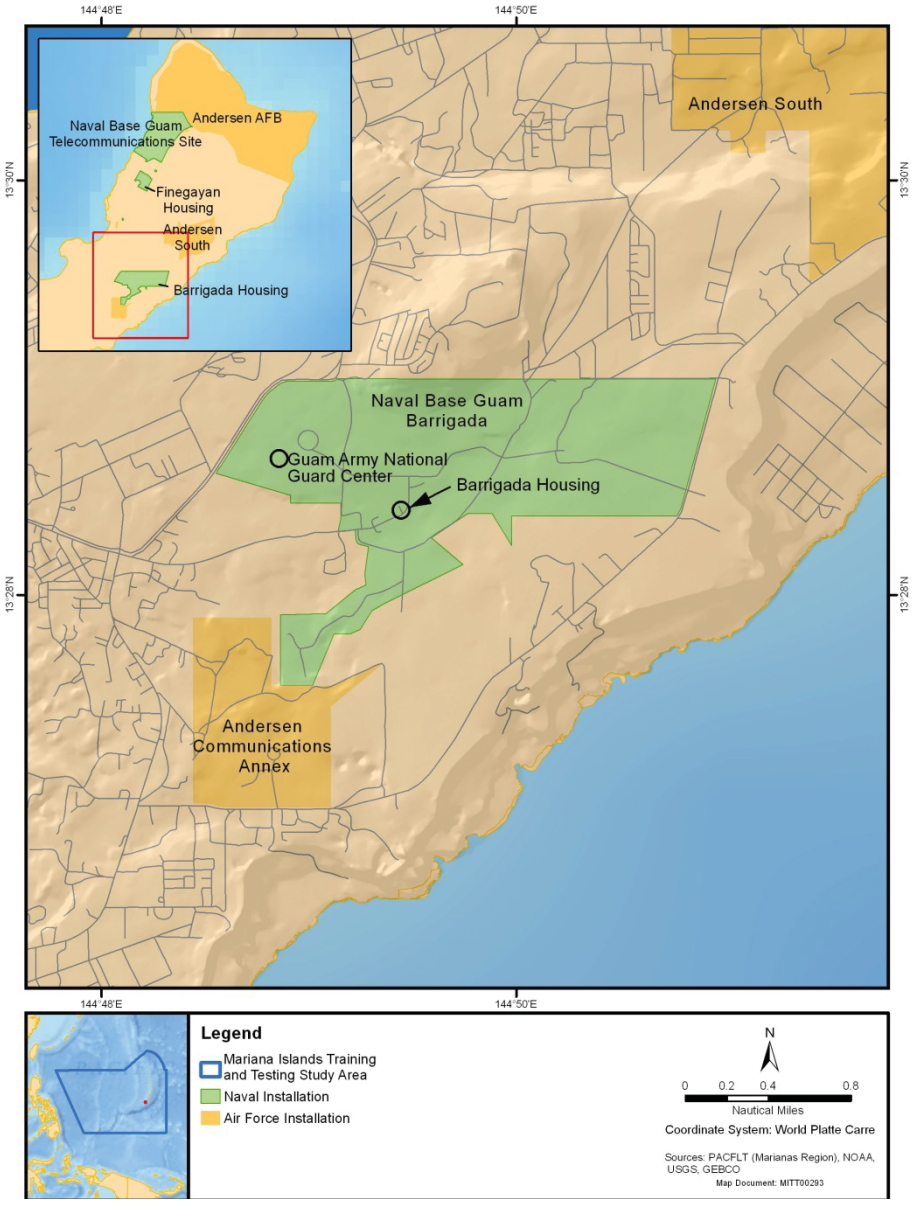

Figure 8. Naval Base Guam Barrigada

Andersen Air Force Base, one of the largest U.S. Air Force airfields, is located in the northern portion of the island of Guam. Andersen Air Force Base includes the main base and Northwest Field which covers 24.5 mi.^{2} (63.5 km^2), Andersen South 3.2 mi.^{2} (8.3 km^2), and Andersen Barrigada Annex 0.7 mi.^{2} (1.8 km^2) (Figure 9).

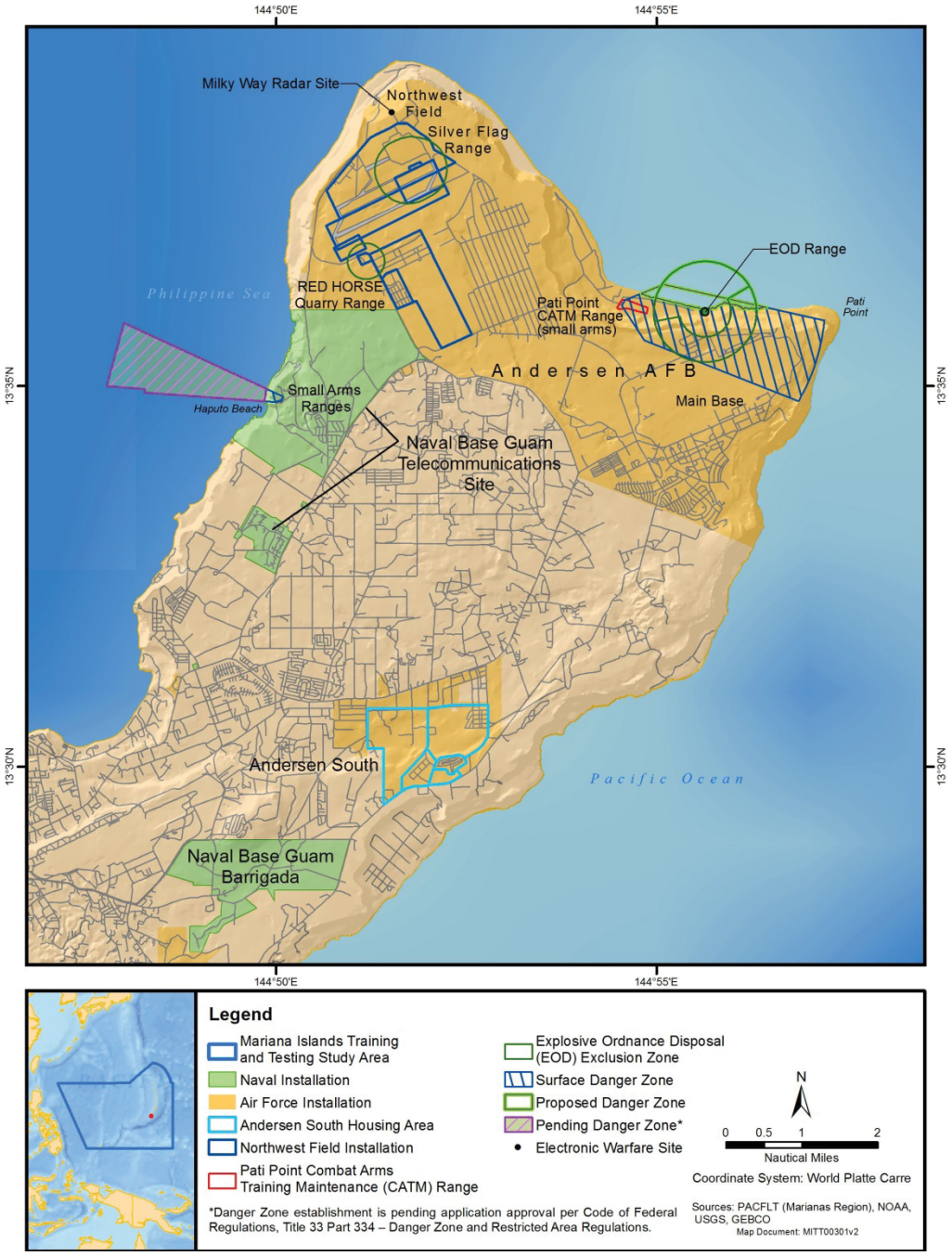

Figure 9. Andersen Air Force Base

2.12.2.5 Commonwealth of the Northern Mariana Islands

No DoD personnel are permanently stationed in the CNMI, with the exception of a U.S. Army Reserve unit located on Saipan.

Farallon de Medinilla (FDM). FDM is a rocky and uninhabited island, approximately 1.7 miles (mi.) (2.7 kilometer [km]) long and 0.3 mi. (0.5 km) wide (Figure 10). The DoD leases FDM for use as a live and inert gunnery, missile, and bombing range.

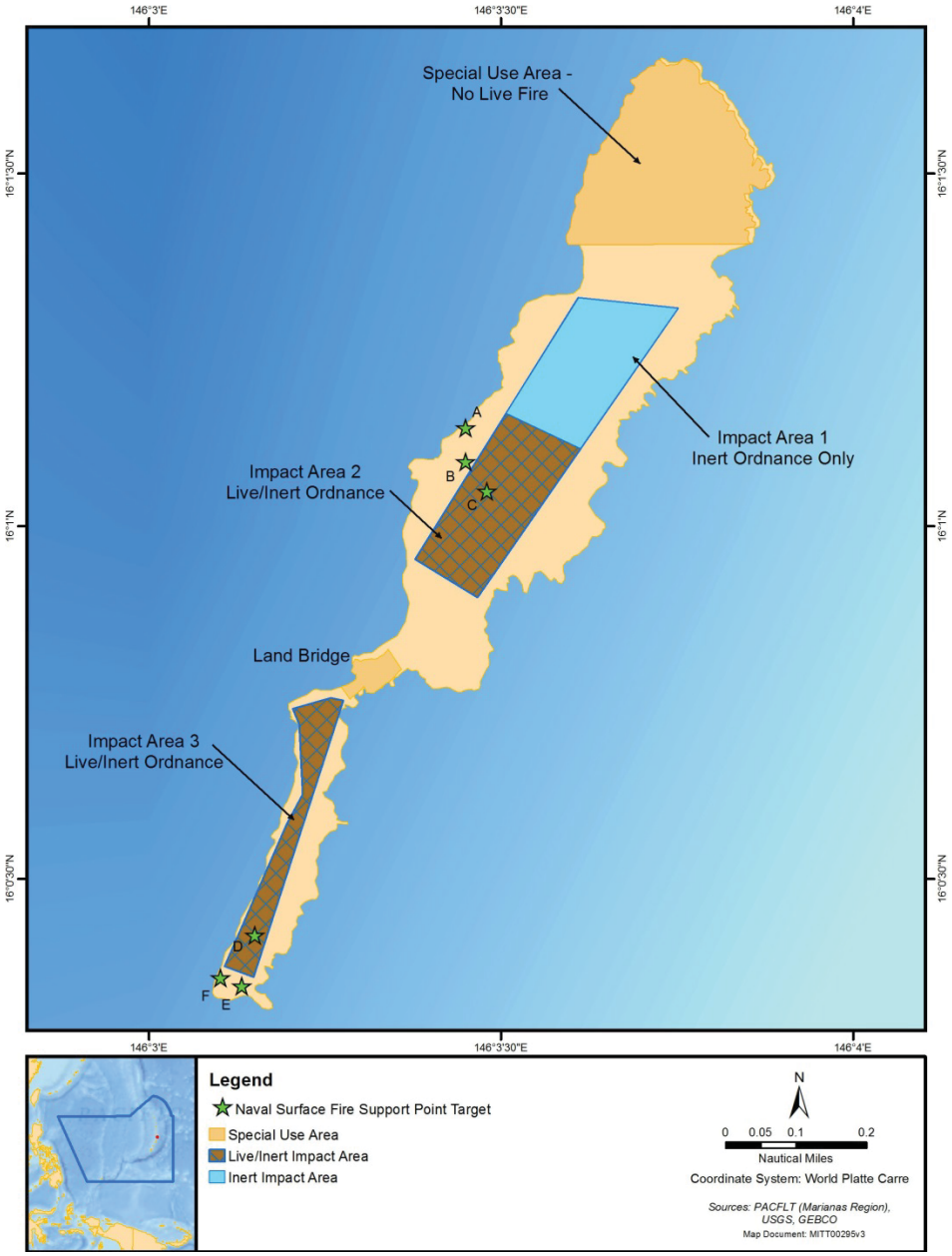

Figure 10. Farallon de Medinilla

Tinian. Tinian has a land area of approximately 39 mi.^{2} (101 km^2). The DoD leases approximately 15,347 contiguous acres (6,210.7 hectares) of northern Tinian (the Military Lease Area) for field training (Figure 11). The Military Lease Area is further divided into the Exclusive Military Use Area and the Leaseback Area.

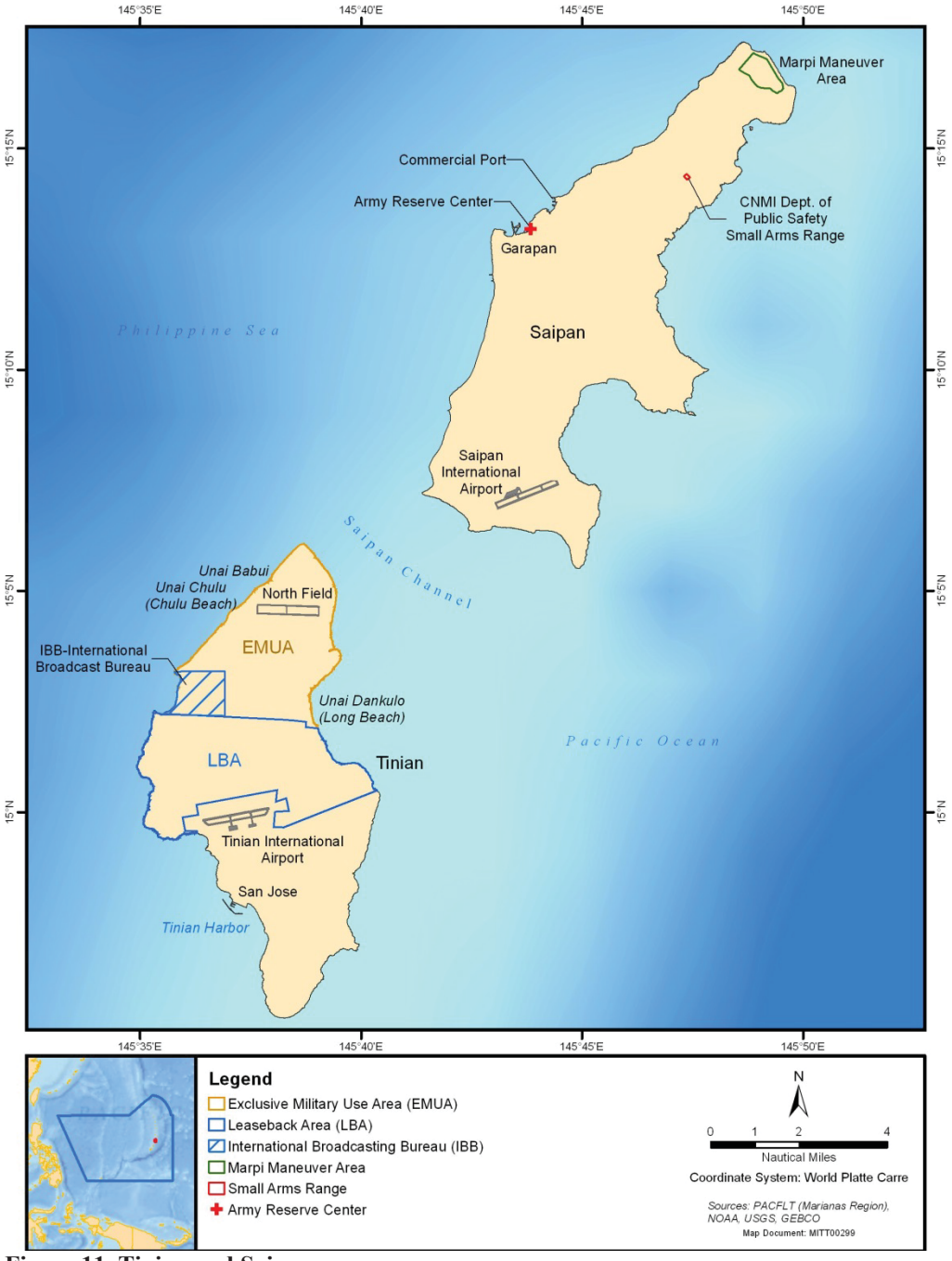

Figure 11. Tinian and Saipan

Saipan. Approximately 0.28 mi.^{2} (0.73 km^2) on Tanapag Harbor (commercial port) is leased by the DoD**.** The Army Reserve center is located in Garapan (Figure 11).

Rota. Rota is approximately 11 mi. (17.7 km) long and 3 mi. (4.8 km) wide (Figure 12). Training on Rota is scheduled with Joint Region Marianas and coordinated with Rota officials for proposed training areas and activities. Training activities conducted on Rota typically include special warfare training and combat search and rescue training.

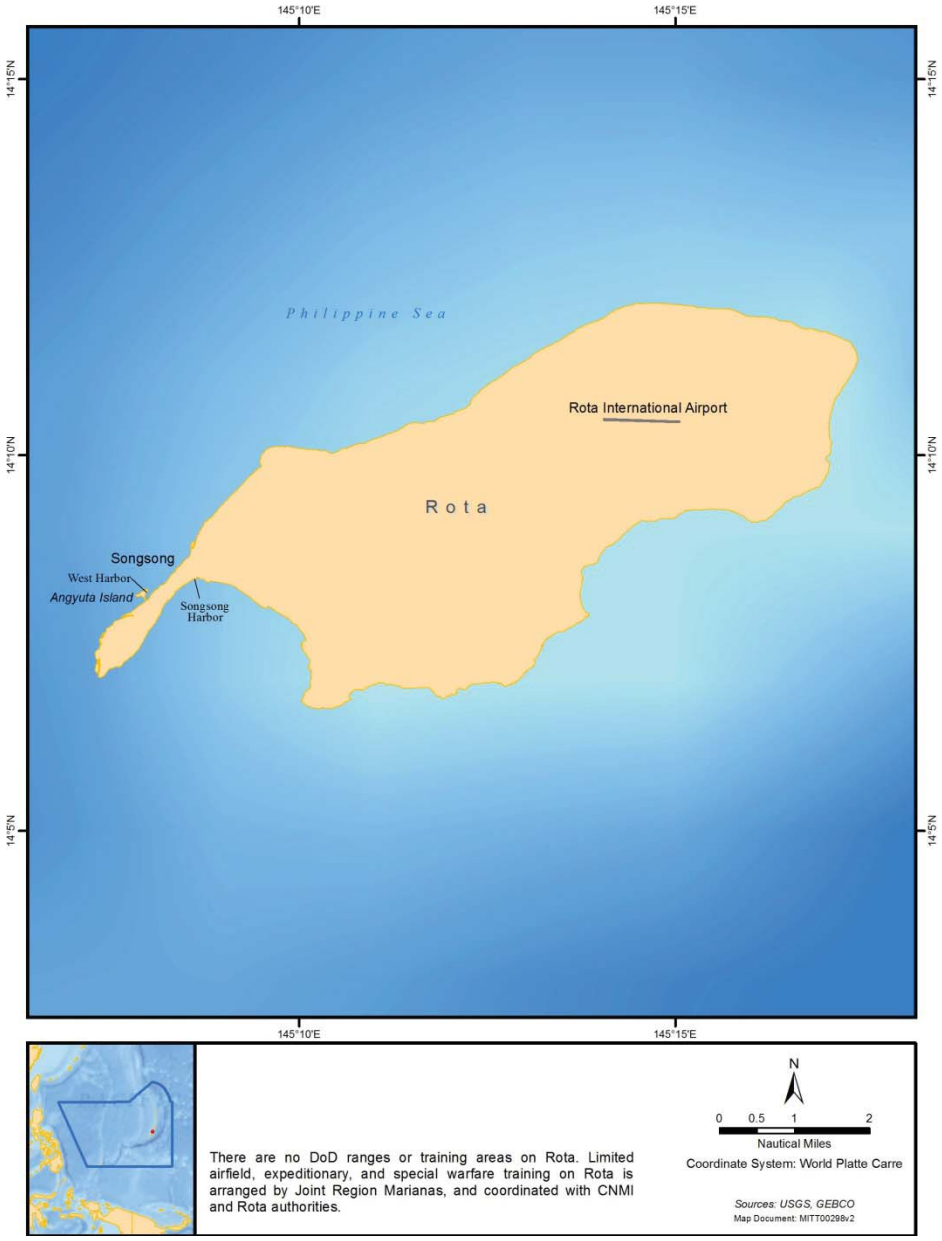

Figure 12. Rota

2.12.3 Ocean Operating Areas Outside the Bounds of the Mariana Islands Range Complex

In addition to the MIRC, the MITT Action Area is expanded and includes the area to the north of the MIRC that is within the Exclusive Economic Zone of the Commonwealth of the Northern Mariana Islands and the areas to the west of the MIRC (Figure 1). The MITT Action Area also includes a transit corridor, which is a direct route between the MIRC and the Hawaii Range Complex.

Although not part of any defined range complex, the transit corridor is important to the Navy in that it provides adequate air, sea, and undersea space in which vessels and aircraft conduct training and some sonar maintenance and testing while in transit.

The transit corridor is defined by a great circle route (e.g., shortest distance) between the MIRC and the HRC. While in transit and along the corridor, vessels and aircraft would, at times, conduct basic and routine unit level training such as gunnery and sonar training as long as the training does not interfere with the primary objective of reaching their intended destination. Ships also conduct sonar maintenance, which includes active sonar transmissions.

Effects of Navy training and testing activities with the portion of the transit corridor that lies within the Hawaii-Southern California Training and Testing (HSTT) Action Area were analyzed separately in the HSTT biological opinion. This biological opinion addresses training and testing activities along the transit corridor outside of the Action Area defined for HSTT (in and around the Hawaiian Islands).

2.12.4 Pierside Locations and Apra Harbor

The Action Area includes pierside locations in the Apra Harbor Naval Complex where surface ship and submarine sonar maintenance testing occur. For purposes of this BO, pierside locations include channels and routes to and from the Navy port in the Apra Harbor Naval Complex, and associated wharves and facilities within the Navy port and shipyard (Figure 5).

2.12.5 Nearshore Training and Testing Areas

The following table and figure describe the nearshore training and testing activities in MITT.

Table 21. Summary of Nearshore Training and Testing Activities

Nearshore Training and Testing Areas	Description
Pacific Ocean off Orote Point, Apra Harbor, Island of Guam, Mariana Islands; Small Arms Firing Range	Used for Small Arms Training. Down range Surface Danger Zone extends out over the nearshore waters of Guam off Orote Point.
Finegayan Small Arms Range	Used for small arms training. Down range Surface Danger Zone extends out over the nearshore waters of Guam off Haputo Point and overlays part of the "Small Arms Safety Drop Zone" shown on NOAA Chart 81048, Guam.
Pati Point Combat Arms Training Maintenance Small Arms Range	Used for small arms training. Down range Surface Danger Zone extends out over the nearshore waters of Guam off Pati Point.
Small Arms Firing Area	An area used by surface vessel crews to conduct small arms training. This firing area is over water west of Guam, beyond 3 nm of Guam and within territorial waters, and within a Navy "Firing Danger Area" charted on NOAA Chart 81048, Guam.
Agat Bay Mine Neutralization Site	Used by divers training to conduct underwater detonations (UNDETs). The Exclusion Zone has a minimum 640-meter (m) radius and is located beyond 3 nm of Guam and within territorial waters.
Piti Point Mine Neutralization Site	Used by divers training to conduct UNDETs. The Exclusion Zone has a minimum 640 m radius and is located within 3 nm of Guam.
Apra Harbor UNDET Site	Used by divers training to conduct UNDETs. The Exclusion Zone has a minimum 640 m radius over water, and is located within Apra Harbor. The Glass Breakwater forms the northern edge of Exclusion Zone.
Pati Point Explosive Ordnance Disposal Range	Land site used by the Air Force to dispose of ordnance. The Exclusion Zone extends partially out of Guam off Pati Point.

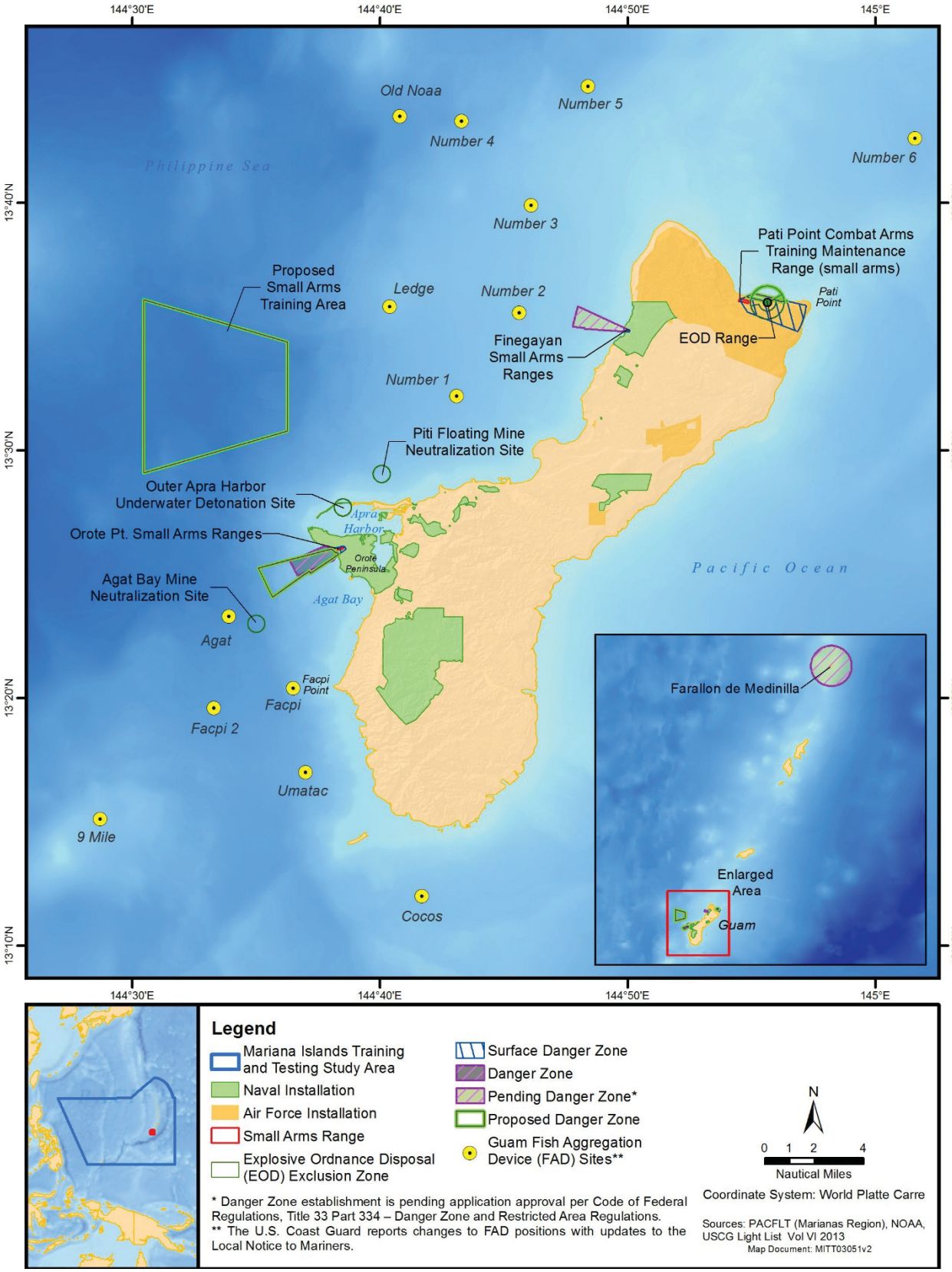

Figure 13. Nearshore Training and Testing Areas

3 APPROACH TO THE ASSESSMENT

Section 7(a)(2) of the ESA requires Federal agencies, in consultation with NMFS, to ensure that their actions are not likely to jeopardize the continued existence of endangered or threatened species, or adversely modify or destroy their designated critical habitat. The jeopardy analysis considers both survival and recovery of the species. The adverse modification analysis considers the impacts on the conservation value of designated critical habitat.

"To jeopardize the continued existence of a listed species" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species (50 CFR §402.02).

This biological opinion does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat at 50 C.F.R. 402.02. Instead, we have relied upon the statutory provisions of the ESA to complete the following analysis.[4]

3.1 Overview of NMFS' Assessment Framework

We will use the following approach to determine whether the proposed action is likely to jeopardize listed species or destroy or adversely modify critical habitat:

- Identify the range-wide status of the species and critical habitat likely to be adversely affected by the proposed action; then
- Describe the *Environmental Baseline* in the Action Area including:
    - Past and present impacts of Federal, state, or private actions and other human activities in the Action Area;
    - Anticipated impacts of proposed Federal projects that have already undergone formal or early section 7 consultation;
    - Impacts of state or private actions that are contemporaneous with the consultation in process; then
- Analyze the effects of the proposed action on both species and their habitat; then
- Consider how the proposed action would affect the species' reproduction, numbers, and distribution; then
- Evaluate the proposed action's effects on critical habitat features; then

[4] Memorandum from William T. Hogarth to Regional Administrators, Office of Protected Resources, NMFS (Application of the "Destruction or Adverse Modification" Standard Under Section 7(a)(2) of the Endangered Species Act) (November 7, 2005).

- Describe any cumulative effects in the Action Area. Cumulative effects, as defined in our implementing regulations (50 CFR §402.02), are the effects of future state or private activities, not involving Federal activities, that are reasonably certain to occur within the Action Area. Future Federal actions that are unrelated to the proposed action are not considered because they require separate section 7 consultation;

We integrate and synthesize the above factors to assess the risk that the proposed action poses to species and critical habitat.

We assess the effects of the action with the impacts to the resources resulting from the *Environmental Baseline* and the *Cumulative Effects* to assess whether the action could reasonably be expected to:

- Reduce appreciably the likelihood of both survival and recovery of the species in the wild by reducing its numbers, reproduction, or distribution; and/or
- Reduce the conservation value of designated or proposed critical habitat. These assessments are made in full consideration of the *Status of Listed Resources* and critical habitat.

Reach jeopardy and adverse modification *Conclusion*. In this step we state our conclusions regarding jeopardy and the destruction or adverse modification of critical habitat (*Integration and Synthesis*).

If necessary, define a reasonable and prudent alternative to the proposed action. If, in completing the last step in the analysis, we determine that the action under consultation is likely to jeopardize the continued existence of listed species or destroy or adversely modify designated critical habitat, we must identify a reasonable and prudent alternative (RPA) to the action. The RPA must not be likely to jeopardize the continued existence of listed species nor adversely modify their designated critical habitat and it must meet other regulatory requirements.

3.2 "Take" and Threatened Species

ESA section 9(a) take prohibitions (16 U.S.C. 1538(a)(1)(B)) apply to all species listed as endangered. In the case of threatened species, section 4(d) of the ESA leaves it to the Secretary's discretion whether and to what extent to extend the statutory 9(a) ''take'' prohibitions, and directs the agency to issue regulations it considers necessary and advisable for the conservation of the species. At this time, NMFS has not issued section 4(d) rules for the threatened coral species or for the threatened scalloped hammerhead shark – Indo-Pacific DPS. Therefore, the take prohibitions of section 9(a) of the ESA have not been extended to these species. However, consistent with *CBD v. Salazar*, 695 F.3d 893 (9th Cir. 2012), we did assess the amount or extent of take to threatened species that is anticipated incidental to Navy training and testing activiites and included this information in the ITS. At such time a 4(d) rule is issued for these species, NMFS and the Navy may need to reinitiate consultation to amend the incidental take statement.

3.3 Defining "Significance"

In biological opinions, we focus on potential physical, chemical, or biotic stressors that are "significant" in the sense of being distinct from ambient or background. We then ask if

a. exposing individuals to those potential stressors is likely to represent a "significant" negative experience in the life history of individuals that have been exposed; and if

b. exposing individuals to those potential stressors is likely to cause the individuals to experience "significant" physical, chemical, or biotic responses; and if

c. any "significant" physical, chemical, or biotic response are likely to have "significant" consequence for the fitness of the individual animal; and if

d. exposing the physical, chemical, or biotic phenomena that we identified as constituent elements in a critical habitat designation or, in the case of critical habitat designations that do not identify constituent elements, those physical, chemical or biotic phenomena that give designated critical habitat value for the conservation of endangered or threatened species is likely to represent a "significant" change in the quantity, quality, or availability of the physical, chemical, or biotic resource; and if

e. any "significant" change in the quantity, quality, or availability of a physical, chemical, or biotic resource is likely to "significantly" reduce the conservation value of the designated critical habitat.

In all of these cases, the term "significant" means "clinically or biotically significant" rather than statistically significant because the presence or absence of statistical significance do not imply the presence or absence of clinical significance (Achinstein 2001; Royall 2004).

For populations (or sub-populations, demes, etc.), we are concerned about whether the number of individuals that are likely to experience "significant" reductions in fitness and the nature of any fitness reductions are likely to have a "significant" consequence for the viability (= probability of demographic, ecological, or genetic extinction) of the population(s) those individuals represent. Here "significant" also means "clinically or biotically significant" rather than statistically significant.

For "species" (the entity that has been listed as endangered or threatened, not the biological species concept), we are concerned about whether the number of populations that are likely to experience "significant" reductions in viability (= increases in their extinction probabilities) and the nature of any reductions in viability are likely to have "significant" consequence for the viability (= probability of demographic, ecological, or genetic extinction) of the "species" those population comprise. Here, again, "significant" also means "clinically or biotically significant" rather than statistically significant.

For designated critical habitat, we are concerned about whether the area that has been designated is likely to experience "significant" reductions in the quantity, quality, or availability of physical, chemical, or biotic resources that are likely to result in "significant" reductions in the conservation value (usually measured using the concept of "carrying capacity") of the entire are contained in the designation.

3.4 Evidence Available for the Consultation

To conduct these analyses, we considered all lines of evidence available through published and unpublished sources that represent evidence of adverse consequences or the absence of such consequences. A considerable body of scientific information on anthropogenic sounds and their

effect on marine mammals and other marine life has become available. NMFS status reviews for listed species also provide information on the status of the species including their resiliency, population trends and specific threats to recovery that contributes to our *Status of Listed Resources*, *Environmental Baseline*, and Risk Analyses.

To comply with our obligation to use the best scientific and commercial data available, we conducted electronic literature searches throughout the consultation, including within NMFS Office of Protected Resources' electronic library (using *EndNote* ® software). We examined the literature that was cited in the submittal documents and any articles we collected through our electronic searches. The U.S. Navy provided NMFS with a draft and final EIS/OEIS on training and testing that are proposed in the Action Area. We also evaluated the Navy's annual and comprehensive major training exercise and monitoring reports to assess effectiveness of mitigation and actual take incidental to actual training and testing activity levels where feasible.

Considering the information that was available, this consultation and our Opinion includes uncertainty about the basic hearing capabilities of some marine mammals, sea turtles, and fishes; how these taxa use sounds as environmental cues; how they perceive acoustic features of their environment; the importance of sound to the normal behavioral and social ecology of species; the mechanisms by which human-generated sounds affect the behavior and physiology (including the non-auditory physiology) of exposed individuals; and the circumstances that are likely to produce outcomes that have adverse consequences for individuals and populations of exposed species.

3.4.1 Consideration of new literature and pending Acoustic Guidance on the Effects of Anthropogenic Sound on Marine Mammals

NOAA is currently in the process of developing Acoustic Guidance on thresholds for onset of auditory impacts from exposure to sound, which will be used to support assessments of the effects of anthropogenic sound on marine mammals. To develop this Guidance, NOAA is compiling, interpreting, and synthesizing the best information currently available on the effects of anthropogenic sound on marine mammals, and is committed to finalizing the Guidance through a systematic, transparent process that involves internal review, external peer review, and public comment. In December 2013, NOAA released for public comment draft Acoustic Guidance that provides acoustic threshold levels for onset of permanent threshold shift (PTS) and temporary threshold shifts (TTS) in marine mammals for all sound sources. NOAA has since been working to incorporate the relevant information received during the public comment period and to make appropriate changes.

In February 2015, while NOAA was still working to finalize the Guidance, the U.S. Navy provided NOAA with a technical paper by Finneran (2015) describing Navy's proposed methodology for updating auditory weighting functions and numeric thresholds for predicting onset of auditory effects (TTS/PTS thresholds) on marine animals exposed to active sonars and other active acoustic sources utilized during Navy training and testing activities. One of the most significant differences between the criteria employed in prior Navy modeling and those proposed in Finneran (2015) is that the low-frequency cetacean and sea turtle TTS and PTS thresholds are higher at all frequencies. This change is intended to account for the relatively poor auditory sensitivities of sea turtles and the suspected elevated thresholds in low-frequency cetaceans relative to mid-frequency cetaceans.

NOAA is working to evaluate and incorporate the information in Finneran (2015) into its Acoustic Guidance before it becomes final. Before doing so, an independent peer review (i.e., second peer review of the Guidance) of the Navy's technical paper will be necessary, along with a subsequent additional public comment period (i.e., second public comment period for the Guidance). After the peer review and public comment processes are complete, NOAA will determine how best to incorporate the Navy's methodology into its final Acoustic Guidance. The Guidance likely will not be finalized until later this year. Thereafter, any new Navy modeling based on our final Acoustic Guidance would likely take a minimum of several months to complete. Consequently, the results of prior Navy modeling described in this Opinion represent the best available estimate of the number and type of take that may result from the Navy's use of acoustic sources in the MITT Action Area. NOAA's continued evaluation of all available science for the Acoustic Guidance could result in changes to the acoustic criteria used to model the Navy's activities for this consultation, and, consequently, the enumerations of "take" estimates. However, consideration of the draft Guidance and information contained in Finneran (2015) does not alter our assessment of the likely responses of affected ESA-listed species to acoustic sources employed by Navy in the MITT Action Area, or the likely fitness consequences of those responses.

Since the Navy's Phase 2 modeling (the NAEMO model considered in this Opinion), there have been ten studies on marine mammal TTS. (e.g., (Finneran et al. 2005a; Finneran et al. 2010; Finneran and Schlundt 2013; Kastelein et al. 2012a; Kastelein et al. 2012d; Kastelein et al. 2014a; Kastelein et al. 2014d; Popov et al. 2013a; Popov et al. 2011)) (Table 22).

3.4.1.1 ***Mid-frequency Cetaceans***

The results from Finneran and Schlundt (2013) demonstrate there are frequency-specific differences by species in TTS onset and growth, and suggest increased susceptibility to auditory fatigue for frequencies between approximately 10 kHz and 30 kHz. This study supports the importance of using auditory weighting functions (i.e., functional hearing groups are more susceptible to noise-induced hearing loss at certain frequencies), but is not expected to change any of the thresholds to onset TTS between those the Navy used in this consultation and the pending Acoustic Guidance (A. Scholik-Schlomer, personal communication, March 26, 2015).

Popov et al. (2013a) and Popov et al. (2014) examined the impacts of half-octave band noise on hearing in two belugas. In their 2013 study, levels beyond TTS onset were induced (i.e., threshold shifts ranged from 7.5 to 62.5 dB) with recovery occurring within 24 h. In their 2014 study, TTS onset was identical to that of a beluga from another study (i.e., NOC from Schlundt et al. (2000); i.e., these studies are not expected to result in any changes to the thresholds).

3.4.1.2 ***High-frequency Cetaceans***

All the recent TTS studies on harbor porpoises were completed by Kastelein using the same individual exposed to either octave band noise (Kastelein et al. 2012a), tones (Kastelein et al. 2013b; Kastelein et al. 2014c) , or 1 to 2 kHz sonar (Kastelein et al. 2014b). The results from Kastelein et al. (2014)are expected to necessitate a change to TTS onset thresholds for non-impulsive sounds for HF cetaceans (i.e., changed from 160 dB SEL_{cum} in Draft NOAA Guidance to 152 dB SEL_{cum}). This potential change to the TTS onset threshold could impact the enumerations of "take" estimates. However, any changes and subsequent modeling by the Navy would not alter our assessment of the likely responses of affected ESA-listed species to acoustic

sources employed by Navy in the MITT Action Area, or the likely fitness consequences of those responses. Other points of note from these Kastelein et al. studies (all of which have been demonstrated from previous marine mammal studies), include showing 1) increasing exposure duration was more effective in elevating TTS compared to increasing level of exposure, 2) low-frequency sounds are unlikely to affect ability for this species to echolocate (since echolocation occurs at much higher frequency: 125 kHz), and 3) interpulse interval plays an important role in determining TTS onset (lower level of TTS onset for continuous exposure compared to intermittent exposure; longer interpulse interval results in less incidences of TTS and faster recovery times), even with exposures with identical SEL_{cum}.

Kastelein et al. (2015) exposed a harbor porpoise to 2,760 pile driving strikes resulting in an unweighted level of 180 dB SEL_{cum}, but threshold shifts of less than 6 dB were induced (i.e., mean threshold shift of 2.3 to 3.6 dB). Thus, are not expected to result in any changes to the thresholds the Navy used in this consultation to those proposed in the pending Acoustic Guidance.

3.4.1.3 ***Phocid Pinnipeds***

Two more recent studies for phocid pinnipeds (harbor seal) were completed by Kastelein et al. (Kastelein et al. 2013a; Kastelein et al. 2012b). Neither of these studies are expected to result in changes in the TTS onset threshold from those the Navy used in this consultation to those proposed in the pending Acoustic Guidance. Of note, the results for Kastelein et al. (2012b) were excluded from consideration from NOAA's analysis because the exposure durations were greater than 1 h (i.e., durations were 120 and 240 minutes of continuous exposure) and considered unlikely to be encountered by wild individuals. The exposure in Kastelein et al. (2013a) resulted in a 44 dB threshold shift that took 4 days to recover (199 dB SEL_{cum}; note that this exposure level is higher than what is being proposed in the Guidance for PTS onset, which is 197 dB SEL_{cum}, and that the exposure in Kastelein did result in recovery).

Table 22. Available underwater marine mammal threshold shift peer reviewed studies (since 2011).

References in Chronologic Order[+]	Sound Source (Sound Source Category)	Sound-Exposed Species (number of individuals^)
(Kastelein et al. 2012b)	Octave-band noise (non-impulsive)	Harbor seal (2)
(Kastelein et al. 2012c)	Octave-band noise (non-impulsive)	Harbor porpoise (1)
(Finneran and Schlundt 2013)	Tones (non-impulsive)	Bottlenose dolphin (2)
(Popov et al. 2013b)	Half-octave band noise (non-impulsive)	Beluga (2)
(Kastelein et al. 2013a)	Octave-band noise (non-impulsive)	Harbor seal (1)
(Kastelein et al. 2013b)	Tone (non-impulsive)	Harbor porpoise (1)
(Popov et al. 2014)	Half-octave band noise (non-impulsive)	Beluga (2)
(Kastelein et al. 2014b)	1-2 kHz sonar (non-impulsive)	Harbor porpoise (1)

References in Chronologic Order+	Sound Source (Sound Source Category)	Sound-Exposed Species (number of individuals^)
(Kastelein et al. 2014c)	6.5 kHz tone (non-impulsive)	Harbor porpoise (1)
(Kastelein et al. 2015)	Impact pile driving (impulsive)	Harbor porpoise (1)
Kastelein et al. unpublished+	Impact pile driving (impulsive)	Harbor seal (2)
Finneran et al. in press+	Multiple airgun shots (impulsive)	Bottlenose dolphin (3)

+Peer reviewed studies available and evaluated as of 1 March 2015. Note: Two papers expected to publish in the near future. However, for all these studies, a TS could not be induced. Thus, neither study affects the acoustic threshold levels and are instead included for completeness.

^Note: Some individuals have been used in multiple studies.

3.4.2 The U.S. Navy's Exposure Estimates

To estimate exposure of marine species to acoustic sounds, the Navy uses acoustic modeling and marine mammal density information developed by the Navy in cooperation with NMFS. A subsequent review on behalf of NMFS by the Center for Independent Experts analyzed the various approaches the Navy used for acoustic effects analyses, leading to the refinement of the previous methodologies for determining acoustic effects. The result was the development of a standard Navy model for acoustic effects, the Navy Acoustic Effects Model (NAEMO).

This Opinion analyzes the environmental consequences based on marine mammal density data, and acoustic modeling methodology that employs acoustic criteria, and new scientific information as summarized below.

3.4.2.1 *The U.S. Navy Acoustic Effects Model (NAEMO)*

Since 1997, the U.S. Navy has modeled the potential acoustic effects on marine mammals and sea turtles from Navy training and testing activities. Various models used "area density" approaches in which acoustic footprints were computed and then multiplied by animal densities to calculate effects. As a result of a review conducted by the Center for Independent Experts, the Navy refined its process. The current model—the Navy Acoustic Effects Model (NAEMO)—is the model used by the Navy to estimate the potential acoustic effects of proposed Navy training and testing activities on marine mammals and sea turtles. We have verified methodology and data used in NAEMO and accept the modeling conclusions on exposure of marine species. A detailed discussion of the NAEMO is contained in chapter 3.4.3.1.6 of the EIS/OEIS, which is incorporated by reference. A full description of NAEMO can be accessed in the Naval Undersea Warfare Center Newport Technical Report 12,071a, 23 August 2013 (updated from 12 March 2012).

3.4.2.1.1 Overview

NAEMO is comprised of seven modules: Scenario Builder, Environment Builder, Acoustic Builder, Marine Species Distribution Builder, Scenario Simulator, Post Processor, and Report Generator. Scenario Builder defines where an activity would occur, the duration of the activity, a description of the activity, and what platforms would be participating. Once a platform is identified, all the sound sources typically associated with that platform are displayed, thus

providing standardization and repeatability when different analysts are entering data. Individual sources can be turned on or off according to the requirements of the scenario. Platforms are either stationary or can be moved through the Action Area in either a defined track or random straight-line movement.

Environment Builder extracts all of the oceanographic and environmental data required for a scenario simulation. When an area is selected, information on bathymetry, sound speed profiles, wind speeds, and bottom properties are extracted from an array of points across the region.

Acoustic Builder generates acoustic propagation data. It reads the Scenario Builder file, allows the user to define analysis points for propagation software, and creates the propagation model inputs. Depending on the source characteristics, the propagation models utilized are Comprehensive Acoustic Simulation System/Gaussian Ray Bundle , Range-Dependent Acoustic Model , or Reflection and Refraction Multilayered Ocean/Ocean Bottoms with Shear Wave Effects (REFMS).

Marine Species Distribution Builder allows the user to distribute marine species within the modeling environment in accordance with the bathymetry and relevant descriptive data. Marine species density data, which include seasonal information when available, are obtained from the Navy Marine Species Density Database (NMSDD); the sizes of cells and density of marine species within each cell vary by species and location.

Scenario Simulator executes the simulation and records the sound received by each marine mammal and sea turtle in the area. It incorporates the scenario definition, sound propagation data, and marine species distribution data and ultimately provides raw data output for each simulation. Most scenarios are run in 4- to 12-hour segments based on representative training and testing activities. Some scenarios are evaluated by platform and single locations, while others are evaluated in multiple locations within a single range complex or testing range. Within each scenario, multiple ship track iterations are run to provide a set of raw data results.

Post Processor provides the computation of estimated effects that exceed defined threshold criteria from each of the raw data files produced by Scenario Simulator. The post-processed computations determine harassment and mortality as defined by the MMPA for military readiness activities. It also tabulates and graphs the output data for review.

Report Generator assembles a series of simulation results from multiple post-processing runs and produces a combined result. Multipliers can be applied to each scenario to compute the effects of conducting them multiple times. Results can also be exported via Microsoft Excel files for further analysis and reporting.

Modeled effects from NAEMO were used to support the U.S. Navy's analyses in the MITT EIS/OEIS, mitigation strategies, Biological Evaluations, and MMPA incidental take authorization applications. We have verified methodology and data used in NAEMO and accept the modeling conclusions on exposure of marine species. A full description of NAEMO can be accessed in the Naval Undersea Warfare Center Newport Technical Report 12,071a, August 23, 2013 (updated from 12 March 2012). The following paragraphs provide an overview of the NAEMO process and its more critical data inputs.

The NAEMO improves upon previous modeling efforts in several ways. First, unlike earlier methods that modeled acoustic sources individually, the NAEMO has the capability to run all sources within a scenario simultaneously, providing a more realistic depiction of the potential effects of an activity. Second, previous models calculated sound received levels within set volumes of water and spread animals uniformly across the volumes; in the NAEMO, animats (virtual animals) are distributed non-uniformly based on higher resolution species-specific density, depth distribution, and group size, and animats serve as dosimeters, recording energy received at their location in the water column. Third, a fully three-dimensional environment is used for calculating sound propagation and animat exposure in the NAEMO, rather than a two-dimensional environment where the worst case sound pressure level across the water column is always encountered. Additionally, NAEMO expands upon previous modelling efforts by incorporating Type II frequency weighting functions, incorporating a behavioral response function, and developing estimates from a new density function (NMSDD). Finally, current efforts incorporate site-specific bathymetry, sound speed profiles, wind speed, and bottom properties into the propagation modeling process rather than the flat-bottomed provinces used during earlier modeling (NUWC 2012).

Using data from the NMSDD, the NAEMO derives an abundance (total number of individuals (i.e., animats)) for the modeled area. The NAEMO then distributes the animats into an area bounded by the maximum distance acoustic energy propagates out to a threshold value (energy footprint). For example, for non-impulsive sources, animats that could receive sound pressure levels greater than or equal to 120 dB are distributed. Animats are distributed based on density differences across the area, the group (pod) size, and known depth distributions (dive profiles) (see Marine Species Modeling Team (2012b) for a discussion of animal dive profiles in detail). Animats change depths every 4 minutes but do not otherwise mimic actual animal behaviors, such as avoidance or attraction to a stimulus (horizontal movement), or foraging, social, or traveling behaviors.

Schecklman et al. (2011) argue static distributions underestimate acoustic exposure compared to models with three-dimensionally moving animals. Their static method is different from the NAEMO in several ways. First, they distribute the entire population at a depth -typical for that species and those animats remain static at that position throughout the entire simulation. In the NAEMO, animats are placed horizontally dependent on non-uniform density information, and then move vertically over time based on species-specific diving behavior. Second, the static method calculates acoustic received level for designated volumes of the ocean and then sumsthe animats that occur within that volume, rather than using the animats themselves as dosimeters, as in the NAEMO. Third, Schecklman et al. (2011) ran 50 iterations of the moving distribution to arrive at an average number of exposures, but because they rely on uniform horizontal density (and static depth density) only a single iteration of the static distribution is realized. In addition to moving the animats vertically, the NAEMO overpopulates the animats over a non-uniform density and then resamples the population a number of times to arrive at an average number of exposures. Tests comparing fully moving animats and horizontally static animats with vertical mobility were compared during development of the NAEMO. For vertical position updates occurring more frequently than every 5 minutes, the number of estimated exposures was similar between the NAEMO and the fully moving distribution; however, computational time was much longer for the fully moving distribution.

The NAEMO calculates the likely propagation for various levels of energy (sound or pressure) resulting from each non-impulse or impulse source used during a training or testing event. These calculations account for bathymetric relief and bottom types (e.g., reflective), estimated sound speeds, and sea surface roughness. Platforms (such as a ship using one or more sound sources) are modeled moving across an area representative of what would normally occur during a training or testing scenario. The model uses typical platform speeds and event durations. Moving source platforms either travel along a predefined track or move in straight lines from a random initial starting point, reflecting at the edges of a predefined boundary. Static sound sources are stationary in a fixed location for the duration of a scenario. Modeling locations were chosen based on historical data where activities have been ongoing and to include environmental variation within the Study.

The NAEMO records the energy received by each animat within the energy footprint of the event and calculates the number of animats having received levels of energy exposures that fall within defined impact thresholds.

Predicted effects on the animats are tallied and the most severe effect (e.g., PTS over TTS) predicted for a given animat is assumed. Each scenario, or each 24-hour period for scenarios lasting greater than 24 hours, is independent of all others.Therefore, the same individual could be impacted during each independent scenario or 24-hour period. In few instances, although the activities themselves all occur within the MITT Action Area, sound may propagate beyond the boundary of the Action Area. Any exposures occurring outside the boundary of the Action Area are counted as if they occurred within the Action Area boundary or within the Action Area for this Opinion.

3.4.2.1.2 Model Assumptions

There are limitations to the data used in the NAEMO, and the results must be interpreted within these context. While the most accurate data and input assumptions have been used, when there is a lack of definitive data to support an aspect of the modeling, assumptions assumed to overestimate exposures have been chosen:

Animats are modeled as being underwater, stationary, and facing the source and therefore always predicted to receive the maximum sound level (i.e., no porpoising or pinnipeds' heads above water). Some odontocetes have been shown to have directional hearing, with best hearing sensitivity facing a sound source and higher hearing thresholds for sounds propagating towards the rear or side of an animal (Kastelein et al. 2009; Mooney et al. 2008; Popov and Supin 2009).

- Animats do not move horizontally (but change their position vertically within the water column), which may overestimate physiological effects such as hearing loss, especially for slow moving or stationary sound sources in the model.

- Animats are stationary horizontally and therefore do not avoid the sound source, unlike in the wild where animals would most often avoid exposures at higher sound levels, especially those exposures that may result in PTS.

- Animats are assumed to receive the full impulse of the initial positive pressure wave of an explosion, although the impulse-based thresholds (onset mortality and onset slight lung injury) assume an impulse delivery time adjusted for animal size and depth. Therefore, these impacts are overestimated at farther distances and increased depths.

- Multiple exposures within any 24-hour period are considered one continuous exposure for the purposes of calculating the temporary or permanent hearing loss, because there are not sufficient data to estimate a hearing recovery function for the time between exposures.

- Mitigation measures implemented during training exercises and testing activities were not considered in the model. In reality, sound-producing activities would be reduced, stopped, or delayed if marine mammals are detected within the mitigation zones.

3.4.3 Navy Marine Species Density Database (NMSDD)

There is no single source of density data for every geographic area, marine species, and season of the year because of the costs, resources, and effort that would be required to provide sufficient survey coverage to estimate density. Therefore, to characterize the marine species density for large affected areas such as the MITT Action Area, the Navy compiled data from several sources, resulting in the Pacific Navy Marine Species Density Database (NMSDD) Technical Report dated September 2013.

For estimating densities of marine mammals and sea turtles in the MITT Action Area, the Navy selected representative areas (Figure 14) including the MITT Action Area including pelagic and nearshore environments and the transit corridor to represent the range of different habitats that could occur along the corridor, including both island (Wake Island) and open ocean habitats.

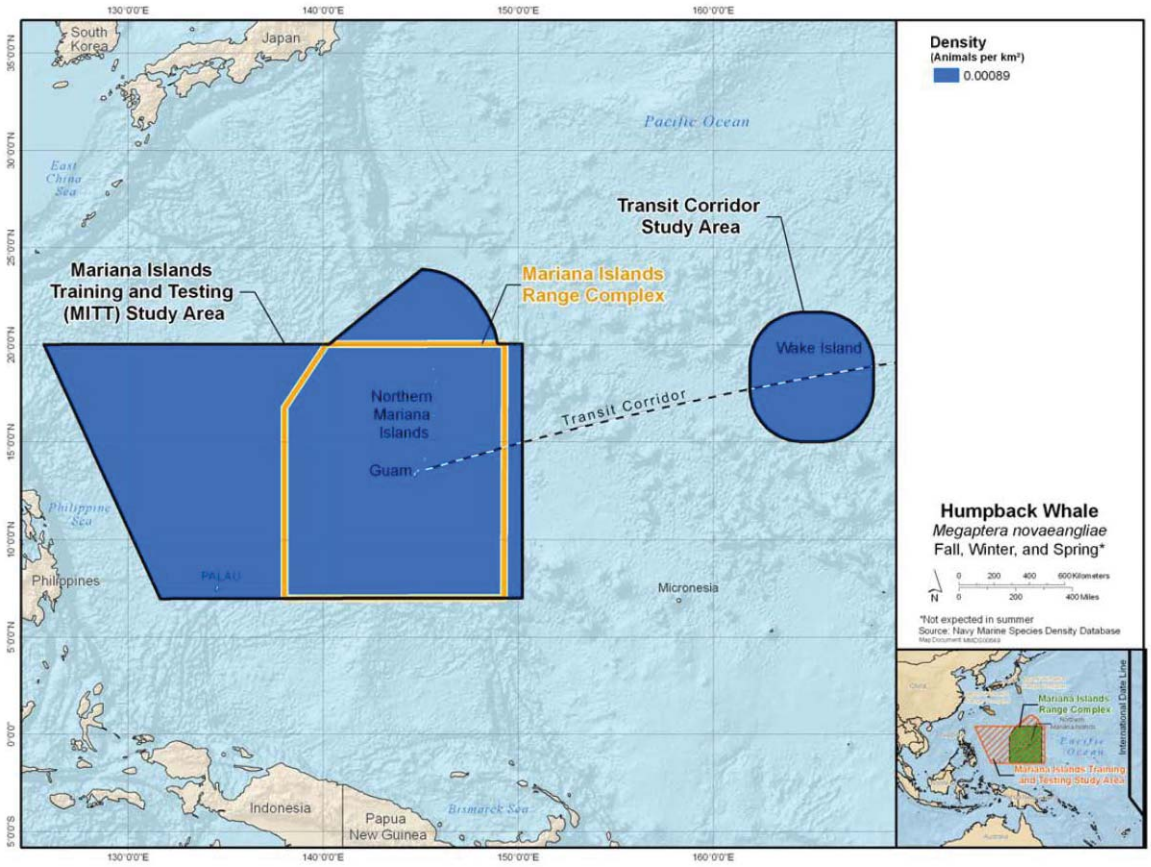

Figure 14. Example of Respresentative Areas Selected for Estimating Marine Species Densities

3.4.4 Differences Between Navy Modeling Considered in Previous Biological Opinions and this Biological Opinion

Phase I (roughly 2008 through 2012) of the Navy's at-sea environmental planning and permitting effort including MIRC addressed U.S. Navy training and testing activities in a number of separate documents. Different modeling processes were used to estimate the effects of sound on marine species incidental to military readiness activities. Phase II (roughly 2013 through 2021) methodology eliminates the varying modeling processes by utilizing a standard model, NAEMO, for all acoustic effects analyses.

The first step earlier in the Phase I modeling process involved propagation modeling. For sonars, the Comprehensive Acoustic System Simulation (CASS)/Gaussian Ray Bundle (GRAB) model was used. Explosive sources were analyzed using either Reflection and Refraction in Multilayered Ocean/Ocean Bottoms with Shear Wave Effects (REFMS) or a modified version of CASS/GRAB. Phase II modeling retains some of the Phase I features, such as use of the same propagation model (i.e., CASS/GRAB), for developing tonal source footprints. Phase II uses REFMS exclusively for explosive propagation and includes the addition of the Range-Dependent Acoustic Model (RAM) to model non-explosive impulsive sources (i.e., airguns).

For Phase I, footprints were created for each active source used in an activity, and the movements of the source were modeled over the operating area. Only one source type was modeled at a time. Unlike Phase I, NAEMO has the capability to simultaneously run multiple sources during a scenario, affording a more realistic depiction of the potential effects of an activity. For example, transmissions emitted by a surface combatant with its hull-mounted sonar, a helicopter with its dipping sonar, a torpedo's homing sonar, and the countermeasures discharged by the targeted submarine can be modeled simultaneously.

Although the acoustic propagation was modeled in three dimensions during Phase I analyses, in some cases, the three-dimensional (3-D) footprint was collapsed into a two-dimensional (2-D) acoustic footprint by utilizing the maximum received level, irrespective of the depth, at each range step. In other areas, a volumetric, 3-D footprint was developed to allow for variations in animal depth. For Phase II analyses, the 3-D acoustic propagation field was maintained throughout the analysis process.

Phase I distributed marine species uniformly in the respective density cells over the area being modeled. The animals were distributed in two dimensions, except in locations where data for species-specific dive profiles were available. In those areas, the animals were distributed in 3-D. In the 2-D distribution, all animals within the range of the maximum energy field would be affected, while in the volumetric approach, effects depended on where the animals were in the water column in relation to the propagation pattern. In Phase II, data on species-specific habitat preference, podding behavior, and dive profiles were taken into account and used to distribute individual animals in the model. An animat, or virtual representation of a marine animal, serves as a dosimeter, recording the energy received from all active sources during a scenario, resulting in the cumulative effects of all sources being accounted for when the impacts are analyzed.

Another difference between Phase I and Phase II modeling involves the environmental data used during propagation modeling. Phase II incorporates bathymetry into the propagation modeling process for non-impulsive sources and non-explosive impulsive (i.e., airgun) sources; Phase I used flat-bottomed bathymetry. Flat-bottom bathymetry will continue to be used in Phase II for all impulsive sources, as it was in Phase I. Futhermore, Phase II uses range-dependent sound speeds, wind speed, and bottom properties.

3.4.5 Discussion of Finneran and Schlundt 2010 and 2011 Dolphin Studies in the Context of Phase II Modeling

The Navy incorporated the data from two Finneran studies (2010 and 2011), in coordination with other scientific literature, to develop auditory weighting functions and "weighted" thresholds for auditory criteria. A summary of the findings from the two papers is provided below as well as an explanation of how the Navy incorporated the results of these papers into the weighting functions and thresholds used to support the MITT EIS/OEIS and this Opinion. We address the likely reasons that takes for ESA species declined when comparing the take estimates for MIRC to the MITT, despite the fact that one might have anticipated the application of the two recent Finneran papers (Finneran 2010) (Finneran 2011) would have resulted in increased estimated takes overall. The Navy and NMFS determined it was appropriate to use a new Navy model—NAEMO—that is considered the best available information and incorporates the new weighting functions and thresholds. NAEMO also incorporates a number of other significant changes and enhancements compared with the SAIC model used in MIRC. This paper surmises that the

changes in density data and distributions incorporated in NAEMO was likely the main factor that influenced an overall reduction of take estimates for ESA species between MIRC and the MITT estimates used in this Biological Opinion.

Finneran and Schlundt (2010)

Finneran and Schlundt (Finneran and Schlundt 2010) measured temporary threshold shift (TTS) in a single female bottlenose dolphin (*Tursiops truncatus*) after exposure to tones at 3 and 20 kHz in order to examine the effects of exposure frequency on the onset and growth of TTS. The preliminary data provide evidence of frequency specific differences in TTS onset and growth between the 3 kHz and 20 kHz exposures. At 20 kHz, where bottlenose dolphin hearing sensitivity is better, TTS not only began at a lower exposure level compared to the 3 kHz exposures, but also grew at a faster rate. This demonstrated that damage risk criteria for dolphins exposed to underwater sound should account for the exposure frequency and that criteria developed for lower frequencies (e.g. 3 kHz) may underestimate the amount of TTS if applied to higher frequencies (e.g. 20 kHz), where hearing sensitivity is better. This research suggests the need for analogous data across the entire audible range so that potential effects of various frequency tones can be properly assessed.

Finneran and Schlundt (2011)

For humans, acoustic damage-risk criteria rely on numeric thresholds based on "weighted" noise levels. Weighted noise levels are calculated by applying a frequency-dependent filter, or "weighting function" to the measured sound pressure before calculation of the overall sound pressure level (SPL). The weighting functions are designed to emphasize frequencies where sensitivity to sound is high and to de-emphasize frequencies where sensitivity is low. This technique allows for a single, weighted damage-risk criterion, regardless of the sound frequency. Weighting functions for humans are derived from equal loudness contours—graphs representing the SPLs that led to a sensation of equal loudness magnitude in the listener as a function of sound frequency (Suzuki and Takeshima 2004). Equal loudness contours are derived from loudness experiments where the listener is asked to judge the relative loudness of two tones with different frequencies. Prior to Finneran and Schlundt (2011a) there were no direct measurements of subjective loudness in non-human animals from which to develop equal loudness contours. Finneran and Schlundt (2011a)trained a bottlenose dolphin to perform a loudness comparison test, where the listener indicated which of two sequential tones was louder. This study demonstrated that a non-human animal could be conditioned for subjective loudness testing and therefore, it was possible to directly measure loudness levels in some species. Additional data is required to more accurately predict the relationship below 2.5 kHz. The weighting function derived here is substantially different than the "M-weighting function" proposed for mid-frequency cetaceans in Southall et al. (Southall et al. 2007b), which is nearly flat over the range of ~1–30 kHz and thus does not mirror the change in equal loudness contours observed over that frequency range. Nor does the M-weighting function capture the difference in TTS onset and growth reported for a single bottlenose dolphin tested at 3 and 20 kHz in Finneran and Schlundt (2010).

3.4.6 Post Processing. Avoidance Behavior and Mitigation Measures as Applied to Sonar and Active Acoustic Sources

As described in the modeling technical report, DEIS/OEIS, the model accounts for an animat's position vertically in the water column by taking into account species-specific dive profiles; however, it does not account for an animat's horizontal movement, so the model assumes that an animal would remain stationary and tolerate repeated intense sound exposures at very close distances. This assumption is invalid because animals are likely to leave the area to avoid intense sound exposure that could cause injury. Similarly, the modeling assumes that certain species known to avoid areas of high anthropogenic activity would remain in the very close vicinity of all Navy training and testing activities, regardless of how many vessels or low-flying aircraft (i.e., helicopters) are involved. The outputs of the model, therefore, present an unrealistically high estimate of acoustic impacts in close proximity to certain Navy training and testing activities.

Additionally, the modeling currently does not account for implementation of mitigation designed to avoid or reduce marine mammal and sea turtle exposures to explosives and high intensity sound, nor does it account for standard operating procedures (procedures designed for the safety of personnel and equipment) implemented to ensure safety and mission success, but which may have incidental environmental benefits. That is, the modeling assumes that any mitigations measures, such as sonar power-down or delay of a detonation, would not be implemented even if an animal could be sighted within the mitigation zone. The Navy's proposed mitigations were developed in cooperation with NMFS and are designed to reduce environmental impacts while being operationally feasible. It is difficult to assess the effectiveness of mitigation measures; however, NMFS assesses annual exercise reports and comprehensive summary reports to assess general trends in implementation andany observed responses to mitigation. The outputs of the model (without mitigation), therefore, present an unrealistically high estimate of acoustic impacts within the mitigation zones of certain Navy training and testing activities.

In order to provide a holistic quantitative assessment of acoustic impacts, the post-model analysis quantitatively assessed the effect of animal avoidance behavior and implementation of mitigation, considering the following:

- Best available science on species' behavior
- Number of platforms (i.e., aircraft, vessels) used during specific activities
- Ability to detect specific species
- Ability to observe the mitigation zone around different platforms during different activities

The steps of the post-model analysis are briefly summarized in Table 23 and presented in the order they are expected to occur during an actual training or testing activity, which is also the order in which they were mathematically considered in the post-model analysis. When feasible for a given activity, mitigation begins prior to the actual production of underwater sound (e.g., 10–30 minutes, dependent upon platform, prior to most sonar and explosive activities); therefore,

mitigation effectiveness is applied in the post-model analysis before animal avoidance is quantified.

Table 23. Post Model Acoustic Impact Analysis Process

Is the Sound Source Sonar/Other Active Acoustic Source or Explosives?	
Sonar and Other Active Acoustic Sources	Explosives
S-1. Is the activity preceded by multiple vessel activity or hovering helicopter?	E-1. Is the activity preceded by multiple vessel activity or hovering helicopter?
Species sensitive to human activity (i.e., beaked whales) are assumed to avoid the activity area, putting them out of the range to Level A harassment. Model-estimated PTS to these species during these activities are unlikely to actually occur and, therefore, are considered to be TTS (animal is assumed to move into the range of potential TTS). The activities preceded by multiple vessel movements or hovering helicopters are listed in Tables 3.4-14 and 3.4-15 in Section 3.4.4.1.2 (Avoidance Behavior and Mitigation Measures as Applied to Sonar and Other Active Acoustic Sources) in the FEIS.	Species sensitive to human activity (i.e., beaked whales) are assumed to avoid the activity area, putting them out of the range to mortality. Model-estimated mortalities to these species during these activities are unlikely to actually occur and, therefore, are considered to be injuries (animal is assumed to move into the range of potential injury). The activities preceded by multiple vessel movements or hovering helicopters are listed in Section 3.4.4.2.2 (Avoidance Behavior and Mitigation as Applied to Explosives) in the FEIS.
S-2. Can Lookouts observe the activity-specific mitigation zone (see Chapter 5) up to and during the sound-producing activity?	E-2. Can Lookouts observe the activity-specific mitigation zone (see Chapter 5) up to and during the sound-producing activity?
If Lookouts are able to observe the mitigation zone up to and during a sound-producing activity, the sound-producing activity would be halted or delayed if a marine mammal is observed and would not resume until the animal is thought to be out of the mitigation zone (per the mitigation measures in Chapter 5). Therefore, model-estimated PTS exposures are reduced by the portion of animals that are likely to be seen [Mitigation Effectiveness (1, 0.5, or 0) x Sightability, g(0)]. Any animals removed from the model-estimated PTS are instead assumed to be TTS (animal is assumed to move into the range of TTS). The g(0) value is associated with the platform (vessel or aircraft) with the dedicated Lookout(s). For activities with lookouts on both platforms, the higher g(0) is used for analysis. The Mitigation Effectiveness values are provided in Section 3.4.4.1.2 (Avoidance Behavior and Mitigation Measures as Applied to Sonar and Other Active Acoustic Sources) in the FEIS.	If Lookouts are able to observe the mitigation zone up to and during an explosion, the explosive activity would be halted or delayed if a marine mammal is observed and would not resume until the animal is thought to be out of the mitigation zone (per the mitigation measures in Chapter 5). Therefore, model-estimated mortalities and injuries are reduced by the portion of animals that are likely to be seen [Mitigation Effectiveness (1, 0.5, or 0) x Sightability, g(0)]. Any animals removed from the model-estimated mortalities or injuries are instead assumed to be injuries or behavioral disturbances, respectively (animals are assumed to move into the range of a lower effect). The g(0) value is associated with the platform (vessel or aircraft) with the dedicated Lookout(s). For activities with lookouts on both platforms, the higher g(0) is used for analysis. The g(0) values are provided in Table 3.4-8. The Mitigation Effectiveness values are provided in Table 3.4-21 in Section 3.4.2.2 (Avoidance Behavior and Mitigation as Applied to Explosives) in the FEIS.

3.4.6.1 Mitigation

The Navy Acoustic Effects Model estimates acoustic effects without taking into account any shutdown or delay of the activity when marine mammals are present and detectable within the mitigation zone; therefore, the model overestimates impacts to marine mammals within mitigation zones. The post-model analysis considers and quantifies the potential for mitigation to reduce the likelihood or risk of PTS (due to sonar and other active acoustic sources) and injuries and mortalities (due to explosives).

Two factors are considered when quantifying the effectiveness of mitigation: (1) the extent to which the type of mitigation proposed for a sound-producing activity (e.g., active sonar) allows for observation of the mitigation zone prior to and during the activity and (2) the sightability of each species that may be present in the mitigation zone, which is affected by species-specific characteristics.

3.4.6.2 Avoidance

At close ranges and high sound levels approaching those that could cause PTS, avoidance of the area immediately around the sound source is the assumed behavioral response for most cases. Because the Navy Acoustic Effects Model does not consider horizontal movement of animats, including avoidance of high-intensity sound exposures, it over-estimates the number of marine mammals and sea turtles that would be exposed to sound sources that could cause injury. In other words, the model estimates PTS impacts as though an animal would tolerate an injurious sound exposure without moving away from the sound source. Therefore, the potential for avoidance is considered in the Navy's post-model analysis.

3.5 Treatment of "Cumulative Impacts" (in the sense of NEPA)

The U.S. Council on Environmental Quality defined "cumulative effects" (which we refer to as "cumulative impacts" to distinguish between NEPA and ESA uses of the same term) as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions" (40 CFR §1508.7). The effects analyses of biological opinions considered the "impacts" on listed species and designated critical habitat that result from the incremental impact of an action by identifying natural and anthropogenic stressors that affect endangered and threatened species throughout their range (the *Status of Listed Resources*) and within an Action Area (the *Environmental Baseline*, which articulate the pre-existing impacts of activities that occur in an Action Area, including the past, contemporaneous, and future impacts of those activities). We assess the effects of a proposed action by adding their direct and indirect effects to the impacts of the activities we identify in an *Environmental Baseline* (50 CFR §402.02), in light of the impacts of the status of the listed species and designated critical habitat throughout their range; as a result, the results of our effects analyses are equivalent to those contained in the "cumulative impact" sections of NEPA documents.

We considered cumulative impacts as part of our consultation. Specifically, we considered (1) stressors that accumulate in the environment, and (2) effects that represent either the response of individuals, populations, or species to that accumulation of stressors. Further, we considered the likely impacts of these accumulative phenomema on an annual basis, over the duration of the five-year MMPA regulations, and under the assumption that these activities would continue into

the reasonably foreseeable future. Given the ongoing nature of the proposed activities, we assume that the type, amount, and extent of training and testing do not exceed maximum levels assessed in the action.

In the sense of Item 1, which captures the normal usage of "cumulative impacts," we concluded that phenomena like sound and ship strike do not accumulate in the environment (sound energy rapidly transforms into other forms of energy and ship strikes are independent events), although phenomena like the acreage of habitat destroyed and concentrations of toxic chemicals, sediment, and other pollutants accumulate.

In the sense of Item 2, we considered phenomena that accumulate in individuals and individually contribute or collectively determine the probable fitness of the individuals that comprise a population. These include, the passage of time and its corollary, the passage or loss of time (specifically, the loss of time to reproduce, to forage, and to migrate, etc.); reproductive success; longevity; energy debt, including allostatic loading; body burdens of toxic chemicals; the fitness costs of behavioral decisions (canonical costs); injuries and tissue damage; and overstimulation of sensory organs (which would include noise-induced losses of hearing sensitivity).

At the level of populations, phenomena that "accumulate" include population abundance; the number or percent of individuals in a population with lifetime reproductive success greater than 2.0; the number or percent of individuals in a population with lifetime reproductive success equal to 2.0; the number or percent of individuals in a population with lifetime reproductive success less than 2.0; the number or percent of individuals that emigrate from a population per unit time; the number or percent of individuals that immigrate into a population per unit time; mortality within a particular age or stage over generation time; and the reservoir of juveniles in a population that have a high probability of surviving to the age of reproduction (population momentum or its absence).

At the species level, when feasible, we accumulate those phenomena that allow us to estimate the extinction risks facing a species. These include increases or decreases in the number of occurrences or populations; the extinction probability of particular occurrences; variance in the rates of population growth or decline; and demographic stochasticity.

Cummulative effects also include effects of future State, tribal, local, or private actions that are reasonably certain to occur in the Action Area considered in this biological opinion. Future Federal actions that are unrelated to the action are not considered in this section because they require separate consultation pursuant to Section 7 of the ESA.

4 STATUS OF LISTED RESOURCES

This section identifies the ESA-listed species that potentially occur within the Action Area that may be affected by Mariana Islands training and testing. It then summarizes the biology and ecology of those species and what is known about their life histories in the Action Area. The species potentially occurring within the Action Area are listed in Table 24, along with their regulatory status.

Table 24. ESA-listed Species That May be Affected by MITT Activities

Species	ESA Status	Critical Habitat	Recovery Plan	Recent Trend†
Marine Mammals – Cetaceans				
Blue Whale (*Balaenoptera musculus*)	E – 35 FR 18319	-- --	07/1998	-
Fin Whale (*Balaenoptera physalus*)	E – 35 FR 18319	-- --	75 FR 47538	?
Humpback Whale (*Megaptera novaeangliae*)*	E – 35 FR 18319	-- --	55 FR 29646	↑
Sei Whale (*Balaenoptera borealis*)	E – 35 FR 18319	-- --	76 FR 43985	?
Sperm Whale (*Physeter macrocephalus*)	E – 35 FR 18319	-- --	75 FR 81584	?
Sea Turtles				
Green Turtle (*Chelonia mydas*)*	T – 43 FR 32800	63 FR 46693	63 FR 28359	↕
Hawksbill Turtle (*Eretmochelys imbricata*)	E – 35 FR 8491	63 FR 46693	63 FR 28359	↓
Leatherback Turtle (*Dermochelys coriacea*)	E – 61 FR 17	44 FR 17710	63 FR 28359	↓
Loggerhead Turtle (*Caretta caretta*) – North Pacific DPS	E – 76 FR 58868	79 FR 39856	63 FR 28359	↓
Olive Ridley Turtle (*Lepidochelys olivacea*)	T – 43 FR 32800	-- --	63 FR 28359	↕
Fishes				
Scalloped hammerhead shark (*Sphyrna lewini*) – Indo-West Pacific DPS	T – 79 FR 38213	-- --	-- --	?
Corals‡				
Acropora globiceps	T – 79 FR 53851	-- --	-- --	?
Acropora retusa	T – 79 FR 53851	-- --	-- --	?
Seriatopora aculeata	T – 79 FR 53851	-- --	-- --	?

***Green sea turtles in the Action Area were proposed as an endangered Central-West Pacific DPS on March 23, 2015 (80 FR 15271). Humpback whales in the Action Area were proposed as a threatened Western North Pacific DPS on April 21, 2015. Although these DPS designation are not final, this Opinion will analyze the effects of green sea turtle and humpback whale take separately on both the currently listed entities (range-wide) and the proposed DPSs.**
† Species status trends from the FY 2013 to 2014 Report to Congress (NMFS 2015): ↑ increasing, ↓ decreasing, ↕ mixed, ? unknown, - stable,
‡NMFS determined neither *Acropora tenella nor Pavona diffluens* occur in the Action Area.

Table 25 summarizes the stressor categories and potential for effects as assessed by the Navy. Our rationale for concurrence with Navy determinations of may affect, not likely to adversely affect, are summaried in Section 4.1 below. Species that are not likely to be adversely affected by any of the stressors in Table 25 were not carried forward in our effects analysis. Species that were likely to be adversely affected by any of the stressor categories are carried forward in our effects analysis.

Table 25. Summary of Navy ESA Effect Determinations and NMFS Final Determinations

Stressor	Navy Determinations		NMFS Final Determinations
	Likely to adversely affect	Not likely to adversely affect	Concurrence with Navy Determination (Yes or No)
Acoustic Stressors			
Non-implusive Acoustic Stressors - Sonar and Other Active Acoustic Sources	Humpback Whale, Blue Whale, Fin Whale, Sei Whale, Sperm Whale, Green Turtle, Hawksbill Turtle, Loggerhead Turtle, Leatherback Turtle	Olive Ridley Turtle, Corals	Yes
Impulsive Acoustic Stressors - Explosives	Green Turtle, Hawksbill Turtle, Scalloped Hammerhead Shark	Humpback Whale, Blue Whale, Fin Whale, Sei Whale, Sperm Whale, Loggerhead Turtle, Olive Ridley Turtle, Leatherback Turtle, **Corals***	**Yes for all determinations except corals. *We determined that impulsive acoustic stressors would be likely to adversely affect *Acropora globiceps*.**
Weapons Firing, Launch, and Impact Noise	--	Humpback Whale, Blue Whale, Fin Whale, Sei Whale, Sperm Whale, Green Turtle, Hawksbill Turtle, Loggerhead Turtle, Olive Ridley Turtle, Leatherback Turtle, Scalloped Hammerhead Shark	Yes
Aircraft Noise	--	Humpback Whale, Blue Whale, Fin Whale, Sei Whale, Sperm Whale, Green Turtle, Hawksbill Turtle, Loggerhead Turtle, Olive Ridley Turtle, Leatherback Turtle. Scalloped Hammerhead Shark	Yes
Vessel Noise	--	Humpback Whale, Blue Whale, Fin Whale, Sei Whale, Sperm Whale, Green Turtle, Hawksbill Turtle, Loggerhead Turtle, Olive Ridley Turtle, Leatherback Turtle, Scalloped Hammerhead Shark	Yes
Energy Stressors			

Stressor	Navy Determinations		NMFS Final Determinations
	Likely to adversely affect	Not likely to adversely affect	Concurrence with Navy Determination (Yes or No)
Electromagnetic Devices	--	Humpback Whale, Blue Whale, Fin Whale, Sei Whale, Sperm Whale, Green Turtle, Hawksbill Turtle, Loggerhead Turtle, Olive Ridley Turtle, Leatherback Turtle, Scalloped Hammerhead Shark	Yes
Physical Disturbance and Strike			
Vessel Strike	--	Humpback Whale, Blue Whale, Fin Whale, Sei Whale, Sperm Whale, Green Turtle, Hawksbill Turtle, Loggerhead Turtle, Olive Ridley Turtle, Leatherback Turtle, Corals, Scalloped Hammerhead Shark,	Yes
In-Water Devices	--	Humpback Whale, Blue Whale, Fin Whale, Sei Whale, Sperm Whale, Green Turtle, Hawksbill Turtle, Loggerhead Turtle, Olive Ridley Turtle, Leatherback Turtle, Corals, Scalloped Hammerhead Shark	Yes
Military Expended Materials	--	Humpback Whale, Blue Whale, Fin Whale, Sei Whale, Sperm Whale, Green Turtle, Hawksbill Turtle, Loggerhead Turtle, Olive Ridley Turtle, Leatherback Turtle, **Corals***, Scalloped Hammerhead Shark	**Yes for all determinations except corals. *We determined that military expended materials would be likely to adversely affect corals.**
Entanglement			
Fiber Optic Cables and Guidance Wires	--	Humpback Whale, Blue Whale, Fin Whale, Sei Whale, Sperm Whale, Green Turtle, Hawksbill Turtle, Loggerhead Turtle, Olive Ridley Turtle, Leatherback Turtle, Scalloped Hammerhead Shark	Yes

Stressor	Navy Determinations		NMFS Final Determinations
	Likely to adversely affect	Not likely to adversely affect	Concurrence with Navy Determination (Yes or No)
Decelerators/ Parachutes	--	Humpback Whale, Blue Whale, Fin Whale, Sei Whale, Sperm Whale, Green Turtle, Hawksbill Turtle, Loggerhead Turtle, Olive Ridley Turtle, Leatherback Turtle, Scalloped Hammerhead Shark	Yes
Ingestion			
Munitions	--	Humpback Whale, Blue Whale, Fin Whale, Sei Whale, Sperm Whale, Green Turtle, Hawksbill Turtle, Loggerhead Turtle, Olive Ridley Turtle, Scalloped Hammerhead Shark	Yes
Military Expended Materials Other Than Munitions	--	Humpback Whale, Blue Whale, Fin Whale, Sei Whale, Sperm Whale, Green Turtle, Hawksbill Turtle, Loggerhead Turtle, Olive Ridley Turtle, Leatherback Turtle, Scalloped Hammerhead Shark	Yes
Secondary Stressors			
Explosives, Metals, Chemicals, Disease, Parasites, Sedimentation	--	Humpback Whale, Blue Whale, Fin Whale, Sei Whale, Sperm Whale, Green Turtle, Hawksbill Turtle, Loggerhead Turtle, Olive Ridley Turtle, Leatherback Turtle, Corals, Scalloped Hammerhead Shark	Yes

-- indicates no species with that determination.

4.1 Species and Designated Critical Habitat Not Considered Further in this Opinion

As described in the *Approach to the Assessment* section of this Opinion, NMFS uses two criteria to identify those endangered or threatened species or critical habitat that are not likely to be adversely affected by proposed Mariana Islands training and testing. The first criterion is *exposure* or some reasonable expectation of a co-occurrence between one or more potential stressor associated with training and testing activities and a particular listed species or designated critical habitat. If we conclude that a listed species or designated critical habitat is not likely to be exposed to training and testing activities, we must also conclude that the listed species or critical habitat is not likely to be adversely affected by those activities. The second criterion is the probability of a *response* given exposure, which considers *susceptibility.* For example, a species

may be exposed to noise from explosions of ordnance, but may be unlikely to be affected by the sound (at sound pressure levels they are likely to be exposed to). We applied these criteria to the species listed in Table 24.

4.1.1 Olive Ridley Sea Turtle

Only one record of an olive ridleys sea turtle has been documented for Guam or the CNMI, allegedly captured near Saipan (Pritchard 1977). Olive ridley sea turtles are rare in the MITT Action Area. For the purposes of modeling effects to species within the Action Area the Navy has estimated the olive ridley sea turtle abundance at 0.000001 animals per km^2. The U.S. Navy determined that stressors resulting from sonar and other active acoustic sources, explosives, weapons firing/launch/impact noise, aircraft noise, vessel noise, electromagnetic devices, vessels and in-water devices, fiber optic cables/wires/parachutes, and military expended materials may affect, but are not likely to adversely affect olive ridley sea turtles as the activities would not impose fitness consequences on an individual that could result in "take" due to very low potential for co-ocurrence of individuals and specific stressors.

The exposure of olive ridley sea turtles to acoustic stressors, including non-impulsive (e.g. sonar) and impulsive sources (e.g. explosives), are anticipated to be rare. Navy models predict 12 exposures at greater than 120 dB from non-impulsive acoustic stressors related to training activities and 15 exposures from testing activities. None of these exposures are anticipated to be greater than 150 dB or rise to the level of take (≥ 175 dB re 1 μPa root mean square). Navy modeling also predicts zero exposures of olive ridley sea turtles to impulsive acoustic stressors greater than 120 dB or 150 dB. Noise from infrequent and short duration munition firing and low density of moving vessels and aircraft are not reasonably expected to co-occur with the rare olive ridley sea turtle. Olive ridley sea turtles would be need to be within 198 m of electromagnetic devices to detect it and potentially respond to it behaviorally. Given the rarity of this species in the Action Area it is not reasonable to expect olive ridley sea turtles to be exposed to electromagnetic (energy) stressors. The Navy's mitigation measures to avoid collisions (lookouts and "safe speed" procedures) and the rarity of olives ridley sea turtles in the Action Area indicate it is not reasonable to expect this species to collide with vessels in the Action Area. Similarly, the rarity of this species and the low speed of non-vessel in-water devices and small footprint of military expended materials indicate it is not reasonable to expect collisions with either of these stressor sources. Fiber optic cables, guidance wires, and decelerators/parachutes used by the Navy are designed to sink quickly. Fiber optic cables do not form loops and break easily reducing the likelihood of entanglement. Guide wires, which are very thin and of a relatively low breaking strength, are used only in deep waters. After sinking to the ocean bottom these wires, would break down within 2 years and no longer pose any risk. Decelerators and parachutes are also used over deep water where sea turtles are not expected to be foraging. Given the limited time entanglement stressors will be present in the water column, the low break-strength and looping ability of fiber optic cables, and the use of these materials over deep water indicates it is not reasonable to expect entranglement of olive ridley sea turtles to occur. The ingestion of small and medium caliber projectiles and other military expended materials is not likely to occur because olive ridley sea turtles are rare in the Action Area and most expendable materials are used over deeper waters where this species is not expected to forage, therefore the ingestion of expended materials is not reasonably expected to occur. Given the rarity of this species it is not reasonable to expect they would be exposed to secondary stressors such as explosion byproducts, metals, chemicals, or exposure to disease.

We conclude that annual training and testing activities in the MITT Action Area are not likely to adversely affect the olive ridley sea turtle in a given year or cumulatively into the reasonably foreseeable future due to a lack of potential for exposure to stressors. Since we anticipate olive ridley sea turtle occurrence to be rare and the potential for exposure to stressors from training and testing activities would be discountable, we do not consider this species further in this Opinion.

4.1.2 Acropora retusa

Colonies of *Acropora retusa* are flat plates with short, thick finger-like branches. Branches look rough and spiky because radial corallites are variable in length. Colonies are typically brown or green in color. *Acropora retusa* is easily confused with other digitate *Acropora* species. It can be distinguished from *Acropora globiceps*, *Acropora gemmifera*, *Acropora monticulosa*, *Acropora macrostomata*, and most other digitate *Acropora* by the rough, spiky branch surfaces due to variable length radial corallites. It can be distinguished from *Acropora humilis* and *Acropora cophodactyla* by the small, tubular, axial corallite. It can be distinguished from *Acropora branchi* by thicker branches when *Acropora branchi* has branches at all (79 FR 53852).

4.1.2.1 Distribution and Abundance

Acropora retusa is distributed from the Red Sea and the Indian Ocean to the central Pacific. Veron (2014) reported that this species is confirmed in 23 of his 133 Indo-Pacific ecoregions, and strongly predicted to be found in an additional 21. Wallace (1999b) reports its occurrence in five of her 29 Indo-Pacific areas, many of which are larger than Veron's ecoregions. Richards (2009) estimated its range at 68 million km^2. Within U.S. waters, this species is confirmed in American Samoa, Guam, and the PRIA. (http://www.fpir.noaa.gov/PRD/prd_coral.html).

Veron (2014) reports that *Acropora retusa* occupied 0.5 percent of 2,984 dive sites sampled in 30 ecoregions of the Indo-Pacific, and had a mean abundance rating of 1.21 on a 1 to 5 rating scale at those sites in which it was found. Based on this semi-quantitative system, the species' abundance was characterized as ''rare.'' Overall abundance was described as ''common in South Africa, rare elsewhere.'' Veron did not infer trends in abundance from these data. According to the Final Rule (79 FR 53852), *Acropora retusa's* absolute abundance is at least millions of colonies at the time of listing.

Within the Mariana Islands, *Acropora retusa* is confirmed in Guam, but not in CNMI (NMFS 2015 "Listed Corals in the Indo-Pacific: *Acropora retusa*, 4 p."). On Guam, a recent review of available coral survey data from numerous sites around the island showed *Acropora retusa* at only one location. Several surveys were conducted within Apra Harbor, but the species was not found there (NMFS/PIRO/HCD Guam coral database, 2015).

4.1.2.2 Habitat

Acropora retusa inhabits shallow water upper reef slopes and tidal pools. It has been reported from depths of 1 to 5 m (79 FR 53852) and down to 11 m (D. Fenner, personal communication, 2015).

4.1.2.3 Reproduction and Growth

Little is known of reproduction and growth in *Acropora retusa*. The available genus-level information for *Acropora* is the best available information, as provided in the *Acropora*

globiceps status (Section 4.2.11.3) . *Acropora retusa* is a hermaphroditic spawner with lecithotrophic (yolk-sac) larvae (79 FR 53852).

4.1.2.4 Status and trends

Acropora retusa was listed as threatened on September 10, 2014 (79 FR 53851). The abundance of *A. retusa* has likely declined over the past 50 to 100 years although a precise quantification is not possible based on the limited species specific information. The species is highly susceptible to ocean warming, and is susceptible to coral disease, ocean acidification, trophic effects of fishing, nutrients over-enrichment, and predation, all of which have increased in the past 50 to 100 years, and continue to increase throughout much of its range. *Acropora retusa*'s geographic distribution extends from the Red Sea and Indian Ocean to the central Pacific. Its depth range is at least zero to 5 meters in upper reef slopes, reef flats, and adjacent habitats. Its absolute abundance is at least millions of colonies across its range. While spatial variability of threats such as ocean warming and acidification across the species' range moderates vulnerability because many colonies are either not exposed to threats or do not negatively respond to a threat at any given point in time, the threats are increasing and will continue to increase in the foreseeable future, thus the species is expected to continue to decline. However, there is inadequate data to quantify current and future population status and trends on any spatial scale, let alone across the range of the species (79 FR 53852).

4.1.2.5 Natural threats

Of the nine primary threats to reef-building corals (ocean warming, coral disease, ocean acidification, sedimentation, nutrients, trophic effects of fishing, sea-level rise, predation, and collection and trade), only predation is considered a natural threat. Due to the lack of species-specific information on the susceptibility of *Acropora retusa*to predation, we summarize the available information on this threat to *Acropora* species in general: The studies cited in the Status Review Report (Brainard et al. 2011b) and Final Rule (79 FR 53852) on predation in *Acropora* report that predators such as crown-of-thorns starfish and *Drupella* snails prefer to eat *Acropora* over other genera. Thus, the available information suggests that *Acropora globiceps* is likely to have some susceptibility to predation (79 FR 53852).

4.1.2.6 Anthropogenic threats

Of the nine primary threats to reef-building corals (ocean warming, coral disease, ocean acidification, sedimentation, nutrients, trophic effects of fishing, sea-level rise, predation, and collection and trade), all but predation are considered anthropogenic threats. Due to the lack of species-specific information on the susceptibilities of *Acropora retusa*to these threats, we summarize the available information for *Acropora* species in general.

Based on the information from the Status Review Report (Brainard et al. 2011b) and Final Rule (79 FR 53852), we make the following inferences regarding the susceptibilities of an unstudied *Acropora* species to these eight anthropogenic threats. For ocean warming, nearly all the studies cited on thermal stress in *Acropora* report high levels of bleaching in response to warming events. Thus, it is possible to predict that an unstudied *Acropora* species is likely to be highly susceptible to warming-induced bleaching, as long as some considerations are kept in mind: (1) Despite high overall susceptibility within the genus to warming-induced bleaching, there can be high variability between species and habitats (Done et al. 2003); (2) colonies that bleach do not necessarily die (in general, *Acropora* species have higher post-bleaching mortality than corals as

a whole, but there is high variability in response throughout the genus); (3) recovery from bleaching provides the mechanism for acclimatization; and (4) while most *Acropora* species readily bleach in response to warming events, most also have the capacity to reestablish local populations relatively quickly through their rapid growth and asexual reproduction capacity.

Diseases are generally more common in *Acropora* than other coral genera, although there are numerous documented exceptions, depending on location. These studies also demonstrate high variability in disease susceptibility across *Acropora* species, depending on growth form, with wide divergence of disease susceptibilities among colony morphological groups under the same conditions. Thus, it is possible to predict that an unstudied *Acropora* species is likely to have some susceptibility to disease. The studies cited above on ocean acidification in *Acropora* report impacts on skeletal growth rates. Thus, it is possible to predict that an unstudied *Acropora* species is likely to have some susceptibility to ocean acidification in terms of impacts on skeletal growth. Most studies on the effects of land-based sources of pollution suggest that an unstudied *Acropora* species is likely to have some susceptibility to sedimentation and nutrient enrichment. The trophic effects of fishing alters trophic interactions by reducing herbivory on algae by removal of herbivorous fish from coral reef systems by fishing, thereby providing a competitive advantage for space to algae over coral. An unstudied *Acropora* species is likely to have some susceptibility to the trophic effects of fishing. Because *Acropora* are not generally sediment-tolerant and are faster growing species, an unstudied *Acropora* species is likely to have some susceptibility to sea-level rise. Because *Acropora* species are some of the most popular coral species to collect and trade, an unstudied *Acropora* species is likely to have some susceptibility to collection and trade.

According to the Status Review Report (Brainard et al. 2011b) and Final Rule (79 FR 53852), there is little if any species-specific information on the susceptibilities of *Acropora globiceps* to threats. However, based on genus-level information, we infer that *Acropora retusa* is likely to be highly susceptible to ocean warming and to have some susceptibility to disease, acidification, sedimentation, nutrients, trophic effects of fishing, sea-level rise, and collection and trade (79 FR 53852).

4.1.2.7 Critical habitat

The NMFS has not designated critical habitat for *Acropora retusa*.

4.1.2.8 Conclusion

Acropora retusa is only known to occur at a single location within the MITT Action Area. This location is in Fouha Bay in southwestern Guam, away from MITT activities. As such, it is unlikely MITT activities will occur within close proximity of adult *Acropora retusa* colonies or that the planktonic eggs, sperm, embryos, or larvae of this species would coincide with MITT activities. Therefore, adverse effects to *Acropora retusa* resulting from MITT activities are not reasonbably expected to occur and are discountable.

4.1.3 *Seriatopora aculeata*

Colonies of *Seriatopora aculeata* have pencil-thick, short, branches which taper sharply at the end, usually in fused clumps. Colonies are pink or cream in color. *S. aculeata* can easily be confused with *Seriatopora stellata*, which also has branches which taper sharply at the end,

however, in *S. stellata* corallites on branch sides are in rows and raised, while on *S. aculeata* they are not (79 FR 53852).

4.1.3.1 Distribution and Abundance

Seriatopora aculeata is distributed from Australia, Fiji, Indonesia, Japan, Papua New Guinea, and Madagascar to the Marshall Islands. Veron reports that *S. aculeata* is confirmed in 19 of his 133 Indo-Pacific ecoregions, and strongly predicted to be found in an additional seven. Within U.S. waters, this species is confirmed in Guam and CNMI (http://www.fpir.noaa.gov/PRD/prd_coral.html). According to the Final Rule (79 FR 53852) *S. aculeata*'s absolute abundance is at least millions of colonies at the time of listing.

Veron (2014) reports that *S. aculeata* occupied 10.3 percent of 2,984 dive sites sampled in 30 ecoregions of the Indo-Pacific, and had a mean abundance rating of 1.70 on a 1 to 5 rating scale at those sites in which it was found. Based on this semi-quantitative system, the species' abundance was characterized as ''common,'' and overall abundance was described as ''uncommon.'' Veron did not infer trends in abundance from these data.

Within the Mariana Islands, *S. aculeata* is confirmed in both Guam and CNMI (NMFS 2015 "Listed Corals in the Indo-Pacific: *Seriatopora aculeata*, 4 p."). On Guam, a recent review of available coral survey data from numerous sites around the island showed *S. aculeata* at two locations around the island. Several surveys were conducted within Apra Harbor, but the species was not found there (NMFS/PIRO/HCD Guam coral database, 2015). In CNMI, coral survey data shows *S. aculeata* on reef slopes at numerous sites around Saipan (Douglas Fenner, personal communication, 2015).

4.1.3.2 Habitat

S. aculeata generally inhabits the reef slope and back-reef, including but not limited to upper reef slopes, mid-slope terraces, lower reef slopes, reef flats, and lagoons. Around Guam it is known to occur along exposed seaward reef slopes with good water circulation and low sedimentation, although it is also found in areas with high sedimentation rates. It is reported from depths of 3 to 40 m (79 FR 53852).

4.1.3.3 Reproduction and Growth

The reproductive characteristics of *Seriatopora aculeata* have not been determined, but its congeners are hermaphroditic brooders. The larvae of the other *Seriatopora* species studied contain zooxanthellae, leading to the development of autotrophic larvae that can supplement maternal provisioning with energy sources provided by their photosynthetic symbionts. The minimum size and estimated age at first reproduction have not been determined for *Seriatopora aculeata*. However, for the congener *Seriatopora hystrix*, the minimum diameter is 8 cm and the estimated age at first reproduction is 1 to 2 years. Larval longevity has not been determined in this genus. *Seriatopora hystrix* can undergo polyp bailout during environmentally stressful conditions and successfully reattach (though at low rates) to the substrate; however, this potential mode of asexual reproduction has not been documented for *Seriatopora aculeata* (Brainard et al, 2011). Little is known of *S. aculeata*'s life history. The much more common species, *S. hystrix*, is a simultaneous hermaphrodite that reproduces sexually via brooded larvae (79 FR 53852).

4.1.3.4 Status and trends

S. aculeata was listed as threatened on September 10, 2014 (79 FR 53851). The abundance of *S. aculeata* has likely declined over the past 50 to 100 years although a precise quantification is not possible based on the limited species specific information (79 FR 53852). The species is highly susceptible to ocean warming, and is susceptible to disease, ocean acidification, trophic effects of fishing, sedimentation, nutrients, sea-level rise, predation, and collection and trade, all of which have increased in the past 50 to 100 years, and continue to increase throughout much of its range. *S. aculeata* is distributed from Madagascar to the Marshall Islands. Its depth range is 3 to 40 meters, and it occurs in a broad range of habitats on the reef slope and back-reef. Its absolute abundance is at least millions of colonies across its range. While spatial variability of threats such as ocean warming and acidification across the species' range moderates vulnerability because many colonies are either not exposed to threats or do not negatively respond to a threat at any given point in time, the threats are increasing and will continue to increase in the foreseeable future, thus the species is expected to continue to decline. However, there is inadequate data to quantify current and future population status and trends on any spatial scale, let alone across the range of the species (79 FR 53852).

4.1.3.5 Natural threats

Of the nine primary threats to reef-building corals (ocean warming, coral disease, ocean acidification, sedimentation, nutrients, trophic effects of fishing, sea-level rise, predation, and collection and trade), only predation is considered a natural threat. Due to the lack of species-specific information on the susceptibility of *S. aculeata* to predation, we summarize the available information on this threat to *Seriatopora* species in general: The studies cited in the Status Review Report (Brainard et al. 2011b) and Final Rule (79 FR 53852) on predation in *Seriatopora* report that the genus *Seriatopora* is susceptible to predation by *Drupella* snails and crown-of-thorns starfish. Thus, the available information suggests that *S. aculeata* is likely to have some susceptibility to predation (79 FR 53852).

4.1.3.6 Anthropogenic threats

Of the nine primary threats to reef-building corals (ocean warming, coral disease, ocean acidification, sedimentation, nutrients, trophic effects of fishing, sea-level rise, predation, and collection and trade), all but predation are considered anthropogenic threats. Due to the lack of species-specific information on the susceptibilities of *S. aculeata* to these threats, we summarize the available information for *Seriatopora* species in general.

Based on the information from the Status Review Report (Brainard et al. 2011b) and Final Rule (79 FR 53852), we make the following inferences regarding the susceptibilities of an unstudied *Seriatopora* species to these eight anthropogenic threats. For ocean warming, nearly all the studies cited on thermal stress in *Seriatopora* report high levels of bleaching in response to warming events. Thus, it is possible to predict that an unstudied *Seriatopora* species is likely to be highly susceptible to warming-induced bleaching, as long as some considerations are kept in mind: (1) Despite high overall susceptibility within the genus to warming-induced bleaching, there can be high variability between species and habitats (Done et al. 2003); (2) colonies that bleach do not necessarily die (in general, *Seriatopora* species have higher post-bleaching mortality than corals as a whole, but there is high variability in response throughout the genus); (3) recovery from bleaching provides the mechanism for acclimatization; and (4) while most *Seriatopora* species readily bleach in response to warming events, most also have the capacity to

reestablish local populations relatively quickly through their rapid growth and asexual reproduction capacity.

Seriatopora species have been reported to be susceptible to one disease but not to another, and to have disease in one area and not in another. Diseases are generally more common in *Acropora* than other coral genera, although there are numerous documented exceptions, depending on location. Thus, it is possible to predict that an unstudied *Seriatopora* species is likely to have some susceptibility to disease. There is no information available on the effects of any other threat for *Seriatopora* species. The Status Review Report (Brainard et al. 2011b) concluded that ocean acidification, sedimentation, nutrients, trophic effects of fishing, and sea-level rise all have significant effects on corals, and so we conclude that *Seriatopora* has some susceptibility to them. *Seriatopora* is heavily traded, thus we conclude that *Seriatopora* has some susceptibility to collection and trade.

According to the Status Review Report (Brainard et al. 2011b) and Final Rule (79 FR 53852), there is little if any species-specific information on the susceptibilities of *S. aculeata* to threats. However, based on genus-level information, we infer that *S. aculeata* is likely to be highly susceptible to ocean warming and to have some susceptibility to disease, acidification, sedimentation, nutrients, trophic effects of fishing, sea-level rise, and collection and trade (79 FR 53852).

4.1.3.7 Critical habitat

The NMFS has not designated critical habitat for *S. aculeata*.

4.1.3.8 Conclusion

Seriatopora aculeata is only known to occur at a single location within the MITT Action Area. This location is in southwestern Guam, away from MITT activities. As such, it is unlikely MITT activities will occur within close proximity of adult *S. aculeata* colonies or that the planktonic eggs, sperm, embryos, or larvae of this species would coincide with MITT activities. Therefore, adverse effects to *S. aculeata* resulting from MITT activities are not reasonbably expected to occur and are discountable.

4.2 Listed Species Considered Further in this Opinion

Based on the anticipated exposure and response of species to stressors, we identified endangered and threatened species or critical habitat that are likely to be adversely affected by proposed MITT activities.

This section of our Opinion consists of narratives for each of the threatened and endangered species that occur in the Action Area and that may be adversely affected by Navy activities in the MITT Action Area. In each narrative, we present a summary of information on each species to provide a foundation for the exposure analyses that appear later in this opinion. We present information on the diving and social behavior of the different species because that behavior helps determine whether aerial and ship board surveys are likely to detect each species. We also summarize information on the vocalizations and hearing of the different species because that background information lays the foundation for our assessment of the how the different species are likely to respond to sounds produced by the Navy's training exercises and testing activities. Then we summarize information on the threats to the species and the species' status given those

threats to provide points of reference for the jeopardy determinations we make later in this opinion. That is, we rely on a species' status and trend to determine whether or not an action's direct or indirect effects are likely to increase the species' probability of becoming extinct.

4.2.1 Blue Whale

The blue whale, *Balaenoptera musculus* (Linnæus 1758), is a cosmopolitan species of baleen whale. It is the largest animal ever known to have lived on Earth: adults in the Antarctic have reached a maximum body length of about 33 m (108 ft) and can weigh more than 150,000 kg (330,700 lbs). The largest blue whales reported from the North Pacific are a female that measured 26.8 m (88 ft) taken at Port Hobron in 1932 (Reeves et al. 1985) and a 27.1 m (89 ft) female taken by Japanese pelagic whaling operations in 1959 (NMFS 1998c).

As is true of other baleen whale species, female blue whales are somewhat larger than males. Blue whales are identified by the following characteristics: a long-body and comparatively slender shape; a broad, flat "rostrum" when viewed from above; a proportionately smaller dorsal fin than other baleen whales; and a mottled gray color pattern that appears light blue when seen through the water. Blue whales may reach 70 to 80 years of age (COSEWIC 2002b; Yochem and Leatherwood 1985b).

4.2.1.1 Distribution

Blue whales inhabit all oceans and typically occur near the coast, over the continental shelf, although they are also found in oceanic waters. Blue whales are highly mobile, and their migratory patterns are not well known (Perry et al. 1999; Reeves et al. 2004). Blue whales migrate toward the warmer waters of the subtropics in the fall to reduce energy costs, avoid ice entrapment, and reproduce (NMFS 1998a).

4.2.1.2 Population Structure

For this and all subsequent species, the term "population" refers to groups of individuals whose patterns of increase or decrease in abundance over time are determined by internal dynamics (births resulting from sexual interactions between individuals in the group and deaths of those individuals) rather than external dynamics (immigration or emigration). This definition is a reformulation of definitions articulated by Futuymda (1986) and Wells and Richmond (1995) and is more restrictive than those uses of 'population' that refer to groups of individuals that co-occur in space and time but do not have internal dynamics that determine whether the size of the group increases or decreases over time (see review by Wells and Richmond 1995). The definition we apply is important to section 7 consultations because such concepts as 'population decline,' 'population collapse,' 'population extinction,' and 'population recovery' apply to the restrictive definition of 'population' but do not explicitly apply to alternative definitions. As a result, we do not treat the different whale "stocks" recognized by the International Whaling Commission or other authorities as populations unless those distinctions were clearly based on demographic criteria. We do, however, acknowledge those "stock" distinctions in these narratives.

At least three subspecies of blue whales have been identified based on body size and geographic distribution (*B. musculus intermedia*, which occurs in the higher latitudes of the Southern Oceans, *B. m. musculus*, which occurs in the Northern Hemisphere, and *B. m. brevicauda* which occurs in the mid-latitude waters of the southern Indian Ocean and north of the Antarctic

convergence), but this consultation will treat them as a single entity. Readers who are interested in these subspecies will find more information in Gilpatrick et al. (1997), Kato et al. (1995), Omura et al. (1970), and Ichihara (1966).

Until recently, blue whale population structure had not been tested using molecular or nuclear genetic analyses (Reeves et al. 1998). A recent study by Conway (2005) suggested that the global population could be divided into four major subdivisions, which roughly correspond to major ocean basins: eastern North and tropical Pacific Ocean, Southern Indian Ocean, Southern Ocean, and western North Atlantic Ocean. The eastern North/tropical Pacific Ocean subpopulation includes California, western Mexico, western Costa Rica, and Ecuador, and the western North Pacific Ocean subpopulation (including blue whales in the MITT Action Area) (Conway 2005). Genetic studies of blue whales occupying a foraging area south of Australia (most likely pygmy blue whales) have been found to belong to a single population (Attard et al. 2010). For this Opinion, blue whales are treated as four distinct populations as outlined by Conway (2005).

Blue whales occur widely throughout the North Pacific. Acoustic monitoring has recorded blue whales off Oahu and the Midway Islands, although sightings or strandings in Hawaiian waters have not been reported (Barlow et al. 1997a; Northrop et al. 1971; Thompson and Friedl 1982a). Nishiwaki (1966) notes blue whale occurrence among the Aleutian Islands and in the Gulf of Alaska, but until recently, no one has sighted a blue whale in Alaska for some time, despite several surveys (Carretta et al. 2005; Forney and Brownell Jr. 1996a; Leatherwood et al. 1982c; Stewart et al. 1987), possibly supporting a return to historical migration patterns (Anonmyous. 2009).

Blue whales are thought to summer in high latitudes and move into the subtropics and tropics during the winter (Yochem and Leatherwood 1985b). Minimal data suggest whales in the western region of the North Pacific may summer southwest of Kamchatka, south of the Aleutians, and in the Gulf of Alaska, and winter in the lower latitudes of the western Pacific (Sea of Japan, the East China, Yellow, and Philippine seas) and less frequently in the central Pacific, including Hawaii (Carretta et al. 2005; Stafford 2003a; Stafford et al. 2001a; Watkins et al. 2000), although this population is severely depleted or has been extirpated (Gilpatrick and Perryman. 2009). However, acoustic recordings made off Oahu showed bimodal peaks of blue whales, suggesting migration into the area during summer and winter (McDonald and Fox 1999; Thompson and Friedl 1982a).

Blue whales from both the eastern and western North Pacific have been heard, tracked, or harvested in waters off Kodiak Island; acoustic detections are made in the Gulf of Alaska from mid-July to mid-December and a peak from August through November (COSEWIC 2002a; Ivashin and Rovnin. 1967; Moore et al. 2006; Stafford 2003b; Stafford et al. 2007; Yochem and Leatherwood 1985a). Although acoustic detections in the Gulf of Alaska were absent since the late 1960s, recordings have increased during 1999 to 2002 and a few sightings have been made in the northern Gulf of Alaska (Calambokidis et al. 2009; Moore et al. 2006; NOAA 2004; Stafford 2003b; Stafford et al. 2007; Stafford and Moore 2005a). However, surveys in the western Gulf of Alaska and east of Kodiak Island have not found blue whales (Rone et al. 2010; Zerbini et al. 2006). Blue whales are rarely observed in nearshore Alaskan waters, but seem to prefer continental shelf edge waters; such areas in the Gulf of Alaska were formerly feeding

grounds for blue whales prior to severe depletion (Rice and Wolman. 1982). Call detections of blue whales from the western North Pacific indicate a greater likelihood of these individual occurring southwest of Kodiak Island (Stafford 2003b).

4.2.1.3 Reproduction

Gestation takes 10 to 12 months, followed by a 6 to 7 month nursing period. Sexual maturity occurs at 5 to 15 years of age and calves are born at 2 to 3 year intervals (COSEWIC 2002b; NMFS 1998b; Yochem and Leatherwood 1985b). Recent data from illegal Russian whaling for Antarctic and pygmy blue whales support sexual maturity at 23 m and 19 to 20 m, respectively (Branch and Mikhalev 2008). The mean intercalving interval in the Gulf of California is roughly two and a half years (Sears et al. 2014). Once mature, females return to the same areas where they were born to give birth themselves (Sears et al. 2014).

4.2.1.4 Movement

Blue whales are highly mobile, and their migratory patterns are not well known (Perry et al. 1999; Reeves et al. 2004). Blue whales migrate toward the warmer waters of the subtropics in fall to reduce energy costs, avoid ice entrapment, and reproduce (NMFS 1998a). Satellite tagging indicates that, for blue whales tagged off Southern California, movement is more linear and faster (3.7 km/h) while traveling versus while foraging (1.7 km/h)(Bailey et al. 2009). Residency times in what are likely prey patches averages 21 days and constituted 29 percent of an individual's time overall, although foraging could apparently occur at any time of year for tagged individuals (Bailey et al. 2009). Broad scale movements also varied greatly, likely in response to oceanographic conditions influencing prey abundance and distribution (Bailey et al. 2009). Blue whales along Southern California were found to be traveling 85 percent of the time and milling 11 percent (Bacon et al. 2011).

4.2.1.5 Feeding

Data indicate that some summer feeding takes place at low latitudes in upwelling-modified waters, and that some whales remain year-round at either low or high latitudes (Clarke and Charif 1998a; Hucke-Gaete et al. 2004; Reilly and Thayer 1990; Yochem and Leatherwood 1985b). One population feeds in California waters from June to November and migrates south in winter/spring (Calambokidis et al. 1990; Mate et al. 1999). Prey availability likely dictates blue whale distribution for most of the year (Burtenshaw et al. 2004b; Clapham et al. 1999; Sears 2002 as cited in NMFS 2006a). The large size of blue whales requires higher energy requirements than smaller whales and potentially prohibits fasting Mate et al. (1999). Krill are the primary prey of blue whales in the North Pacific (Kawamura 1980; Yochem and Leatherwood 1985b). Blue whales typically occur alone or in groups of up to five animals, although larger foraging aggregations of up to 50 have been reported including aggregations mixed with other rorquals such as fin whales (Corkeron et al. 1999; Shirihai 2002). While feeding, blue whales show slowed and less obvious avoidance behavior then when not feeding (Sears et al. 1983 as cited in NMFS 2005c). Barlow (2003) reported mean group sizes of 1.0 to 1.9 during surveys off California, Oregon, and Washington.

4.2.1.6 Diving and Social Behavior

Blue whales spend more than 94 percent of their time underwater (Lagerquist et al. 2000). Generally, blue whales dive 5 to 20 times at 12 to 20 sec intervals before a deep dive of 3 to 30 min (Croll et al. 1999a; Leatherwood et al. 1976; Maser et al. 1981; Yochem and Leatherwood

1985a). Average foraging dives are 140 m deep and last for 7.8 min (Croll et al. 2001a). Non-foraging dives are shallower and shorter, averaging 68 m and 4.9 min (Croll et al. 2001a). However, dives of up to 300 m are known (Calambokidis et al. 2003). Nighttime dives are generally shallower (50 m).

Blue whales occur singly or in groups of two or three (Aguayo 1974; Mackintosh 1965; Nemoto 1964; Pike and Macaskie 1969; Ruud 1956; Slijper 1962). However, larger foraging aggregations, even with other species such as fin whales, are regularly reported (Corkeron et al. 1999; Fiedler et al. 1998; Schoenherr 1991; Shirihai 2002). Little is known of the mating behavior of blue whales. The primary and preferred diet of blue whales is krill (euphausiids).

Satellite tagging indicates that, for blue whales tagged off Southern California, movement is more linear and faster (3.7 km/h) while traveling versus while foraging (1.7 km/h)(Bailey et al. 2009). Residency times in what are likely prey patches averages 21 days and constituted 29 percent of an individual's time overall, although foraging could apparently occur at any time of year for tagged individuals (Bailey et al. 2009). Broad scale movements also varied greatly, likely in response to oceanographic conditions influencing prey abundance and distribution (Bailey et al. 2009). Blue whales along Southern California were found to be traveling 85 percent of the time and milling 11 percent (Bacon et al. 2011). While feeding, blue whales show slowed and less obvious avoidance behavior then when not feeding (Sears et al. 1983 as cited in NMFS 2005c). In review of a 24-year blue whale sighting history, Sears et al. (Sears et al. 2013) documented a link between female blue whales sighted in the Gulf of California and the U.S. West Coast, although the authors suggest that only some of the U.S. West Coast blue whales migrate to the Gulf of California.

4.2.1.7 Vocalization and Hearing

Blue whales produce prolonged low-frequency vocalizations that include moans in the range from 12.5 to 400 Hz, with dominant frequencies from 16 to 25 Hz, and songs that span frequencies from 16 to 60 Hz that last up to 36 seconds repeated every 1 to 2 minutes (see McDonald et al. 1995). Berchok et al. (2006b) examined vocalizations of St. Lawrence blue whales and found mean peak frequencies ranging from 17.0 to 78.7 Hz. Reported source levels are 180 to 188 dB re 1µPa, but may reach 195 dB re 1µPa (Aburto et al. 1997b; Clark and Gagnon 2004; Ketten 1998; McDonald et al. 2001a). Samaran et al. (2010) estimated Antarctic blue whale calls in the Indian Ocean at 179 ± 5 dB re 1 μPa_{rms} -1 m in the 17 to 30 Hz range and pygmy blue whale calls at 175± 1 dB re 1 μPa_{rms} -1 m in the 17 to 50 Hz range.

As with other baleen whale vocalizations, blue whale vocalization function is unknown, although numerous hypotheses exist (maintaining spacing between individuals, recognition, socialization, navigation, contextual information transmission, and location of prey resources) (Edds-Walton 1997; Payne and Webb. 1971; Thompson et al. 1992). Intense bouts of long, patterned sounds are common from fall through spring in low latitudes, but these also occur less frequently while in summer high-latitude feeding areas. Short, rapid sequences of 30 to 90 Hz calls are associated with socialization and may be displays by males based upon call seasonality and structure. The low-frequency sounds produced by blue whales can, in theory, travel long distances, and it is possible that such long-distance communication occurs (Edds-Walton 1997; Payne and Webb. 1971). The long-range sounds may also be used for echolocation in orientation or navigation (Tyack 1999).

Cetaceans have an auditory anatomy that follows the basic mammalian pattern, with some modifications to adapt to the demands of hearing in the sea. The typical mammalian ear is divided into the outer ear, middle ear, and inner ear. The outer ear is separated from the inner ear by the tympanic membrane, or eardrum. In terrestrial mammals, the outer ear, eardrum, and middle ear function to transmit airborne sound to the inner ear, where the sound is detected in a fluid. Since cetaceans already live in a fluid medium, they do not require this matching, and thus do not have an air-filled external ear canal. The inner ear is where sound energy is converted into neural signals that are transmitted to the central nervous system via the auditory nerve. Acoustic energy causes the basilar membrane in the cochlea to vibrate. Sensory cells at different positions along the basilar membrane are excited by different frequencies of sound (Tyack 1999). Baleen whales have inner ears that appear to be specialized for low-frequency hearing. In a study of the morphology of the mysticete auditory apparatus, Ketten (1997b) hypothesized that large mysticetes have acute infrasonic hearing.

Blue whale vocalizations tend to be long (>20 s), low-frequency (<100 Hz) signals (Thomson and Richardson 1995), with a range of 12 to 400 Hz and dominant energy in the infrasonic range of 12 to 25 Hz (Ketten 1998; McDonald et al. 2001b; Mellinger and Clark 2003). Vocalizations are predominantly songs and calls. Blue whale calls have high acoustic energy, with reports of 186 to 188 dB re 1 µPa-m (Cummings and Thompson 1971; McDonald et al. 2001b) and 195 dB re 1 µPa-m (Aburto et al. 1997a) source levels. Calls are short-duration sounds (2 to 5 s) that are transient and frequency-modulated, having a higher frequency range and shorter duration than song units and often sweeping down in frequency (80 to 30Hz), with seasonally variable occurrence.

Blue whale songs consist of repetitively patterned sounds produced over time spans of minutes to hours, or even days (Cummings and Thompson 1971; McDonald et al. 2001b). The songs are divided into pulsed/tonal units, which are continuous segments of sound, and phrases, which are repeated combinations of 1 to 5 units (Mellinger and Clark 2003; Payne and McVay 1971). A song is composed of many repeated phrases. Songs can be detected for hundreds, and even thousands of kilometers (Stafford et al. 1998), and have only been attributed to males (McDonald et al. 2001b; Oleson et al. 2007a). Worldwide, songs are showing a downward shift in frequency (Mcdonald et al. 2009). For example, a comparison of recordings from November 2003 and November 1964 and 1965 reveals a long-term shift in the frequency of blue whale calling near San Nicolas Island. In 2003, the spectral energy peak was 16 Hz compared to ~22.5 Hz in 1964 and 1965, illustrating a more than 30 percent shift in call frequency over four decades (McDonald et al. 2006b). McDonald et al. (2009) observed a 31 percent downward frequency shift in blue whale calls off the coast of California, and also noted lower frequencies in 7 of the world's 10 known blue whale songs originating in the Atlantic, Pacific, Southern, and Indian Oceans. Many possible explanations for the shifts exist, but none have emerged as the probable cause.

Although general characteristics of blue whale calls are shared in distinct regions (McDonald et al. 2001b; Mellinger and Clark 2003; Rankin et al. 2005; Thompson et al. 1996), some variability appears to exist among different geographic areas (Rivers 1997). Sounds in the North Atlantic have been confirmed to have different characteristics (i.e., frequency, duration, and repetition) than those recorded in other parts of the world (Berchok et al. 2006a; Mellinger and Clark 2003). Clear differences in call structure suggestive of separate populations for the western

and eastern regions of the North Pacific have also been reported (Stafford et al. 2001b); however, some overlap in calls from these geographically distinct regions have been observed, indicating that the whales may have the ability to mimic calls (Stafford and Moore 2005b).

In Southern Califronia, blues whales produce two predominant call types: Type B and D. B-calls are stereotypic of the blue whale population found in the eastern North Pacific (McDonald et al. 2006b) and are produced exclusively by males and associated with mating behavior (Oleson et al. 2007a). These calls have long durations (20 sec) and low frequencies (10 to 100 Hz); they are produced either as repetitive sequences (song) or as singular calls. The B call has a set of harmonic tonals, and may be paired with a pulsed type A call. Blue whale D calls are down-swept in frequency (100 to 40 Hz) with duration of several seconds. These calls are similar worldwide and are associated with feeding animals; they may be produced as call- counter call between multiple animals (Oleson et al. 2007c). In the SOCAL Range Complex region, D calls are produced in highest numbers during the late spring and early summer, and in diminished numbers during the fall, when A-B song dominates blue whale calling (Hildebrand et al. 2011; Hildebrand et al. 2012; Oleson et al. 2007d).

Calling rates of blue whales tend to vary based on feeding behavior. Stafford et al. (2005b) recorded the highest calling rates when blue whale prey was closest to the surface during its vertical migration. Wiggins et al. (2005) reported the same trend of reduced vocalization during daytime foraging followed by an increase at dusk as prey moved up into the water column and dispersed. Blue whales make seasonal migrations to areas of high productivity to feed, and vocalize less at the feeding grounds than during migration (Burtenshaw et al. 2004a). Oleson et al. (2007d) reported higher calling rates in shallow diving (<100 ft) whales, while deeper diving whales (>165 ft) were likely feeding and calling less.

Direct studies of blue whale hearing have not been conducted, but it is assumed that blue whales can hear the same frequencies that they produce (low-frequency) and are likely most sensitive to this frequency range (Ketten 1997a; Richardson et al. 1995c). Based on vocalizations and anatomy, blue whales are assumed to predominantly hear low-frequency sounds below 400 Hz (Croll et al. 2001b) (Croll et al. 2001c; Oleson et al. 2007d; Stafford and Moore 2005b). In terms of functional hearing capability, blue whales belong to the low-frequency group, which have a hearing range of 7 Hz to 22 kHz (Southall et al. 2007b).

Nevertheless, recent studies indicate that blue whales can hear and respond to sounds in the mid-frequency range. Nineteen controlled exposure experiments were conducted on blue whales during the Southern California-10 behavorial response study (Southall et al. 2011a) and 13 in the Southern California-11 behavorial response study (Southall et al. 2012). Both controlled exposure experiments simulated exposure to Navy MFA sonar. Behavioral response was observed in some blue whales and consisted primarily of small changes in dive behavior and general avoidance of the sound source. Preliminary assessments showed behavior appearing to return to baseline shortly after the transmissions ended, however, it is possible that the changes observed were a direct response to the transmission or some other unknown or un-analyzed factors (Southall et al. 2012). During other controlled exposure experiments, blue whales responded to a mid-frequency sound source, with a source level between 160 to 210 dB re 1 µPa at 1 m and a received sound level up to 160 dB re 1 µPa, by exhibiting generalized avoidance responses and changes to dive behavior (Goldbogen et al. 2013). However, reactions were

temporary and were not consistent across individuals based on received sound levels alone. Results were likely the result of a complex interaction between sound exposure factors such as proximity to sound source and sound type (mid-frequency sonar simulation vs. pseudo-random noise), environmental conditions, and behavioral state. Surface feeding whales did not show a change in behavior during controlled exposure experiments, but deep feeding and non-feeding whales showed temporary reactions that often quickly abated after sound exposure. Distances of the sound source from the whales during controlled exposure experiments were sometimes less than a mile. Melcón et al. (2012) tested whether MFA sonar and other anthropogenic noises in the mid-frequency band affected the "D-calls" produced by blue whales in the Southern California Bight. The likelihood of an animal calling decreased with the increased received level of mid-frequency sonar, beginning at a sound pressure level of approximately 110 to 120 dB re 1 µPa. It is not known whether the lower rates of calling actually indicated a reduction in feeding behavior or social contact since the study used data from remotely deployed, passive acoustic monitoring buoys.

4.2.1.8 Status and Trends

Blue whales (including all subspecies) were originally listed as endangered in 1970 (35 FR 18319), and this status has continued since the inception of the ESA in 1973. Blue whales are also listed as endangered on the IUCN Red List of Threatened Animals (IUCN 2010) and are protected by the Convention on International Trade in Endangered Species of wild flora and fauna and the MMPA. Critical habitat has not been designated for blue whales.

It is difficult to assess the current status of blue whales globally because (1) there is no general agreement on the size of the blue whale population prior to whaling and (2) estimates of the current size of the different blue whale populations vary widely. We may never know the size of the blue whale population in the North Pacific prior to whaling, although some authors have concluded that their population numbered about 200,000 animals before whaling. Similarly, estimates of the global abundance of blue whales are uncertain. Since the cessation of whaling, the global population of blue whales has been estimated to range from 11,200 to 13,000 animals (Maser et al. 1981). These estimates, however, are more than 20 years old.

Estimates of blue whale abundance in the North Pacific are uncertain. Prior to whaling, Gambell (1976) reported there may have been as many as 4,900 blue whales. Blue whales were hunted in the Pacific Ocean, where 5,761 were killed from 1889 to 1965 (Perry et al. 1999). This estimate does not account for under-reporting by Soviet whalers, who took approximately 800 more individuals than were reported (Ivashchenko et al. 2013). The IWC banned commercial whaling in the North Pacific in 1966, although Soviet whaling continued after the ban. Although blue whale abundance has likely increased since its protection in 1966, the possibility of unauthorized harvest by Soviet whaling vessel, incidental ship strikes, and gillnet mortalities make this uncertain. Punt (2010) estimated the rate of increase for blue whales in the eastern North Pacific to be 3.2 percent annually (1.4 SE) between 1991 and 2005, while Calambokidis et al. (2010) estimated a growth rate of 3 percent annually.

To our knowledge, there have been no recent sightings of blue whales in the Action Area. The closest documented sighting occurred in 1995 near Cocos (Brent Tibbatts, pers. comm., June 25, 2013, as cited in Uyeyama (2014)). The Pacific Islands Fisheries Science Center has deployed high-frequency acoustic recording packages (HARPS) to monitor marine mammals in the U.S.

Exclusive Economic Zone (EEZ) around the CNMI. These monitors have acoustically detected blue whales (Oleson et al. 2013), though given the long distance blue whale calls can travel it is not known if the animals were actually within the Action Area. With the exception of sightings by observers on fishing vessels (Carretta et al. 2011), there have been no sightings of blue whales during systematic surveys off Hawaii (Barlow 2006; Mobley Jr. et al. 2000), and no blue whales were detected during a 2007 winter survey of the Action Area nor during Navy-funded monitoring for the MIRC in 2009 through 2015 (Fulling et al. 2011; HDR 2011; HDR 2012a; Hill et al. 2013; Hill et al. 2011; Ligon et al. 2011; Oleson and Hill 2010) . The Navy's NMSDD estimates 0.00001 blue whales per km^2 in the MITT Action Area (DoN 2014).

4.2.1.9 Natural Threats

As the world's largest animals, blue whales are only occasionally known to be killed by killer whales (Sears et al. 1990; Tarpy 1979). Blue whales engage in a flight response to evade killer whales, which involves high energetic output, but show little resistance if overtaken (Ford and Reeves 2008). Blue whales are known to become infected with the nematode *Carricauda boopis*, which are believed to have caused mortality in fin whale due to renal failure (Lambertsen 1986).

4.2.1.10 Anthropogenic Threats

Blue whales have faced threats from several historical and current sources. Blue whale populations are severely depleted originally due to historical whaling activity.

Increasing oceanic noise may impair blue whale behavior. Although available data do not presently support traumatic injury from sonar, the general trend in increasing ambient low-frequency noise in the deep oceans of the world, primarily from ship engines, could impair the ability of blue whales to communicate or navigate through these vast expanses (Aburto et al. 1997c; Clark 2006). Blue whales off California altered call levels and rates in association with changes in local vessel traffic (Mckenna 2011).

To date, there has not been a ship strike as a result of Navy training and testing activities in the Study Area; however, ship strike is a concern for balaenopterids in the North Pacific. In the California/Mexico stock of blue whales, annual incidental mortality due to ship strikes averaged one whale every 5 years, but we cannot determine if this reflects the actual number of blue whales struck and killed by ships (i.e., individuals not observed when struck and those who do not strand; Barlow et al. (1997a)). Ship strikes have recently averaged roughly one every other year (eight ship strike incidents are known (Jensen and Silber 2004)), but in September 2007, ships struck five blue whales within a few-day period off southern California (Calambokidis personal communication 2008)(Berman-Kowalewski et al. 2010). Dive data support a surface-oriented behavior during nighttime that would make blue whales particularly vulnerable to ship strikes during this time. Ship strikes were implicated in the deaths of five blue whales, from 2004 to 2008 (Carretta et al. 2012). Four of these deaths occurred in 2007, the highest number recorded for any year. During 2004 to 2008, there were an additional eight injuries of unidentified large whales attributed to ship strikes. Several blue whales have been photographed in California with large gashes in their dorsal surface that appear to be from ship strikes (J. Calambokidis, personal communication). Blue whale mortality and injuries attributed to ship strikes in California waters averaged 1.0 per year for 2004 to 2008. Ship strike is an issue for blue whales of Sri Lanka engaged in foraging in shipping lanes, with several individuals stranding or being found with evidence of being struck (De Vos et al. 2013; Ilangakoon 2012).

There is a paucity of contaminant data regarding blue whales. Available information indicates that organochlorines, including dichloro-diphenyl-trichloroethane (DDT), polychlorinated biphenyls (PCB), benzene hexachloride (HCH), hexachlorobenzene (HCB), chlordane, dieldrin, methoxychlor, and mirex have been isolated from blue whale blubber and liver samples (Gauthier et al. 1997b; Metcalfe et al. 2004). Contaminant transfer between mother and calf occurs, meaning that young often start life with concentrations of contaminants equal to their mothers, before accumulating additional contaminant loads during life and passing higher loads to the next generation (Gauthier et al. 1997a; Metcalfe et al. 2004). This is supported by ear plug data showing maternal transfer of pesticides and flame retardants in the first year of life (Trumble et al. 2013). These data also support pulses of mercury in body tissues of the male studied (Trumble et al. 2013).

4.2.1.11 Critical Habitat

The NMFS has not designated critical habitat for blue whales.

4.2.2 Fin Whale

The fin whale, *Balaenoptera physalus* (Linnæus 1758), is a cosmopolitan species of baleen whale (Gambell 1985b). Fin whales are the second-largest whale species by length. Fin whales are long-bodied and slender, with a prominent dorsal fin set about two-thirds of the way back on the body. The streamlined appearance can change during feeding when the pleated throat and chest area becomes distended by the influx of prey and seawater, giving the animal a tadpole-like appearance. The basic body color of the fin whale is dark gray dorsally and white ventrally, but the pigmentation pattern is complex. The lower jaw is gray or black on the left side and creamy white on the right side. This asymmetrical coloration extends to the baleen plates as well, and is reversed on the tongue. Individually distinctive features of pigmentation, along with dorsal fin shapes and body scars, have been used in photo-identification studies (Agler et al. 1990). Fin whales can be found in social groups of 2 to 7 whales. Aguilar and Lockyer (1987) suggested annual natural mortality rates in northeast Atlantic fin whales may range from 0.04 to 0.06. This is supported by an estimated annual survival rate of 0.955 for Gulf of St. Lawrence fin whales (Ramp et al. 2014). Fin whales live 70 to 80 years (Kjeld et al. 2006b).

4.2.2.1 Distribution

Fin whales are distributed widely in every ocean except the Arctic Ocean. In the North Atlantic Ocean, fin whales occur in summer foraging areas from the coast of North America to the Arctic, around Greenland, Iceland, northern Norway, Jan Meyen, Spitzbergen, and the Barents Sea. In the western Atlantic, they winter from the edge of sea ice south to the Gulf of Mexico and the West Indies. In the eastern Atlantic, they winter from southern Norway, the Bay of Biscay, and Spain with some whales migrating into the Mediterranean Sea (Gambell 1985b).

In the Southern Hemisphere, fin whales are distributed broadly south of 50°S in the summer and migrate into the Atlantic, Indian, and Pacific Oceans in the winter, along the coast of South America (as far north as Peru and Brazil), Africa, and the islands in Oceania north of Australia and New Zealand (Gambell 1985b).

Fin whales undertake migrations from low-latitude winter grounds to high-latitude summer grounds and extensive longitudinal movements both within and between years (Mizroch et al. 1999a). Fin whales are sparsely distributed during November through April, from 60° N, south to

the northern edge of the tropics, where mating and calving may take place (Mizroch et al. 1999a). However, fin whales have been sighted as far as 60° N throughout winter (Mizroch et al. 1999b). A resident fin whale population may exist in the Gulf of California (Tershy et al. 1993).

Fin whales are observed year-round off central and southern California with peak numbers in the summer and fall (Barlow 1997; Campbell et al. 2015; Dohl et al. 1983; Forney et al. 1995a). Peak numbers are seen during the summer off Oregon, and in summer and fall in the Gulf of Alaska and southeastern Bering Sea (Moore et al. 2000; Perry et al. 1999). Fin whales are observed feeding in Hawaiian waters during mid-May, and their sounds have been recorded there during the autumn and winter (Balcomb 1987; Northrop et al. 1968; Shallenberger 1981; Thompson and Friedl 1982a). They have been recorded at Nihoa and other areas of the NWHI in the winter and spring months (Meigs et al. 2013). Fin whales in the western Pacific winter in the Sea of Japan, the East China, Yellow, and Philippine seas (Gambell 1985a).

The distribution of fin whales in the Pacific during the summer includes the northern area of the Hawaii portion of the Action Area to 32° N off the coast of California (Barlow 1995b; Forney et al. 1995b). Fin whales are relatively abundant in north Pacific offshore waters, including the Hawaii portion of the Action Area (Berzin and Vladimirov 1981; Mizroch et al. 2009). Fin whales have been recorded in the eastern tropical Pacific (Ferguson 2005) and are frequently sighted there during offshore ship surveys.

Locations of breeding and calving grounds for the fin whale are unknown, but it is known that the whales typically migrate seasonally to higher latitudes every year to feed and migrate to lower latitudes to breed (Kjeld et al. 2006a; Macleod et al. 2006). The fin whale's ability to adapt to areas of high productivity controls migratory patterns (Canese et al. 2006; Reeves et al. 2002). Fin whales are one of the fastest cetaceans, capable of attaining speeds of 25 mi. (40.2 km) per hour (Jefferson et al. 2008; Marini et al. 1996).

In the North Pacific Ocean, fin whales occur in summer foraging areas in the Chukchi Sea, the Sea of Okhotsk, around the Aleutian Islands, and the Gulf of Alaska; in the eastern Pacific, they occur south to California; in the western Pacific, they occur south to Japan. Fin whales in the eastern Pacific winter from California south; in the western Pacific, they winter from the Sea of Japan, the East China and Yellow Seas, and the Philippine Sea (Gambell 1985b). The overall distribution may be based on prey availability. Fin whales are larger and faster than humpback and right whales and are less concentrated in nearshore environments.

4.2.2.2 Population Structure

Fin whales have two recognized subspecies: *Balaoptera physalus physalus* occurs in the North Atlantic Ocean while *B. p. quoyi* (Fischer 1829) occurs in the Southern Ocean. A third possible subspecies occurs off South America (Archer et al. 2013; Gray 1865; Van Waerebeek and Engblom 2007). Globally, fin whales are sub-divided into three major groups: Atlantic, Pacific, and Antarctic. Within these major areas, different organizations use different population structure.

In the North Pacific Ocean, the International Whaling Commission recognizes two "stocks": (1) East China Sea and (2) rest of the North Pacific (Donovan 1991). However, Mizroch et al. (1984a) concluded that there were five possible "stocks" of fin whales within the North Pacific

based on histological analyses and tagging experiments: (1) East and West Pacific that intermingle around the Aleutian Islands; (2) East China Sea; (3) British Columbia; (4) Southern-Central California to Gulf of Alaska; and (5) Gulf of California. Based on genetic analyses, Berube et al. (1998) concluded that fin whales in the Sea of Cortez represent an isolated population that has very little genetic exchange with other populations in the North Pacific Ocean (although the geographic distribution of this population and other populations can overlap seasonally). They also concluded that fin whales in the Gulf of St. Lawrence and Gulf of Maine are distinct from fin whales found off Spain and in the Mediterranean Sea.

Regardless of how different authors structure the fin whale population, mark-recapture studies have demonstrated that individual fin whales migrate between management units (Mitchell 1974a; Sigurjonsson et al. 1989), which suggests that these management units are not geographically isolated populations.

Mizroch et al. (1984a) identified five fin whale "feeding aggregations" in the Pacific Ocean: (1) an eastern group that move along the Aleutians, (2) a western group that move along the Aleutians (Berzin and Rovnin 1966; Nasu 1974b); (3) an East China Sea group; (4) a group that moves north and south along the west coast of North America between California and the Gulf of Alaska (Rice 1974a); and (5) a group centered in the Sea of Cortez (Gulf of California).

4.2.2.3 Reproduction

Fin whales reach sexual maturity between 5–15 years of age (COSEWIC 2005; Gambell 1985a; Lockyer 1972). Mating and calving occurs primarily from October-January, gestation lasts approximately 11 months, and nursing occurs for 6 to 11 months (Boyd et al. 1999; Hain et al. 1992). The average calving interval in the North Atlantic is estimated at about 2 to 3 years (Agler et al. 1993; Christensen et al. 1992). The location of winter breeding grounds is uncertain but mating is assumed to occur in pelagic mid-latitude waters (Perry et al. 1999). This was recently contradicted by acoustic surveys in the Davis Strait and off Greenland, where singing by fin whales peaked in November through December; the authors suggested that mating may occur prior to southbound migration (Simon et al. 2010). Although seasonal migration occurs between presumed foraging and breeding locations, fin whales have been acoustically detected throughout the North Atlantic Ocean and Mediterranean Sea year-round, implying that not all individuals follow a set migratory pattern (Notarbartolo-Di-Sciara et al. 1999; Simon et al. 2010). (Notarbartolo-Di-Sciara et al. 1999; Simon et al. 2010)(Notarbartolo-Di-Sciara et al. 1999; Simon et al. 2010)Reductions in pregnancy rates appear correlated with reduced blubber thickness and prey availability (Williams et al. 2013). Recent IWC scientific whaling data suggest that, compared to commercial whaling periods, preganancy rates have decreased, age at sexual maturity has increased, size growth is slowing, and males now compose a slightly higher proportion of the population than female (Gunnlaugsson et al. 2013).

4.2.2.4 Feeding

Most fin whales in the Southern Hemisphere migrate seasonally from Antarctic feeding areas in the summer to low-latitude breeding and calving grounds in winter. Fin whales in the North Atlantic eat pelagic crustaceans (mainly krill and schooling fish such as capelin, herring, and sand lance (Borobia and Béland 1995; Christensen et al. 1992; Hjort and Ruud 1929; Ingebrigtsen 1929; Jonsgård 1966; Mitchell 1974b; Overholtz and Nicolas 1979; Sergeant 1977; Shirihai 2002; Watkins et al. 1984). In the North Pacific, fin whales also prefer euphausiids and

large copepods, followed by schooling fish such as herring, walleye pollock, and capelin (Kawamura 1982a; Kawamura 1982b; Ladrón De Guevara et al. 2008; Nemoto 1970; Paloma et al. 2008). Fin whales frequently forage along cold eastern current boundaries (Perry et al. 1999). Antarctic fin whales feed on krill, *Euphausia superba*, which occurs in dense near-surface schools (Nemoto 1959). However, off the coast of Chile, fin whales are known to feed on the euphausiid *E. mucronata* (Antezana 1970; Perez et al. 2006). Feeding may occur in waters as shallow as 10 m when prey are at the surface, but most foraging is observed in high-productivity, upwelling, or thermal front marine waters (Gaskin 1972; Nature Conservancy Council 1979 as cited in ONR 2001; Panigada et al. 2008; Sergeant 1977). While foraging, fin whales in the Mediterranean Sea have been found to move through restricted territories in a convoluted manner (Lafortuna et al. 1999). Fin whales in the central Tyrrhenian Sea appear to ephemerally exploit the area for foraging during summer, particularly areas of high primary productivity (Arcangeli et al. 2013).

4.2.2.5 Diving and Social Behavior

The amount of time fin whales spend at the surface varies. Some authors have reported that fin whales make 5 to 20 shallow dives, each of 13 to 20 s duration, followed by a deep dive of 1.5 to 15 min (Gambell 1985a; Lafortuna et al. 2003; Stone et al. 1992). Other authors have reported that the fin whale's most common dives last 2 to 6 min (Hain et al. 1992; Watkins 1981b). The most recent data support average dives of 98 m and 6.3 min for foraging fin whales, while non-foraging dives are 59 m and 4.2 min (Croll et al. 2001a). However, Lafortuna et al. (1999) found that foraging fin whales have a higher blow rate than when traveling. Foraging dives in excess of 150 m are known (Panigada et al. 1999).

Fin whales along Southern California were found to be traveling 87 percent of the time and milling 5 percent in groups that averaged 1.7 individuals (Bacon et al. 2011). Most fin whales in the Southern Hemisphere migrate seasonally from Antarctic feeding areas in the summer to low-latitude breeding and calving grounds in winter. Fin whales tend to avoid tropical and pack-ice waters, with the high-latitude limit of their range set by ice and the lower-latitude limit by warm water of approximately 15° C (Sergeant 1977). Fin whale concentrations generally form along frontal boundary, or mixing zones between coastal and oceanic waters, which corresponds roughly to the 200 m isobath (the continental shelf edge) (Cotte et al. 2009; Nasu 1974a).

4.2.2.6 Vocalization and Hearing

Fin whales produce a variety of low-frequency sounds in the 10 Hz to 200 Hz range (Edds 1988; Thompson et al. 1992; Watkins 1981c; Watkins et al. 1987). Typical vocalizations are long, patterned pulses of short duration (0.5 to 2 s) in the 18 Hz to 35 Hz range, but only males are known to produce these (Clark et al. 2002; Patterson and Hamilton 1964). Richardson et al. (1995c) reported the most common sound as a 1 second vocalization of about 20 Hz, occurring in short series during spring, summer, and fall, and in repeated stereotyped patterns in winter. Au (Au and Green 2000) reported moans of 14 Hz to 118 Hz, with a dominant frequency of 20 Hz, tonal vocalizations of 34 Hz 150 Hz, and songs of 17 Hz to 25 Hz (Cummings and Thompson 1994; Edds 1988; Watkins 1981c). Source levels for fin whale vocalizations are 140 to 200 dB re 1µPa-m (see also Clark and Gagnon 2004; as compiled by Erbe 2002b). The source depth of calling fin whales has been reported to be about 50 m (Watkins et al. 1987).

Although their function is still in doubt, low-frequency fin whale vocalizations travel over long distances and may aid in long-distance communication (Edds-Walton 1997; Payne and Webb. 1971). During the breeding season, fin whales produce pulses in a regular repeating pattern, which have been proposed to be mating displays similar to those of humpbacks (Croll et al. 2002). These vocal bouts last for a day or longer (Tyack 1999).

The inner ear is where sound energy is converted into neural signals that are transmitted to the central nervous system via the auditory nerve. Acoustic energy causes the basilar membrane in the cochlea to vibrate. Sensory cells at different positions along the basilar membrane are excited by different frequencies of sound (Tyack 1999). Baleen whales have inner ears that appear to be specialized for low-frequency hearing. In a study of the morphology of the mysticete auditory apparatus, Ketten (1997b) hypothesized that large mysticetes have acute infrasonic hearing. In a study using computer tomography scans of a calf fin whale skull, Cranford and Krysl (2015) found sensitivy to a broad range of frequencies between 10 Hz and 12 kHz and a maximum sensitivity to sounds in the 1 kHz to 2 kHz range.

Direct studies of fin whale hearing have not been conducted, but it is assumed that fin whales can hear the same frequencies that they produce (low) and are likely most sensitive to this frequency range (Ketten 1997a; Richardson et al. 1995c).

Fin whales produce a variety of low frequency (< 1 kHz) sounds, but the most typically recorded is a 20 Hz pulse lasting about 1 second, and reaching source levels of 189 ± 4 dB re 1 µPam (Charif et al. 2002; Clark et al. 2002; Edds 1988; Richardson et al. 1995c; Sirovic et al. 2007; Watkins 1981c; Watkins et al. 1987). These pulses frequently occur in long sequenced patterns, are down swept (e.g., 23 to 18 Hz), and can be repeated over the course of many hours (Watkins et al. 1987). In temperate waters, intense bouts of these patterned sounds are very common from fall through spring, but also occur to a lesser extent during the summer in high latitude feeding areas (Clarke and Charif 1998b). The seasonality and stereotypic nature of these vocal sequences suggest that they are male reproductive displays (Watkins 1981c; Watkins et al. 1987); a notion further supported by recent data linking these vocalizations to male fin whales only (Croll et al. 2002). In Southern California, the 20 Hz pulses are the dominant fin whale call type associated both with call-counter-call between multiple animals and with singing (Navy 2010; Navy 2012). An additional fin whale sound, the 40 Hz call described by Watkins (1981c), was also frequently recorded, although these calls are not as common as the 20 Hz fin whale pulses. Seasonality of the 40 Hz calls differed from the 20 Hz calls, since 40 Hz calls were more prominent in the spring, as observed at other sites across the northeast Pacific (Sirovic et al. 2012). Source levels of Eastern Pacific fin whale 20-Hz calls has been reported as 189 +/- 5.8 dB re 1uPa at 1m (Weirathmueller et al. 2013). Although acoustic recordings of fin whales from many diverse regions show close adherence to the typical 20 Hz bandwidth and sequencing when performing these vocalizations, there have been slight differences in the pulse patterns, indicative of some geographic variation (Thompson et al. 1992; Watkins et al. 1987).

Responses to conspecific sounds have been demonstrated in a number of mysticetes, and there is no reason to believe that fin whales do not communicate similarly (Edds-Walton 1997). The low-frequency sounds produced by fin whales have the potential to travel over long distances, and it is possible that long-distance communication occurs in fin whales (Edds-Walton 1997; Payne and Webb. 1971). Also, there is speculation that the sounds may function for long range

echolocation of large-scale geographic targets such as seamounts, which might be used for orientation and navigation (Tyack 1999).

Although no studies have directly measured the sound sensitivity of fin whales, experts assume that fin whales are able to receive sound signals in roughly the same frequencies as the signals they produce. This suggests fin whales, like other baleen whales, are more likely to have their best hearing capacities at low frequencies, including frequencies lower than those of normal human hearing, rather than at mid- to high-frequencies (Ketten 1997a). Several fin whales were tagged during the Southern California-10 BRS and no obvious responses to a mid-frequency sound source were detected by the visual observers or in the initial tag analysis (Southall et al. 2011a). Results of studies on blue whales (Goldbogen et al. 2013) (Southall et al. 2011a), which have similar auditory physiology compared to fin whales, indicate that some individuals hear some sounds in the mid-frequency range and exhibit behavioral responses to sounds in this range depending on received level and context. In terms of functional hearing capability fin whales belong to the low-frequency group, which have a hearing range of 7 Hz to 22 kHz (Southall et al. 2007b).

4.2.2.7 Status and Trends

Fin whales were originally listed as endangered in 1970 (35 FR 18319), and this status has continued since the inception of the ESA in 1973. Although fin whale population structure remains unclear, various abundance estimates are available. Pre-exploitation fin whale abundance is estimated at 464,000 individuals worldwide; the estimate for 1991 was roughly 25 percent of this (Braham 1991). Historically, worldwide populations were severely depleted by commercial whaling, with more than 700,000 whales harvested in the twentieth century (Cherfas 1989). The most recent abundance estimates for fin whales that we are aware of are 16,625 individuals in the North Pacific Ocean and 119,000 individuals worldwide (Braham 1991). Fin whales of the north Pacific appear to be increasing in abundance although the trend is unclear or declining thoughout the rest of their range (NMFS 2011a).

Based on ecological theory and demographic patterns derived from several hundred imperiled species and populations, fin whales appear to exist at population sizes that are large enough to avoid demographic phenomena that are known to increase the extinction probability of species that exist as “small” populations (that is, “small” populations experience phenomena such as demographic stochasticity, inbreeding depression, and Allee effects, among others, that cause their population size to become a threat in and of itself). As a result, we assume that fin whales are likely to be threatened more by exogenous threats such as anthropogenic activities (primarily whaling, entanglement, and ship strikes) or natural phenomena (such as disease, predation, or changes in the distribution and abundance of their prey in response to changing climate) than endogenous threats caused by the small size of their population.

Fin whales are typically not expected south of 20°N during summer and are less likely to occur near Guam (Miyashita et al. 1996). Miyashita et al. (1996) presented a compilation of at-sea sighting results by species, from commercial fisheries vessels in the Pacific Ocean from 1964 to 1990. For fin whales in August, Miyashita et al. (1996) reported no sightings south of 20°N, and significantly more sightings north of 40°N. However, they also showed limited search effort south of 20°N. There were no fin whale sightings during the winter 2007 survey of the Action Area (Fulling et al. 2011)nor during Navy-funded monitoring for the MIRC in 2009 through

2013 (HDR 2011; HDR 2012a; Hill et al. 2013; Hill et al. 2011; Ligon et al. 2011; Oleson and Hill 2010). The Pacific Islands Fisheries Science Center has deployed several passive acoustic monitoring devices to monitor marine mammals and ambient noise levels in U.S. EEZ waters off the Mariana Islands. Recordings from these instruments are currently being analyzed, but it has been confirmed that fin whales have been acoustically detected (Oleson et al. 2013). The Navy's NMSDD estimates 0.00001 fin whales per km^2 in the MITT Action Area (DoN 2014).

4.2.2.8 Natural Threats

Natural sources and rates of mortality are largely unknown, but Aguilar and Lockyer (1987) suggested annual natural mortality rates might range from 0.04 to 0.06 for northeast Atlantic fin whales. The occurrence of the nematode *Crassicauda boopis* appears to increase the potential for kidney failure and may be preventing some fin whale populations from recovering (Lambertsen 1992). Adult fin whales engage in a flight responses (up to 40 km/h) to evade killer whales, which involves high energetic output, but show little resistance if overtaken (Ford and Reeves 2008). Shark attacks may also result in serious injury or death in very young and sick individuals (Perry et al. 1999).

4.2.2.9 Anthropogenic Threats

Fin whales have undergone significant exploitation, but are currently protected under the IWC. Fin whales are still hunted in subsistence fisheries off West Greenland. In 2003, two males and four females were landed and two others were struck and lost (IWC 2005). In 2004, five males and six females were killed, and two other fin whales were struck and lost. Between 2003 and 2007, the IWC set a catch limit of up to 19 fin whales in this subsistence fishery. However, the scientific recommendation was to limit the number killed to four individuals until accurate populations could be produced (IWC 2005). In the Antarctic Ocean, fin whales are hunted by Japanese whalers who have been allowed to kill up to 10 fin whales each year for the 2005 to 2006 and 2006 to 2007 seasons under an Antarctic Special Permit NMFS (2006c). Japanese whalers plan to kill 50 whales per year starting in the 2007 to 2008 season and continuing for the next 12 years (IWC 2006; Nishiwaki et al. 2006).

Fin whales experience significant injury and mortality from fishing gear and ship strikes (Carretta et al. 2007; Douglas et al. 2008; Lien 1994; Perkins and Beamish 1979; Waring et al. 2007a). Between 1969 and 1990, 14 fin whales were captured in coastal fisheries off Newfoundland and Labrador; of these seven are known to have died because of capture (Lien 1994; Perkins and Beamish 1979). According to Waring et al. (2007a), four fin whales in the western North Atlantic died or were seriously injured in fishing gear, while another five were killed or injured as a result of ship strikes between January 2000 and December 2004. Between 1999 and 2005, there were 15 reports of fin whales strikes by vessels along the U.S. and Canadian Atlantic coasts (Cole et al. 2005a; Nelson et al. 2007a). Of these, 13 were confirmed, resulting in the deaths of 11 individuals. Similarly, 2.4 percent of living fin whales from the Mediterranean show ship strike injury and 16 percent of stranded individuals were killed by vessel collision (Panigada et al. 2006). There are also numerous reports of ship strikes off the Atlantic coasts of France and England (Jensen and Silber 2004).

Management measures aimed at reducing the risk of ships hitting right whales should also reduce the risk of collisions with fin whales. In the Bay of Fundy, recommendations for slower vessel speeds to avoid right whale ship strike appear to be largely ignored (Vanderlaan et al. 2008).

However, new rules for seasonal (June through December) slowing of vessel traffic to 10 knots and changing shipping lanes by less than one nautical mile to avoid the greatest concentrations of right whales are predicted to be capable of reducing fin whale ship strike mortality by 27 percent in the Bay of Fundy region. Jensen and Silber's (2004) review of the NMFS' ship strike database revealed fin whales as the most frequently confirmed victims of ship strikes (26 percent of the recorded ship strikes [n = 75/292 records]), with most collisions occurring off the east coast, followed by the west coast of the U.S. and Alaska/Hawaii. Five of seven fin whales stranded along Washington State and Oregon showed evidence of ship strike with incidence increasing since 2002 (Douglas et al. 2008). From 1994 to 1998, two fin whales were presumed killed by ship strikes. More recently, in 2002, three fin whales were struck and killed by vessels in the eastern North Pacific (Jensen and Silber 2003c).

The vast majority of ship strike mortalities are never identified, and actual mortality is higher than currently documented; however, it is Navy policy to report all ship strikes.

Increased noise in the ocean stemming from shipping seems to alter the acoustic patterns of singing fin whales, possibly hampering reproductive parameters across wide regions (Castellote et al. 2012b).

The organochlorines DDE, DDT, and PCBs have been identified from fin whale blubber, but levels are lower than in toothed whales due to the lower level in the food chain that fin whales feed at (Aguilar and Borrell 1988; Borrell 1993; Borrell and Aguilar 1987; Henry and Best 1983; Marsili and Focardi 1996). Females contained lower burdens than males, likely due to mobilization of contaminants during pregnancy and lactation (Aguilar and Borrell 1988; Gauthier et al. 1997a; Gauthier et al. 1997b). Contaminant levels increase steadily with age until sexual maturity, at which time levels begin to drop in females and continue to increase in males (Aguilar and Borrell 1988).

Climate change also presents a potential threat to fin whales, particularly in the Mediterranean Sea, where fin whales appear to rely exclusively upon northern krill as a prey source. These krill occupy the southern extent of their range and increases in water temperature could result in their decline and that of fin whales in the Mediterranean Sea (Gambaiani et al. 2009).

4.2.2.10 Critical Habitat

The NMFS has not designated critical habitat for fin whales.

4.2.3 Humpback Whale

Humpback whales (*Megaptera novaeangliae*) are distinguished from other whales in the same Family (Balaenopteridae) by extraordinarily long flippers (up to 5 m or about 1/3 total body length), a more robust body, fewer throat grooves (14 to 35), more variable dorsal fin, and utilization of very long (up to 30 min.), complex, repetitive vocalizations (songs) (Payne and McVay 1971) during courtship. Their grayish-black baleen plates, approximately 270 to 440 on each side of the jaw, are intermediate in length (6570 cm) to those of other baleen whales. Humpbacks in different geographical areas vary somewhat in body length, but maximum recorded size is 18m (Winn and Reichley 1985a).

The whales are generally dark on the back, but the flippers, sides and ventral surface of the body and flukes may have substantial areas of natural white pigmentation plus acquired scars (white or

black). Researchers distinguish individual humpbacks by the apparently unique black and white patterns on the underside of the flukes as well as other individually variable features (Glockner and Venus 1983; Katona and Whitehead 1981; Kaufman and Osmond 1987).

4.2.3.1 Distribution

Humpback whales are a cosmopolitan species that occur in the Atlantic, Indian, Pacific, and Southern oceans. Humpback whales migrate seasonally between warmer, tropical or sub-tropical waters in winter months (where they breed and give birth to calves, although feeding occasionally occurs) and cooler, temperate or sub-Arctic waters in summer months (where they feed). In both regions, humpback whales tend to occupy coastal waters. However, migrations are undertaken through deep, pelagic waters (Winn and Reichley 1985a).

In the eastern and central North Pacific Ocean, the summer range of humpback whales includes coastal and inland waters from Point Conception, California, north to the Gulf of Alaska and the Bering Sea, and west along the Aleutian Islands to the Kamchatka Peninsula and into the Sea of Okhotsk (Tomlin 1967, Nemoto 1957, Johnson and Wolman 1984 as cited in NMFS 1991). These whales migrate to calving grounds near Hawaii, southern Japan, the Mariana Islands, and Mexico during the winter months.

4.2.3.2 Population Structure

Though the ESA-listed entity is the worldwide population of humpback whales, some evidence suggests there may be multiple distinct populations within the North Pacific Ocean. Descriptions of the population structure of humpback whales differ depending on whether an author focuses on where humpback whales winter or where they feed. During winter months in northern or southern hemispheres, adult humpback whales migrate to specific areas in warmer, tropical waters to reproduce and give birth to calves. During summer months, humpback whales migrate to specific areas in northern temperate or sub-arctic waters to forage. In summer months, humpback whales from different "reproductive areas" will congregate to feed; in the winter months, whales will migrate from different foraging areas to a single wintering area. In either case, humpback whales appear to form "open" populations; that is, populations that are connected through the movement of individual animals.

Based on genetic and photo-identification studies, Hill and DeMaster (1998a) recognized four stocks, likely corresponding to populations of humpback whales in the North Pacific Ocean: two in the eastern North Pacific, one in the central North Pacific, and one in the western Pacific (Hill and DeMaster 1998a). However, gene flow between them may exist. Humpback whales summer in coastal and inland waters from Point Conception, California, north to the Gulf of Alaska and the Bering Sea, and west along the Aleutian Islands to the Kamchatka Peninsula and into the Sea of Okhotsk (Johnson and Wolman 1984; Nemoto 1957; Tomilin 1967). These whales migrate to Hawaii, southern Japan, the Mariana Islands, and Mexico during winter. However, more northerly penetrations in Arctic waters occur on occasion (Hashagen et al. 2009). The central North Pacific population winters in the waters around Hawaii while the eastern North Pacific population (also called the California-Oregon-Washington stock) winters along Central America and Mexico. However, Calambokidis et al. (1997) identified individuals from several populations wintering (and potentially breeding) in the areas of other populations, highlighting the potential fluidity of population structure. Herman (1979) presented extensive evidence that humpback whales associated with the main Hawaiian Islands immigrated there only in the past

200 years. Winn and Reichley (1985a) identified genetic exchange between the humpback whales that winter off Hawaii and Mexico (with further mixing on feeding areas in Alaska) and suggested that humpback whales that winter in Hawaii may have emigrated from Mexican wintering areas. A "population" of humpback whales winters in the South China Sea east through the Philippines, Ryukyu Retto, Ogasawara Gunto, Mariana Islands, and Marshall Islands, with occurrence in the Mariana Islands, at Guam, Rota, and Saipan from January through March (Darling and Cerchio 1993; Eldredge 1991; Eldredge 2003; Fulling et al. 2011; Rice 1998). During summer, whales from this population migrate to the Kuril Islands, Bering Sea, Aleutian Islands, Kodiak, Southeast Alaska, and British Columbia to feed (Angliss and Outlaw 2008; Calambokidis 1997; Calambokidis et al. 2001).

Separate feeding groups of humpback whales are thought to inhabit western U.S. and Canadian waters, with the boundary between them located roughly at the U.S./Canadian border. The southern feeding ground ranges between 32° and 48° N, with limited interchange with areas north of Washington State (Calambokidis et al. 2004; Calambokidis et al. 1996). On April 21, 2015, NMFS proposed to divide the globally listed endangered humpback whale population into 14 DPSs (80 FR 22304). Ten of these DPS are not proposed for listing under the ESA while two are proposed as endangered and two are proposed as threatened. The humpback whales in the Action Area belong to the proposed threatened Western North Pacific DPS.

4.2.3.3 Reproduction and Growth

Humpback whale calving and breeding generally occurs during winter at lower latitudes. Gestation takes about 11 months, followed by a nursing period of up to 1 year (Baraff and Weinrich 1993). Sexual maturity is reached at between 5 to 7 years of age in the western North Atlantic, but may take as long as 11 years in the North Pacific, and perhaps over 11 years (e.g., southeast Alaska, Gabriele et al. 2007). Females usually breed every 2 to 3 years, although consecutive calving is not unheard of (Clapham and Mayo 1987; 1990; Glockner-Ferrari and Ferrari 1985 as cited in NMFS 2005b; Weinrich et al. 1993). Males appear to return to breeding grounds more frequently than do females (Herman et al. 2011). Larger females tend to produce larger calves that may have a greater chance of survival (Pack et al. 2009). Females appear to preferentially select larger-sized males (Pack et al. 2012). In some Atlantic areas, females tend to prefer shallow nearshore waters for calving and rearing, even when these areas are extensively trafficked by humans (Picanco et al. 2009). Offspring appear to return to the same breeding areas at which they were born one they are independent (Baker et al. 2013).

In calving areas, males sing long complex songs directed towards females, other males, or both. The breeding season can best be described as a floating lek or male dominance polygamy (Clapham 1996). Calving occurs in the shallow coastal waters of continental shelves and oceanic islands worldwide (Perry et al. 1999). Males court females in escort groups and compete for proximity and presumably access to reproduce females (particularly larger females)(Pack et al. 2009). Although long-term relationships do not appear to exist between males and females, mature females do pair with other females; those individuals with the longest standing relationships also have the highest reproductive output, possibly as a result of improved feeding cooperation (Ramp et al. 2010). Site fidelity off Brazilian breeding grounds was extremely low, both within and between years (Baracho-Neto et al. 2012).

Generation time for humpback whales is estimated at 21.5 years, with individuals surviving from 80-100 years (COSEWIC 2011).

4.2.3.4 Feeding

During the feeding season, humpback whales form small groups that occasionally aggregate on concentrations of food that may be stable for long-periods of times. Humpbacks use a wide variety of behaviors to feed on various small, schooling prey including krill and fish (Hain et al. 1982; Hain et al. 1995; Jurasz and Jurasz 1979; Weinrich et al. 1992; Witteveen et al. 2011). The principal fish prey in the western North Atlantic are sand lance, herring, and capelin (Kenney et al. 1985). There is good evidence of some territoriality on feeding and calving areas (Clapham 1994; Clapham 1996; Tyack 1981). Humpback whales are generally believed to fast while migrating and on breeding grounds, but some individuals apparently feed while in low-latitude waters normally believed to be used exclusively for reproduction and calf-rearing (Danilewicz et al. 2009; Pinto De Sa Alves et al. 2009). Some individuals, such as juveniles, may not undertake migrations at all (Findlay and Best. 1995). Additional evidence, such as songs sung in northern latitudes during winter, provide additional support to plastic seasonal distribution (Smith and G.Pike 2009). Relatively high rates of resighting in foraging sites in suggest whales return to the same areas year after year (Ashe et al. 2013; Kragh Boye et al. 2010). This trend appears to be maternally linked, with offspring returning to the same areas their mother brought them once calves are independent (Baker et al. 2013; Barendse et al. 2013). Humpback whales in foraging areas may forage largely or exclusively at night when prey are closer to the surface while in foraging areas (Friedlaender et al. 2013). Humpback whales primarily feed along the shelf break and continental slope (Green et al. 1992; Tynan et al. 2005b).

4.2.3.5 Diving and Social Behavior

In Hawaiian waters, humpback whales remain almost exclusively within the 1,800 m isobath and usually within water depths of less than 182 m. Maximum diving depths are approximately 170 m (but usually <60 m), with a very deep dive (240 m) recorded off Bermuda (Hamilton et al. 1997). Dives can last for up to 21 min, although feeding dives ranged from 2.1 to 5.1 min in the North Atlantic (Dolphin 1987). In southeast Alaska, average dive times were 2.8 min for feeding whales, 3.0 min for non-feeding whales, and 4.3 min for resting whales (Dolphin 1987). In the Gulf of California, humpback whale dive durations averaged 3.5 min (Strong 1990). Because most humpback prey is likely found within 300 m of the surface, most humpback dives are probably relatively shallow. In Alaska, capelin are the primary prey of humpback and are found primarily between 92 and 120 m; depths to which humpbacks apparently dive for foraging (Witteveen et al. 2008).

Humpback whales migrate seasonally between warmer, tropical or sub-tropical waters in winter months (where they breed and give birth to calves, although feeding occasionally occurs) and cooler, temperate or sub-Arctic waters in summer months (where they feed; (Gendron and Urban 1993). In both regions, humpback whales tend to occupy shallow, coastal waters. However, migrations are undertaken through deep, pelagic waters (Winn and Reichley 1985b). Humpback whales wintering in the West Indies migrate relatively directly to the Gulf of Maine and areas around Iceland and Norway (Kennedy et al. 2013). Some individuals may not migrate, or species occurrence in foraging areas may extend beyond summer months (Van Opzeeland et al. 2013). Average group size near Kodiak Island is 2 to 4 individuals, although larger groups are seen near

Shuyak and Sitkalidak islands and groups of 20 or more have been documented (Wynne et al. 2005).

4.2.3.6 Vocalization and Hearing

Humpback whale vocalization is much better understood than is hearing. Different sounds are produced that correspond to different functions: feeding, breeding, and other social calls (Dunlop et al. 2008). Males sing complex sounds while in low-latitude breeding areas in a frequency range of 20 Hz to 4 kHz with estimated source levels from 144 to 174 dB (Au et al. 2006b; Au et al. 2000b; Frazer and Mercado III 2000; Richardson et al. 1995c; Winn et al. 1970). Males also produce sounds associated with aggression, which are generally characterized as frequencies between 50 Hz to 10 kHz and having most energy below 3 kHz (Silber 1986; Tyack 1983). Such sounds can be heard up to 9 km away (Tyack 1983). Other social sounds from 50 Hz to 10 kHz (most energy below 3 kHz) are also produced in breeding areas (Richardson et al. 1995c; Tyack 1983). While in northern feeding areas, both sexes vocalize in grunts (25 Hz to 1.9 kHz), pulses (25 to 89 Hz), and songs (ranging from 30 Hz to 8 kHz but dominant frequencies of 120 Hz to 4 kHz) which can be very loud (175 to 192 dB re 1 μPa at 1 m) (Au et al. 2000b; Erbe 2002a; Payne 1985; Richardson et al. 1995c; Thompson et al. 1986). However, humpbacks tend to be less vocal in northern feeding areas than in southern breeding areas (Richardson et al. 1995c).

Humpback whales are known to produce three classes of vocalizations: (1) "songs" in the late fall, winter, and spring by solitary males; (2) social sounds made by calves (Zoidis et al. 2008) or within groups on the wintering (calving) grounds; and (3) social sounds made on the feeding grounds (Thomson and Richardson 1995). The best-known types of sounds produced by humpback whales are songs, which are thought to be reproductive displays used on breeding grounds only by adult males (Clark and Clapham 2004; Gabriele and Frankel. 2002; Helweg et al. 1992; Schevill et al. 1964; Smith et al. 2008). Singing is most common on breeding grounds during the winter and spring months, but is occasionally heard in other regions and seasons (Clark and Clapham 2004; Gabriele and Frankel. 2002; McSweeney et al. 1989). Au et al. (2000a) noted that humpbacks off Hawaii tended to sing louder at night compared to the day. There is geographical variation in humpback whale song, with different populations singing a basic form of a song that is unique to their own group. However, the song evolves over the course of a breeding season, but remains nearly unchanged from the end of one season to the start of the next (Payne et al. 1983). The song is an elaborate series of patterned vocalizations that are hierarchical in nature, with a series of songs ('song sessions') sometimes lasting for hours (Payne and McVay 1971). Components of the song range from below 20 Hz up to 4 kHz, with source levels measured between 151 and 189 dB re 1 μPa-m and high-frequency harmonics extending beyond 24 kHz (Au et al. 2006b; Winn et al. 1970).

Social calls range from 20 Hz to 10 kHz, with dominant frequencies below 3 kHz (D'Vincent et al. 1985; Dunlop et al. 2008; Silber 1986; Simao and Moreira 2005). Female vocalizations appear to be simple; Simao and Moreira (2005) noted little complexity.

"Feeding" calls, unlike song and social sounds are a highly stereotyped series of narrow-band trumpeting calls. These calls are 20 Hz to 2 kHz, less than 1 second in duration, and have source levels of 162 to 192 dB re 1 μPa-m (D'Vincent et al. 1985; Thompson et al. 1986). The fundamental frequency of feeding calls is approximately 500 Hz (D'Vincent et al. 1985) (D'Vincent et al. 1985; Thompson et al. 1986). The acoustics and dive profiles associated with

humpback whale feeding behavior in the northwest Atlantic has been documented with Digital Acoustic Recording Tags (DTAGs[5]) (Stimpert et al. 2007). Underwater lunge behavior was associated with nocturnal feeding at depth and with multiple bouts of broadband click trains that were acoustically different from toothed whale echolocation: Stimpert et al. (Stimpert et al. 2007) termed these sounds "mega-clicks" which showed relatively low received levels at the DTAGs (143 to 154 dB re 1 µPa), with the majority of acoustic energy below 2 kHz.

Humpback whale audiograms using a mathematical model based on the internal structure of the ear estimate sensitivity is from 700 Hz to 10 kHz, with maximum relative sensitivity between 2 kHz and 6 kHz (Ketten and Mountain 2014). Previously mentioned research by Au et al. (2001) and Au et al. (2006a) off Hawaii indicated the presence of high-frequency harmonics in vocalizations up to and beyond 24 kHz. While recognizing this was the upper limit of the recording equipment, it does not demonstrate that humpbacks can actually hear those harmonics, which may simply be correlated harmonics of the frequency fundamental in the humpback whale song. The ability of humpbacks to hear frequencies around 3 kHz may have been demonstrated in a playback study. Maybaum (1990) reported that humpback whales showed a mild response to a handheld sonar marine mammal detection and location device with frequency of 3.3 kHz at 219 dB re 1µPa-m or frequency sweep of 3.1 kHz to 3.6 kHz (although it should be noted that this system is significantly different from the Navy's hull mounted sonar). In addition, the system had some low frequency components (below 1 kHz) which may have been an artifact of the acoustic equipment. This possible artifact may have affected the response of the whales to both the control and sonar playback conditions.

Results of studies on blue whales (Goldbogen et al. 2013) (Southall et al. 2011a), which have similar auditory physiology compared to humpback whales, indicate that some individuals hear some sounds in the mid-frequency range and exhibit behavioral responses to sounds in this range depending on received level and context. In terms of functional hearing capability humpback whales belong to low-frequency cetaceans which have a hearing range of 7 Hz to 22 kHz (Southall et al. 2007b).

Humpback whales are the most abundant ESA-listed species observed during Navy visual surveys in the winter months. To date, humpback whales have been documented as the species which has received the highest sound pressure levels from US Navy mid-frequency active sonar (MFAS) training (i.e. at least 183 dB re 1microPa) based upon an analysis which utilized shipboard Marine Mammal Observer sightings on February 18, 2011 (Farak et al. 2011), combined with PMRF range hydrophone data (Martin and Manzano-Roth 2012). Analysis of PMRF range hydrophone data for purpose of estimating received levels on marine mammals has

[5] *DTAG is a novel archival tag, developed to monitor the behavior of marine mammals, and their response to sound, continuously throughout the dive cycle. The tag contains a large array of solid-state memory and records continuously from a built-in hydrophone and suite of sensors. The sensors sample the orientation of the animal in three dimensions with sufficient speed and resolution to capture individual fluke strokes. Audio and sensor recording is synchronous so the relative timing of sounds and motion can be determined precisely Johnson, M. P., and P. L. Tyack. 2003. A digital acoustic recording tag for measuring the response of wild marine mammals to sound. IEEE Journal of Oceanic Engineering 28(1):3-12..*

also been done in conjunction with satellite tagged animals (Baird et al. 2014) and aerial focal follows (Mobley Jr. and Pacini 2013). Passive acoustic monitoring (PAM) of PMRF hydrophones during Navy training for the month of Feb from 2011 to 2013 has shown that acoustically localized minke whales are reduced during periods involving MFAS training activity when compared to other periods of time (Martin et al. 2014) . PAM monitoring for beaked whale foraging dives at PMRF has also shown reduced foraging dive rates during periods of MFAS training with estimated receive levels on the group dive members (mean levels of 109 dB re 1 microPa) in February of 2012 (Manzano-Roth et al. 2013a). Acoustic analysis has also shown that marine mammals near the sea surface can be exposed to higher estimated receive levels due to ducted propagation, that typically exists at PMRF. Analysis of behaviors observed during one focal follow taken during aerial surveys, in conjunction with estimated received levels using PMRF passive acoustic data products, are reported as a case study of a single focal follow on a humpback whale in the vicinity of MFAS (Mobley Jr. and Pacini 2013).

4.2.3.7 Status and Trends

Humpback whales were originally listed as endangered in 1970 (35 FR 18319), and this status remains under the ESA. On April 21, 2015, NMFS proposed to divide the globally listed endangered humpback whale population into 14 DPSs (80 FR 22304). The humpback whales in the Action Area belong to the proposed threatened Western North Pacific DPS.

It is estimated that 15,000 humpback whales resided in the North Pacific in 1905 (Rice 1978a). However, from 1905 to 1965, nearly 28,000 humpback whales were harvested in whaling operations, reducing the number of all North Pacific humpback whale to roughly 1,000 (Perry et al. 1999). The overall abundance of humpback whales in the north Pacific was recently estimated at 21,808 individuals (coefficient of variation = 0.04), confirming that this population of humpback whales has continued to increase and is now greater than some pre-whaling abundance estimates (Barlow et al. 2011). Data indicates the north Pacific population has been increasing at a rate of between 5.5 percent and 6.0 percent per year, therefore approximately doubling every 10 years (Calambokidis et al. 2008a).

Modeled abundance increase in southeastern Alaska was 5.1 percent annually from 1986 to 2008 (Hendrix et al. 2012); a more specific estimate from Glacier Bay, the site of a long-term monitoring study over roughly the same time frame found a rate of increase of 4.4 percent (Saracco et al. 2013). For Asia, an annual rate of growth of 6.7 percent has been estimated (Calambokidis et al. 2008b).

In the Pacific, the stock structure of humpback whales is defined based on feeding areas because of the species' fidelity to feeding grounds (Carretta et al. 2010). The NMFS has designated four stocks for management purposes under the MMPA: (1) the Central North Pacific stock, with feeding areas from Southeast Alaska to the Alaska Peninsula; (2) the Western North Pacific stock, with feeding areas from the Aleutian Islands, Bering Sea, and Russia; (3) the California, Oregon, Washington, and Mexico stock, with feeding areas off the U.S. west coast; and (4) the American Samoa stock, with feeding areas as far south as the Antarctic Peninsula (Allen and Angliss 2010c). Humpback whales in the Action Area are most likely part of the Western North Pacific stock, since this population is known to winter in the Ogasawara Islands, Ryukyu (Okinawa) Islands, Taiwan, the Philippines, and the Mariana Islands (Calambokidis et al. 2008a). The current population estimate for this stock is 938 to 1,107 animals (Allen and Angliss

2011). The Navy's NMSDD estimates 0.00089 humpback whales per km^2 in the MITT Action Area (DoN 2014).

The April 21, 2015 proposed rule to designate 14 DPSs for humpback whales indicates the humpack whales in the MITT Action Area are part of the proposed Western North Pacific DPS. This DPS has an abundance estimate of approximately 1,000 individuals as described above for the Western North Pacific MMPA stock.

Humpback whales have only been infrequently sighted during the Navy's routine aerial surveys of Farallon de Medinilla (FDM); two sightings in 2006 (January and March), both close to the island, and another sighting in February 2007, 18 miles (mi.) (29 kilometers [km]) north of Saipan (Vogt 2008). During a ship survey in the Action Area (January through April 2007), humpback whales were observed and/or detected acoustically in both deep (2,625 to 3,940 feet [ft.] [800 to 1,200 m]) and shallow (1,234 ft. [374 m]) waters northeast of Saipan (Fulling et al. 2011). Acoustic detections of humpback song were also made during these sightings as well as on other occasions (Fulling et al. 2011). These observations suggest that there could be a small wintering population of humpback whales transiting during migration through the Action Area (Fulling et al. 2011; Ligon et al. 2011). During Navy-funded monitoring for the MIRC in 2009 through 2014, no humpback whales were sighted (Fulling et al. 2011; HDR 2011; HDR 2012a; Hill et al. 2013; Hill et al. 2011; Ligon et al. 2011; Oleson and Hill 2010). However, preliminary HARP data analysis shows detection of humpback whales off Saipan from February to May (Oleson et al. 2014).

4.2.3.8 Natural Threats

Natural sources and rates of mortality of humpback whales are not well known. Based upon prevalence of tooth marks, attacks by killer whales appear to be highest among humpback whales migrating between Mexico and California, although populations throughout the Pacific Ocean appear to be targeted to some degree (Steiger et al. 2008). Juveniles appear to be the primary age group targeted. Humpback whales engage in grouping behavior, flailing tails, and rolling extensively to fight off attacks. Calves remain protected near mothers or within a group and lone calves have been known to be protected by presumably unrelated adults when confronted with attack (Ford and Reeves 2008).

Parasites and biotoxins from red-tide blooms are other potential causes of mortality (Perry et al. 1999). The occurrence of the nematode *Crassicauda boopis* appears to increase the potential for kidney failure in humpback whales and may be preventing some populations from recovering (Lambertsen 1992). Studies of 14 humpback whales that stranded along Cape Cod between November 1987 and January 1988 indicate they apparently died from a toxin produced by dinoflagellates during this period. One-quarter of humpback whales of the Arabian Sea population show signs of tattoo skin disease, which may reduce the fitness of afflicted individuals (Baldwin et al. 2010). Emaciated calf and juvenile humpbacks were found in numbers an order of magnitude higher than normal along Western Australia in 2009 due to unknown causes (Coughran et al. 2013).

4.2.3.9 Anthropogenic Threats

Three human activities are known to threaten humpback whales: whaling, commercial fishing, and shipping. Historically, whaling represented the greatest threat to every population of whales and was ultimately responsible for listing several species as endangered.

Humpback whales are also killed or injured during interactions with commercial fishing gear. Like fin whales, humpback whales have been entangled by fishing gear off Newfoundland and Labrador, Canada. A total of 595 humpback whales were reported captured in coastal fisheries in those two provinces between 1969 and 1990, of which 94 died (Lien 1994; Perkins and Beamish 1979). From 1979 through 2008, 1,209 whales were recorded entangled, 80 percent of which were humpback whales (Benjamins et al. 2012). Along the Atlantic coast of the U.S. and the Maritime Provinces of Canada, there were 160 reports of humpback whales being entangled in fishing gear between 1999 and 2005 (Cole et al. 2005b; Nelson et al. 2007b). Of these, 95 entangled humpback whales were confirmed, with 11 whales sustaining injuries and nine dying of their wounds. Along the Pacific coast of Canada, 40 humpback whales have been reported as entangled since 1980, four of which are known to have died (COSEWIC 2011; Ford et al. 2009). Between 30 and 40 percent of humpback whales in the Arabian Sea show scarring from entanglements, with fishing effort on the rise (Baldwin et al. 2010). Alava et al. (2012) reported that 0.53 percent of humpback whale populations breeding along Ecuador are bycaught annually in commercial fishing gear (mortality of 15 to 33 individuals per year). From 2004 to 2008, 18 humpback whales were observed to be entangled along the U.S. west coast, of which 14 were considered seriously injured and two are known to have died (Carretta et al. 2013b). From 2006 to 2010, 29 entangled whales were identified with serious injury or mortality resulting from the entanglement (Waring et al. 2013). From 1996 to 2000, 22 humpback whales of the Central North Pacific population were found entangled in fishing gear (Angliss and Lodge. 2004). In 1996, a vessel from the Pacific Missile Range Facility in Hawaii rescued an entangled humpback, removing two crabpot floats from the whale. A photography study of humpback whales in southeastern Alaska in 2003 and 2004 found at least 53 percent of individuals showed some kind of scarring from fishing gear entanglement (Neilson et al. 2005). There are also reports of entangled humpback whales from the Hawaiian Islands. In 1991, a humpback whale was observed entangled in longline gear and released alive (Hill et al. 1997). In 1995, a humpback whale in Maui waters was found trailing numerous lines (not fishery-related) and entangled in mooring lines. The whale was successfully released, but subsequently stranded and was attacked and killed by tiger sharks in the surf zone. From 2001 through 2006, there were 23 reports of entangled humpback whales in Hawaiian waters; 16 of these reports were from 2005 and 2006. A photography study of humpback whales in southeastern Alaska in 2003 and 2004 found at least 53 percent of individuals showed some kind of scarring from fishing gear entanglement (Neilson et al. 2005). Between 30 and 40 percent of humpback whales in the Arabian Sea show scarring from entanglements, with fishing effort on the rise (Baldwin et al. 2010). Alava et al. (2012) reported that 0.53 percent of humpback whale populations breeding along Ecuador are bycaught annually in commercial fishing gear (mortality of 15 to 33 individuals per year). Ten humpback whales were found entangled in gill nets or long lines between 1995 and 2002 off Peru (Garcia-Godos et al. 2013).

Many of the entangled humpback whales observed in Hawaiian waters brought the gear with them from higher latitude feeding grounds; for example, the whale the U.S. Navy rescued in 1996 had been entangled in gear that was traced to a recreational fisherman in southeast Alaska.

Thus far, 6 of the entangled humpback whales observed in the Hawaiian Islands have been confirmed to have been entangled in gear from Alaska. Nevertheless, humpback whales are also entangled in fishing gear in the Hawaiian Islands. Since 2001, there have been 5 observed interactions between humpback whales and gear associated with the Hawaii-based longline fisheries (NMFS 2008a). In each instance, however, all of the whales were disentangled and released or they were able to break free from the gear without reports of impairment of the animal's ability to swim or feed.

More humpback whales are killed in collisions with ships than any other whale species except fin whales (Jensen and Silber 2003a). Of 123 humpback whales that stranded along the Atlantic coast of the U.S. between 1975 and 1996, 10 (8.1 percent) showed evidence of collisions with ships (Laist et al. 2001). From 1975 through 2011, 68 collisions were actually witnessed in the main Hawaiian Islands, 63 percent involving calves and subadults, with the rate of collisions increasing over time even accounting for higher numbers of whales present (Lammers et al. 2013). Between 1999 and 2005, there were 18 reports of humpback whales being struck by vessels along the Atlantic coast of the U.S. and the Maritime Provinces of Canada (Cole et al. 2005b; Nelson et al. 2007b). Of these reports, 13 were confirmed as ship strikes and in seven cases, ship strike was determined to be the cause of death. Along Pacific Canada, 21q reports of ship strikes involving humpback whales were reported from 2001 to 2008 (COSEWIC 2011; Ford et al. 2009). From 2006 to 2010, 10 instances of mortality stemming from vessel collision were documented (Waring et al. 2013). In the Bay of Fundy, recommendations for slower vessel speeds to avoid right whale ship strike appear to be largely ignored (Vanderlaan et al. 2008). However, new rules for seasonal (June through December) slowing of vessel traffic to 10 knots and changing shipping lanes by less than one nautical mile to avoid the greatest concentrations of right whales are expected to reduce the chance of humpback whales being hit by ships by 9 percent. The first estimate of population-level effects of entanglement were recently produced, with over 12 percent of the Gulf of Maine population of humpbacks acquiring new scars from entanglement interactions annually (Mattila and Rowles 2010). Two humpbacks were recorded as ships truck and died along the west coast from 2004 to 2008; a third was known to have been struck but its outcome is unknown (Carretta et al. 2013b). On the Pacific coast, a humpback whale is killed about every other year by ship strikes (Barlow et al. 1997b). The humpback whale calf that was found stranded on Oahu with evidence of vessel collision (propeller cuts) in 1996 suggests that ship collisions might kill adults, juvenile, and calves (NMFS unpublished data). Although data for actual strikes is lacking off Pacific Panama, study of shipping data and satellite tag data on humpback whales showed that 8 of 15 whales tagged came within 200 m of 81 different ships on 98 occasions in a period of 11 days (Guzman et al. 2013).

Organochlorines, including PCB and DDT, have been identified from humpback whale blubber (Gauthier et al. 1997a). Higher PCB levels have been observed in western Atlantic waters versus Pacific waters along the United States and levels tend to increase with individual age (Elfes et al. 2010); eastern Atlantic individuals fall between these two in contaminant burden (Ryan et al. 2014). Although humpback whales in the Gulf of Maine and off Southern California tend to have the highest PCB concentrations, overall levels are on par with other baleen whales, which are generally lower than odontocete cetaceans (Elfes et al. 2010). As with blue whales, these contaminants are transferred to young through the placenta, leaving newborns with contaminant loads equal to that of mothers before bioaccumulating additional contaminants during life and passing the additional burden to the next generation (Metcalfe et al. 2004). Contaminant levels

are relatively high in humpback whales as compared to blue whales. Humpback whales feed higher on the food chain, where prey carry higher contaminant loads than the krill that blue whales feed on.

Foraging locations in the North Atlantic have shifted by significant distances over the past few decades, potentially as a result of global warming (Palsboll et al. 2013).

4.2.3.10 Critical Habitat

The NMFS has not designated critical habitat for humback whales.

4.2.4 Sei Whale

Sei whales (pronounced "say" or "sigh"; *Balaenoptera borealis*) are members of the baleen whale family and are considered one of the "great whales" or rorquals. Two subspecies of sei whales are recognized, *B. b. borealis* in the Northern Hemisphere and *B. b. schlegellii* in the Southern Hemisphere. These large animals can reach lengths of 40 to 60 ft (12 to 18 m) and weigh 100,000 lbs (45,000 kg). Females may be slightly longer than males. Sei whales have a long, sleek body that is dark bluish-gray to black in color and pale underneath. The body is often covered in oval-shaped scars (probably caused from cookie-cutter shark and lamprey bites) and sometimes has subtle "mottling".

The Sei is regarded as the fastest swimmer among the great whales, reaching bursts of speed in excess of 20 knots. When a sei whale begins a dive it usually submerges by sinking quietly below the surface, often remaining only a few meters deep, leaving a series of swirls or tracks as it move its flukes. When at the water's surface, sei whales can be sighted by a columnar or bushy blow that is about 10 to 13 feet (3 to 4 m) in height. The dorsal fin usually appears at the same time as the blowhole, when the animal surfaces to breathe. This species usually does not arch its back or raise its flukes when diving.

Sei whales become sexually mature at 6 to 12 years of age when they reach about 45 ft (13 m) in length, and generally mate and give birth during the winter in lower latitudes. Females breed every 2 to 3 years, with a gestation period of 11 to 13 months. Females give birth to a single calf that is about 15 ft (4.6 m) long and weighs about 1,500 lbs (680 kg). Calves are usually nursed for 6 to 9 months before being weaned on the preferred feeding grounds. Sei whales have an estimated lifespan of 50 to 70 years.

4.2.4.1 Distribution

The sei whale occurs in all oceans of the world except the Arctic. The migratory pattern of this species is thought to encompass long distances from high-latitude feeding areas in summer to low-latitude breeding areas in winter; however, the location of winter areas remains largely unknown (Perry et al. 1999). Sei whales are often associated with deeper waters and areas along continental shelf edges (Hain et al. 1985a). This general offshore pattern is disrupted during occasional incursions into shallower inshore waters (Waring et al. 2004b). The species appears to lack a well-defined social structure and individuals are usually found alone or in small groups of up to six whales (Perry et al. 1999). When on feeding grounds, larger groupings have been observed (Gambell 1985d).

In the North Pacific Ocean, sei whales occur from the Bering Sea south to California (on the east) and the coasts of Japan and Korea (on the west). During the winter, sei whales are found

from 20° to 23°N (Gambell 1985d; Masaki 1977a). Sasaki et al. (2013) demonstrated that sei whale in the North Pacific are strongly correlated with sea surface temperatures between 13.1 and 16.8 degrees C. Sei whales have been seen in monitoring efforts in Hawaii in 2007 and in 2010.

4.2.4.2 Population Structure

The population structure of sei whales is not well defined, but presumed to be discrete by ocean basin (north and south), except for sei whales in the Southern Ocean, which may form a ubiquitous population or several discrete ones.

Mark-recapture, catch distribution, and morphological research indicate more than one population may exist in the North Pacific – one between 155° and 175° W, and another east of 155° W (Masaki 1976a; Masaki 1977a). Sei whales have been reported primarily south of the Aleutian Islands, in Shelikof Strait and waters surrounding Kodiak Island, in the Gulf of Alaska, and inside waters of southeast Alaska and south to California to the east and Japan and Korea to the west (Leatherwood et al. 1982b; Nasu 1974b). Sightings have also occurred in Hawaiian waters. In Navy-funded surveys 2007 through 2012, there were three confirmed sighting of sei whales for a total of five individuals—all made from vessels (HDR 2012b). Two sightings were documented northeast of Oahu in 2007 (Smultea et al. 2007), while the third was encountered near Perret Seamount west of the Island of Hawaii in 2010 (HDR 2012b). Bottom depths for the sei whale sightings were from 3,100 to 4,500 m. Sightings were made during BSS 2-4. Smultea et al. (2010) noted that the lack of sightings of sei whales in the Hawaiian Islands may be due to misidentification and/or poor sighting conditions. Sei whales have been occasionally reported from the Bering Sea and in low numbers on the central Bering Sea shelf (Hill and DeMaster 1998a). Whaling data suggest that sei whales do not venture north of about 55° N (Gregr et al. 2000). Harwood (1987) evaluated Japanese sighting data and concluded that sei whales rarely occur in the Bering Sea. Harwood (1987) reported that 75 to 85 percent of the North Pacific population resides east of 180°. Considering the many British Columbia whaling catches in the early to mid 1900s, sei whales have clearly utilized this area in the past (Gregr et al. 2000; Pike and Macaskie 1969). Masaki (1977a) reported sei whales concentrating in the northern and western Bering Sea from July through September, although other researchers question these observations because no other surveys have reported sei whales in the northern and western Bering Sea.

Sei whales appear to prefer to forage in regions of steep bathymetric relief, such as continental shelf breaks, canyons, or basins situated between banks and ledges (Best and Lockyer 2002; Gregr and Trites 2001b; Kenney and Winn 1987), where local hydrographic features appear to help concentrate zooplankton, especially copepods. In their foraging areas, sei whales appear to associate with oceanic frontal systems (Horwood 1987b). In the north Pacific, sei whales are found feeding particularly along the cold eastern currents (Perry et al. 1999). Masaki (1977a) presented sightings data on sei whales in the North Pacific from the mid-1960s to the early 1970s. Over that time interval sei whales did not appear to occur in waters of Washington State and southern British Columbia in May or June, their densities increased in those waters in July and August (1.9 to 2.4 and 0.7 to 0.9 whales per 100 miles of distance for July and August, respectively), then declined again in September. More recently, sei whales have become known for an irruptive migratory habit in which they appear in an area then disappear for time periods that can extend to decades.).

4.2.4.3 Reproduction

Very little is known regarding sei whale reproduction. Reproductive activities for sei whales occur primarily in winter. Gestation is about 12.7 months, calves are weaned at 6–9 months, and the calving interval is about 2–3 years (Gambell 1985c; Rice 1977). Sei whales become sexually mature at about age 10 (Rice 1977). Of 32 adult female sei whales harvested by Japanese whalers, 28 were found to be pregnant while one was pregnant and lactating during May–July 2009 cruises in the western North Pacific (Tamura et al. 2009).

4.2.4.4 Movement

The migratory pattern of this species is thought to encompass long distances from high-latitude feeding areas in summer to low-latitude breeding areas in winter; however, the location of winter areas remains largely unknown (Perry et al. 1999). Sei whales are often associated with deeper waters and areas along continental shelf edges (Hain et al. 1985b). This general offshore pattern is disrupted during occasional incursions into shallower inshore waters (Waring et al. 2004a). The species appears to lack a well-defined social structure and individuals are usually found alone or in small groups of up to six whales (Perry et al. 1999). When on feeding grounds, larger groupings have been observed (Gambell 1985c).

4.2.4.5 Feeding

Sei whales are primarily planktivorous, feeding mainly on euphausiids and copepods, although they are also known to consume fish (Waring et al. 2006). In the Northern Hemisphere, sei whales consume small schooling fish such as anchovies, sardines, and mackerel when locally abundant (Konishi et al. 2009; Mizroch et al. 1984b; Rice 1977). Sei whales in the North Pacific feed on euphausiids and copepods, which make up about 95 percent of their diets (Calkins 1986a). The dominant food for sei whales off California during June-August is northern anchovy, while in September-October whales feed primarily on krill (Rice 1977). The balance of their diet consists of squid and schooling fish, including smelt, sand lance, Arctic cod, rockfish, pollack, capelin, and Atka mackerel (Nemoto and Kawamura 1977b). In the Southern Ocean, analysis of stomach contents indicates sei whales consume *Calanus* spp. and small-sized euphasiids with prey composition showing latitudinal trends (Kawamura 1974). Sei whales in the Southern Hemisphere may reduce direct interspecific competition with blue and fin whales by consuming a wider variety of prey and by arriving later to feeding grounds (Kirkwood 1992b). Rice (1977) suggested that the diverse diet of sei whales may allow them greater opportunity to take advantage of variable prey resources, but may also increase their potential for competition with commercial fisheries. In the North Pacific, sei whales appear to prefer feeding along the cold eastern currents (Perry et al. 1999). Sei whales have the flexibility to skim or engulf prey (Brodie and Vikingsson 2009).

4.2.4.6 Diving and Social Behavior

Generally, sei whales make 5 to 20 shallow dives of 20 to 30 second duration followed by a deep dive of up to 15 minutes (Gambell 1985d). The depths of sei whale dives have not been studied; however the composition of their diet suggests that they do not perform dives in excess of 300 meters. Sei whales are usually found in small groups of up to 6 individuals, but they commonly form larger groupings when they are on feeding grounds (Gambell 1985d).

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whales consume small schooling fish such as anchovies, sardines, and mackerel when locally abundant (Mizroch et al. 1984a; Rice 1977). Sei whales in the North Pacific feed on euphausiids and copepods, which make up about 95 percent of their diets (Calkins 1986b). The dominant food for sei whales off California during June through August is northern anchovy, while in September and October whales feed primarily on krill (Rice 1977). The balance of their diet consists of squid and schooling fish, including smelt, sand lance, Arctic cod, rockfish, pollack, capelin, and Atka mackerel (Nemoto and Kawamura 1977a). In the Southern Ocean, analysis of stomach contents indicates sei whales consume Calanus spp. and small-sized euphasiids with prey composition showing latitudinal trends (Kawamura 1974). Evidence indicates that sei whales in the Southern Hemisphere reduce direct interspecific competition with blue and fin whales by consuming a wider variety of prey and by arriving later to feeding grounds (Kirkwood 1992a). Rice (1977) suggested that the diverse diet of sei whales may allow them greater opportunity to take advantage of variable prey resources, but may also increase their potential for competition with commercial fisheries.

Little is known about the actual social system of these animals. Groups of two to five individuals are typically observed, but sometimes thousands may gather if food is abundant. However, these large aggregations may not be dependent on food supply alone, as they often occur during times of migration. Norwegian workers call the times of great sei whale abundance "invasion years." During mating season, males and females may form a social unit, but strong data on this issue are lacking.

4.2.4.7 Vocalization and Hearing

Data on sei whale vocal behavior is limited, but includes records off the Antarctic Peninsula of broadband sounds in the 100 Hz to 600 Hz range with 1.5 s duration and tonal and upsweep calls in the 200 Hz to 600 Hz range of 1 to 3 s durations (McDonald et al. 2005). Differences may exist in vocalizations between ocean basins (Rankin et al. 2009). Vocalizations from the North Atlantic consisted of paired sequences (0.5 to 0.8 sec, separated by 0.4 to 1.0 sec) of 10 to 20 short (4 msec) FM sweeps between 1.5 to 3.5 kHz (Richardson et al. 1995c).

Recordings made in the presence of sei whales have shown that they produce sounds ranging from short, mid-frequency pulse sequences (Knowlton et al. 1991; Thompson et al. 1979) to low frequency broadband calls characteristic of mysticetes (Baumgartner et al. 2008; McDonald et al. 2005; Rankin and Barlow 2007). Off the coast of Nova Scotia, Canada, Knowlton et al. (1991) recorded two-phased calls lasting about 0.5 to 0.8 s and ranging in frequency from 1.5 kHz to 3.5 kHz in the presence of sei whales—data similar to that reported by Thompson et al. (1979). These mid-frequency calls are distinctly different from low-frequency tonal and frequency swept calls recorded in later studies. For example, calls recorded in the Antarctic averaged 0.45 ± 0.3 s in duration at 433 ± 192 Hz, with a maximum source level of 156 ± 3.6 dB re 1 µPa-m (McDonald et al. 2005). During winter months off Hawaii, (Rankin and Barlow 2007)recorded down swept calls by sei whales that exhibited two distinct low frequency ranges of 100 Hz to 44 Hz and 39 Hz to 21 Hz, with the former range usually shorter in duration. Similar sei whale calls were also found near the Gulf of Maine in the northwest Atlantic, ranging from 82.3 Hz to 34.0 Hz and averaging 1.38 s in duration (Baumgartner et al. 2008). These calls were primarily single occurrences, but some double or triple calls were noted as well. It is thought that the difference in call frequency may be functional, with the mid-frequency type serving a reproductive purpose and the low frequency calls aiding in feeding/social communication (McDonald et al. 2005). Sei

whales have also been shown to reduce their calling rates near the Gulf of Maine at night, presumably when feeding, and increase them during the day, likely for social activity (Baumgartner and Fratantoni 2008). Off the Mariana Islands, 32 sei whale calls were recorded, 25 of which were backed up by sightings (Norris et al. 2012). The peak mean frequency of these calls ranged from 890.6 Hz to 1,046.9 Hz with a mean duration of 3.5 to 0.2 seconds. Norris et al. (2012)reported that simultaneous acoustic detections of called were made from the towed array during three visual sightings. The encounters occurred primarily in the central and southern region of the study area, ranging from the island of Tinian to the southeast corner of the study area. A higher concentration was found in the southeast corner and along the Mariana Trench (Norris et al. 2012).

While no data on hearing ability for this species are available, Ketten (1997b) hypothesized that mysticetes have acute infrasonic hearing. Results of studies on blue whales (Goldbogen et al. 2013) (Southall et al. 2011a), which have similar auditory physiology compared to sei whales, indicate that some individuals hear some sounds in the mid-frequency range and exhibit behavioral responses to sounds in this range depending on received level and context. In terms of functional hearing capability, sei whales belong to low-frequency cetaceans which have a hearing range of 7 Hz to 22 kHz (Southall et al. 2007b). There are no tests or modeling estimates of specific sei whale hearing ranges.

4.2.4.8 Status and Trends

The sei whale was originally listed as endangered in 1970 (35 FR 18319), and this status remained since the inception of the ESA in 1973.

Ohsumi and Fukuda (1975) estimated that sei whales in the North Pacific numbered about 49,000 whales in 1963, had been reduced to 37,000 to 38,000 whales by 1967, and reduced again to 20,600 to 23,700 whales by 1973. From 1910 to 1975, approximately 74,215 sei whales were caught in the entire North Pacific Ocean (Horwood 1987a; Perry et al. 1999). From the early 1900s, Japanese whaling operations consisted of a large proportion of sei whales: 300 to 600 sei whales were killed per year from 1911 to 1955. The sei whale catch peaked in 1959, when 1,340 sei whales were killed. In 1971, after a decade of high sei whale catch numbers, sei whales were scarce in Japanese waters. Japanese and Soviet catches of sei whales in the North Pacific and Bering Sea increased from 260 whales in 1962 to over 4,500 in 1968 to 1969, after which the sei whale population declined rapidly (Mizroch et al. 1984b). This estimate does not account for over-reporting by Soviet whalers, who took approximately 3,700 fewer individuals than were reported (Ivashchenko et al. 2013). When commercial whaling for sei whales ended in 1974, the population in the North Pacific had been reduced to 7,260 to 12,620 animals (Tillman 1977). The most current population estimate for sei whales in the entire north Pacific is 9,110 (Calambokidis et al. 2008a) and 25,000 individuals worldwide (Braham 1991).

NMFS has designated three stocks of sei whale for management purposes under the MMPA in the north Pacific: (1) the Hawaii stock, (2) the California/Oregon/Washington stock, and (3) the Alaska stock (Carretta et al. 2011). Little is known about the stock structure of sei whales in the Action Area. Various scientists have described the seasonal distribution of sei whales as occurring from 20° N to 23° N during the winter and from 35° N to 50° N during the summer (Horwood 2009; Masaki 1976b; Masaki 1977b; Smultea et al. 2010). However, sei whales were sighted during the 2007 survey of the Action Area, thus providing evidence that this species

occurs south of 20°N in the winter (Fulling et al. 2011). Observations during the Navy-funded 2007 survey of the Action Area indicated this species most often occurs in deep water (10,381 to 30,583 ft. [3,164 to 9,322 m]). Most sei whale sightings were also associated with steep bathymetric relief (e.g., steeply sloping areas), including sightings adjacent to the Chamorro Seamounts east of the CNMI (Fulling et al. 2011). All confirmed sightings of sei whales were south of Saipan (approximately 15° N) with concentrations in the southeastern corner of the Action Area (Fulling et al. 2011). Sightings also often occurred in mixed groups with Bryde's whales. Sei whales were considered to be extralimital in the Action Area but during the 2007 systematic survey, sei whales were sighted on 16 occasions with a resulting abundance estimate of 166 individuals (CV = 0.49) (Fulling et al. 2011). No data on the current population trend are available; however, the population in the North Pacific is expected to have increased since sei whales began receiving protection in 1976 (Carretta et al. 2013a). A sei whale was also detected with sonobuoys on the January to February 2010 Oscar Elton Sette Cruise from Hawaii to Guam. However, the information we have did not allow us to determine if this detection occurred in the MITT Action Area. The Navy's NMSDD seasonally estimates between zero and 0.00029 sei whales per km^2 in the MITT Action Area (DoN 2014).

4.2.4.9 Natural Threats

Andrews (1916) suggested that killer whales attacked sei whales less frequently than fin and blue whales in the same areas. Sei whales engage in a flight responses to evade killer whales, which involves high energetic output, but show little resistance if overtaken (Ford and Reeves 2008). Endoparasitic helminths (worms) are commonly found in sei whales and can result in pathogenic effects when infestations occur in the liver and kidneys (Rice 1977).

4.2.4.10 Anthropogenic Threats

Human activities known to threaten sei whales include whaling, commercial fishing, and vessel strikes. Historically, whaling represented the greatest threat to every population of sei whales and was ultimately responsible for listing sei whales as an endangered species. Sei whales are thought to not be widely hunted, although harvest for scientific whaling or illegal harvesting may occur in some areas. In 2009, 100 sei whales were killed during western North Pacific surveys (Bando et al. 2010).

Sei whales are occasionally killed in collisions with vessels; however, there are no known Navy ship strikes in the area. Of three sei whales that stranded along the U.S. Atlantic coast during 1975 to 1996, two showed evidence of collisions (Laist et al. 2001). Between 1999 and 2005, there were three reports of sei whales being struck by vessels along the U.S. Atlantic coast and Canada's Maritime Provinces (Cole et al. 2005b; Nelson et al. 2007b). Two of these ship strikes were reported as having resulted in death. New rules for seasonal (June through December) slowing of vessel traffic in the Bay of Fundy to 10 knots and changing shipping lanes by less than one nautical mile to avoid the greatest concentrations of right whales are predicted to reduce sei whale ship strike mortality by 17 percent.

Sei whales are known to accumulate DDT, DDE, and PCBs (Borrell 1993; Borrell and Aguilar 1987; Henry and Best 1983). Males carry larger burdens than females, as gestation and lactation transfer these toxins from mother to offspring.

4.2.4.11 Critical Habitat
The NMFS has not designated critical habitat for sei whales.

4.2.5 Sperm Whale
Sperm whales (*Physeter macrocephalus*) are the largest of the odontocetes (toothed whales) and the most sexually dimorphic cetaceans, with males considerably larger than females. Adult females may grow to lengths of 36 feet (11 m) and weigh 15 tons (13,607 kg). Adult males, however, reach about 52 feet (16 m) and may weigh as much as 45 tons (40,823 kg).

The sperm whale is distinguished by its extremely large head, which takes up to 25 to 35 percent of its total body length. It is the only living cetacean that has a single blowhole asymmetrically situated on the left side of the head near the tip. Sperm whales have the largest brain of any animal (on average 17 pounds (7.8 kg) in mature males). However, compared to their large body size, the brain is not exceptional in size. Sperm whales are mostly dark gray, but oftentimes the interior of the mouth is bright white, and some whales have white patches on the belly. Their flippers are paddle-shaped and small compared to the size of the body, and their flukes are very triangular in shape. They have small dorsal fins that are low, thick, and usually rounded.

4.2.5.1 Distribution
Sperm whales are distributed in all of the world's oceans, from equatorial to polar waters, and are highly migratory. Mature males range between 70º N in the North Atlantic and 70º S in the Southern Ocean (Barlow et al. 1997b; Perry et al. 1999), whereas mature females and immature individuals of both sexes are seldom found higher than 50º N or S (Barlow et al. 1997b). In winter, sperm whales migrate closer to equatorial waters (Kasuya and Miyashita 1988; Waring 1993) where adult males join them to breed.

4.2.5.2 Population Structure
There is no clear understanding of the global population structure of sperm whales (Dufault et al. 1999). Recent ocean-wide genetic studies indicate low, but statistically significant, genetic diversity and no clear geographic structure, but strong differentiation between social groups (Lyrholm and Gyllensten 1998; Lyrholm et al. 1996; Lyrholm et al. 1999). Chemical analysis also suggest significant differences in diet for animals captured in different regions of the North Atlantic. However, vocal dialects indicate parent-offspring transmission that indicates differentiation in populations (Rendell et al. 2011). Vocal differences exist not only across ocean basins, but also over much smaller spatial scales (Amano et al. 2014). Therefore, population-level differences may be more extensive than are currently understood.

The IWC currently recognizes four sperm whale stocks: North Atlantic, North Pacific, northern Indian Ocean, and Southern Hemisphere (Dufault et al. 1999; Reeves and Whitehead 1997). The NMFS recognizes six stocks under the MMPA: three in the Atlantic/Gulf of Mexico and three in the Pacific (Alaska, California-Oregon-Washington, and Hawaii; (Perry et al. 1999; Waring et al. 2004a). Genetic studies indicate that movements of both sexes through expanses of ocean basins are common, and that males, but not females, often breed in different ocean basins than the ones in which they were born (Whitehead 2003). Sperm whale populations appear to be structured socially, at the level of the clan, rather than geographically (Whitehead 2003; Whitehead et al. 2008). Matrilinear groups in the eastern Pacific share nuclear DNA within broader clans, but North Atlantic matrilinear groups do not share this genetic heritage (Whitehead et al. 2012).

Sperm whales are found throughout the North Pacific and are distributed broadly in tropical and temperate waters to the Bering Sea as far north as Cape Navarin in summer, and occur south of 40° N in winter (Gosho et al. 1984; Miyashita et al. 1995 as cited in Carretta et al. 2005; Rice 1974b). Sperm whales are found year-round in Californian and Hawaiian waters (Barlow 1995a; Dohl et al. 1983; Forney et al. 1995a; Lee 1993; Mobley Jr . et al. 2000; Rice 1960; Shallenberger 1981), but they reach peak abundance from April through mid-June and from the end of August through mid-November (Rice 1974b). They are seen in every season except winter (December-February) off Washington and Oregon (Green et al. 1992). Summer/fall surveys in the eastern tropical Pacific (Wade and Gerrodette 1993) show that although sperm whales are widely distributed in the tropics, their relative abundance tapers off markedly towards the middle of the tropical Pacific and northward towards the tip of Baja California (Carretta et al. 2006). Sperm whales occupying the California Current region are genetically distinct from those in the eastern tropical Pacific and Hawaiian waters (Mesnick et al. 2011), although occurrence seems to be continuance from California through Hawaii (Barlow and Taylor 2005). The discreteness of the latter two areas remains uncertain (Mesnick et al. 2011).

In the Gulf of Alaska, sperm whales have been sighted along the Aleutian Trench as well as over deeper waters and have been detected acoustically throughout the year (Forney and Brownell Jr. 1996b; Mellinger et al. 2004). Occurrence is higher from July through September than January through March (Mellinger et al. 2004; Moore et al. 2006). The vast majority of individuals in the region are likely male based upon whaling records and genetic studies; the area is a summer foraging area for these individuals (Allen and Angliss 2010a; Reeves et al. 1985; Straley and O'Connell 2005; Straley et al. 2005). Mean group size has been reported to be 1.2 individuals (Wade et al. 2003; Waite 2003). However, female groups may rarely occur at least up to the central Aleutian Islands (Fearnbach et al. 2012).

4.2.5.3 Movement

Mature males range between 70º N in the North Atlantic and 70º S in the Southern Ocean (Perry et al. 1999; Reeves and Whitehead 1997), whereas mature females and immature individuals of both sexes are seldom found higher than 50º N or S (Reeves and Whitehead 1997). In winter, sperm whales migrate closer to equatorial waters (Kasuya and Miyashita 1988; Waring et al. 1993a) where adult males join them to breed. Movement patterns of Pacific female and immature male groups appear to follow prey distribution and, although not random, movements are difficult to anticipate and are likely associated with feeding success, perception of the environment, and memory of optimal foraging areas (Whitehead et al. 2008). However, no sperm whale in the Pacific has been known to travel to points over 5,000 km apart and only rarely have been known to move over 4,000 km within a time frame of several years. This means that although sperm whales do not appear to cross from eastern to western sides of the Pacific (or vice-versa), significant mixing occurs that can maintain genetic exchange. Movements of several hundred kilometers are common, (i.e. between the Galapagos Islands and the Pacific coastal Americas). Movements appear to be group or clan specific, with some groups traveling straighter courses than others over the course of several days. However, general transit speed averages about 4 km/h. Sperm whales in the Caribbean region appear to be much more restricted in their movements, with individuals repeatedly sighted within less than 160 km of previous sightings.

4.2.5.4 Habitat

Sperm whales have a strong preference for waters deeper than 1,000 m (Reeves and Whitehead 1997; Watkins 1977), although Berzin (1971a) reported that they are restricted to waters deeper than 300 m. While deep water is their typical habitat, sperm whales are rarely found in waters less than 300 m in depth (Clarke 1956b; Rice 1989c). Sperm whales have been observed near Long Island, New York, in water between 40 to 55 m deep (Scott and Sadove 1997b). When they are found relatively close to shore, sperm whales are usually associated with sharp increases in topography where upwelling occurs and biological production is high, implying the presence of a good food supply (Clarke 1956b). Such areas include oceanic islands and along the outer continental shelf.

Sperm whales are frequently found in locations of high productivity due to upwelling or steep underwater topography, such as continental slopes, seamounts, or canyon features (Jaquet and Whitehead 1996a; Jaquet et al. 1996). Cold-core eddy features are also attractive to sperm whales in the Gulf of Mexico, likely because of the large numbers of squid that are drawn to the high concentrations of plankton associated with these features (Biggs et al. 2000a; Davis et al. 2000c; Davis et al. 2000d; Davis et al. 2000e; Davis et al. 2002a; Wormuth et al. 2000). Surface waters with sharp horizontal thermal gradients, such as along the Gulf Stream in the Atlantic, may also be temporary feeding areas for sperm whales (Griffin 1999; Jaquet et al. 1996; Waring et al. 1993a). Sperm whales over George's Bank were associated with surface temperatures of 23.2 to 24.9° C (Waring et al. 2003).

Local information is inconsistent regarding some aspects of sperm whale habitat utilization. Gregr and Trites (2001a) reported that female sperm whales off British Columbia were relatively unaffected by the surrounding oceanography. However, Tynan et al. (2005a) reported increased sperm whales densities with strong turbulence-associated topographic features along the continental slope near Heceta Bank.

4.2.5.5 Reproduction

Female sperm whales become sexually mature at an average of 9 years or 8.25 to 8.8 m (Kasuya 1991). Males reach a length of 10 to 12 m at sexual maturity and take 9 to 20 years to become sexually mature, but require another 10 years to become large enough to successfully breed (Kasuya 1991; Würsig et al. 2000). Mean age at physical maturity is 45 years for males and 30 years for females (Waring et al. 2004a). Adult females give birth after roughly 15 months of gestation and nurse their calves for 2 to 3 years (Waring et al. 2004a). The calving interval is estimated to be every 4 to 6 years between the ages of 12 and 40 (Kasuya 1991; Whitehead et al. 2008). In the North Pacific, female sperm whales and their calves are usually found in tropical and temperate waters year round, while it is generally understood that males move north in the summer to feed in the Gulf of Alaska, Bering Sea, and waters off of the Aleutian Islands (Kasuya and Miyashita 1988). It has been suggested that some mature males may not migrate to breeding grounds annually during winter, and instead may remain in higher latitude feeding grounds for more than 1 year at a time (Whitehead and Arnbom 1987).

Sperm whale age distribution is unknown, but sperm whales are believed to live at least 60 years (Rice 1978b). Estimated annual mortality rates of sperm whales are thought to vary by age, but previous estimates of mortality rate for juveniles and adults are now considered unreliable (IWC

1980). In addition to anthropogenic threats, there is evidence that sperm whale age classes are subject to predation by killer whales (Arnbom et al. 1987; Pitman et al. 2001).

Stable, long-term associations among females form the core of sperm whale societies (Christal et al. 1998). Up to about a dozen females usually live in such groups, accompanied by their female and young male offspring. Young individuals are subject to alloparental care by members of either sex and may be suckled by non-maternal individuals (Gero et al. 2009). Group sizes may be smaller overall in the Caribbean Sea (6 to 12 individuals) versus the Pacific (25 to 30 individuals)(Jaquet and Gendron 2009). Groups may be stable for long periods, such as for 80 days in the Gulf of California (Jaquet and Gendron 2009). Males start leaving these family groups at about 6 years of age, after which they live in "bachelor schools," but this may occur more than a decade later (Pinela et al. 2009). The cohesion among males within a bachelor school declines with age. During their breeding prime and old age, male sperm whales are essentially solitary (Christal and Whitehead 1997).

4.2.5.6 Diving and Social Behavior

Sperm whales are probably the deepest and longest diving mammalian species, with dives to 3 km down and durations in excess of 2 hours (Clarke 1976; Watkins et al. 1993; Watkins et al. 1985a). However, dives are generally shorter (25 to 45 min) and shallower (400 to 1,000 m). Dives are separated by 8 to 11 min rests at the surface (Gordon 1987; Jochens et al. 2006; Papastavrou et al. 1989; Watwood et al. 2006; Würsig et al. 2000). Sperm whales typically travel approximately 3 km horizontally and 0.5 km vertically during a foraging dive (Whitehead 2003). Differences in night and day diving patterns are not known for this species, but, like most diving air-breathers for which there are data (rorquals, fur seals, and chinstrap penguins), sperm whales probably make relatively shallow dives at night when prey are closer to the surface.

Unlike other cetaceans, there is a preponderance of dive information for this species, most likely because it is the deepest diver of all cetacean species and therefore generates a lot of interest. Sperm whales feed on large and medium-sized squid, octopus, rays and sharks, on or near the ocean floor (Clarke 1986; Whitehead 2002b). Some evidence suggests that they do not always dive to the bottom of the sea floor (likely if food is elsewhere in the water column), but that they do generally feed at the bottom of the dive. Davis et al. (2007) report that dive-depths (100 to 500 m) of sperm whales in the Gulf of California overlapped with depth distributions (200 to 400 m) of jumbo squid, based on data from satellite-linked dive recorders placed on both species, particularly during daytime hours. Their research also showed that sperm whales foraged throughout a 24-hour period, and that they rarely dove to the sea floor bottom (>1000 m). The most consistent sperm whale dive type is U-shaped, during which the whale makes a rapid descent to the bottom of the dive, forages at various velocities while at depth (likely while chasing prey) and then ascends rapidly to the surface. There is some evidence that male sperm whales, feeding at higher latitudes during summer months, may forage at several depths including <200 m, and utilize different strategies depending on position in the water column (Teloni et al. 2007).

Movement patterns of Pacific female and immature male groups appear to follow prey distribution and, although not random, movements are difficult to anticipate and are likely associated with feeding success, perception of the environment, and memory of optimal foraging areas (Whitehead 2008). However, no sperm whale in the Pacific has been known to travel to

points over 5,000 km apart and only rarely have been known to move over 4,000 km within a time frame of several years. This means that although sperm whales do not appear to cross from eastern to western sides of the Pacific (or vice-versa), significant mixing occurs that can maintain genetic exchange. Movements of several hundred miles are common, (i.e. between the Galapagos Islands and the Pacific coastal Americas). Movements appear to be group or clan specific, with some groups traveling straighter courses than others over the course of several days. However, general transit speed averages about 4 km/h. Sperm whales in the Caribbean region appear to be much more restricted in their movements, with individuals repeatedly sighted within less than 160 km of previous sightings.

Gaskin (1973) proposed a northward population shift of sperm whales off New Zealand in the austral autumn based on reduction of available food species and probable temperature tolerances of calves.

Sperm whales have a strong preference for waters deeper than 1,000 m (Barlow et al. 1997b; Watkins and Schevill 1977), although Berzin (1971b) reported that they are restricted to waters deeper than 300 m. While deep water is their typical habitat, sperm whales are rarely found in waters less than 300 m in depth (Clarke 1956a; Rice 1989b). Sperm whales have been observed near Long Island, New York, in water between 40 and 55 m deep (Scott and Sadove 1997a).

Sperm whales are frequently found in locations of high productivity due to upwelling or steep underwater topography, such as continental slopes, seamounts, or canyon features (Jaquet 1996; Jaquet and Whitehead 1996b). Cold-core eddy features are also attractive to sperm whales in the Gulf of Mexico, likely because of the large numbers of squid that are drawn to the high concentrations of plankton associated with these features (Biggs et al. 2000b; Davis et al. 2000b; Davis et al. 2002b). Surface waters with sharp horizontal thermal gradients, such as along the Gulf Stream in the Atlantic, may also be temporary feeding areas for sperm whales (Griffin 1999; Jaquet and Whitehead 1996b; Waring et al. 1993b). Sperm whales over George's Bank were associated with surface temperatures of 23.2 to 24.9 °C (Waring et al. 2004b).

Local information is inconsistent regarding sperm whale tendencies. Gregr and Trites (2001b) reported that female sperm whales off British Columbia were relatively unaffected by the surrounding oceanography. However, Tynan et al. (2005b) reported increased sperm whales densities with strong turbulence associated topographic features along the continental slope near Heceta Bank. Two noteworthy strandings in the region include an infamous incident (well publicized by the media) of attempts to dispose of a decomposed sperm whale carcass on an Oregon beach by using explosives. In addition, a mass stranding of 47 individuals in Oregon occurred during June 1979 (Norman et al. 2004a; Rice et al. 1986).

4.2.5.7 Feeding

Sperm whales appear to feed regularly throughout the year (NMFS 2006d). It is estimated they consume about 3 to 3.5 percent of their body weight daily (Lockyer 1981). They seem to forage mainly on or near the bottom, often ingesting stones, sand, sponges, and other non-food items (Rice 1989c). A large proportion of a sperm whale's diet consists of low-fat, ammoniacal, or luminescent squids (Clarke 1996; Clarke 1980b; Martin and Clarke 1986). While sperm whales feed primarily on large and medium-sized squids, the list of documented food items is fairly long and diverse. Prey items include other cephalopods, such as octopi, and medium- and large-sized

demersal fishes, such as rays, sharks, and many teleosts (Angliss and Lodge 2004; Berzin 1972; Clarke 1977; Clarke 1980a; Rice 1989c). The diet of large males in some areas, especially in high northern latitudes, is dominated by fish (Rice 1989c). In some areas of the North Atlantic, however, males prey heavily on the oil-rich squid *Gonatus fabricii*, a species also frequently eaten by northern bottlenose whales (Clarke 1997).

4.2.5.8 Vocalization and Hearing

Sound production and reception by sperm whales are better understood than in most cetaceans. Sperm whales produce broad-band clicks in the frequency range of 100 Hz to 20 kHz that can be extremely loud for a biological source (200 to 236 dB re 1μPa), although lower source level energy has been suggested at around 171 dB re 1 μPa (Goold and Jones 1995; Møhl et al. 2003; Weilgart and Whitehead 1993a; Weilgart and Whitehead 1997b). Most of the energy in sperm whale clicks is concentrated at around 2 kHz to 4 kHz and 10 kHz to 16 kHz (Goold and Jones 1995; NMFS 2006d; Weilgart and Whitehead 1993a). The highly asymmetric head anatomy of sperm whales is likely an adaptation to produce the unique clicks recorded from these animals (Cranford 1992; Norris and Harvey 1972; Norris and Harvey. 1972). Long, repeated clicks are associated with feeding and echolocation (Goold and Jones 1995; Weilgart and Whitehead 1993a; Weilgart and Whitehead 1997b). However, clicks are also used in short patterns (codas) during social behavior and intragroup interactions (Weilgart and Whitehead 1993a). They may also aid in intra-specific communication. Another class of sound, “squeals”, are produced with frequencies of 100 Hz to 20 kHz (e.g., Weir et al. 2007).

Our understanding of sperm whale hearing stems largely from the sounds they produce. The only direct measurement of hearing was from a young stranded individual from which auditory evoked potentials were recorded (Carder and Ridgway 1990). From this whale, responses support a hearing range of 2.5 kHz to 60 kHz. However, behavioral responses of adult, free-ranging individuals also provide insight into hearing range; sperm whales have been observed to frequently stop echolocating in the presence of underwater pulses made by echosounders and submarine sonar (Watkins et al. 1985a; Watkins and Schevill 1975b). They also stop vocalizing for brief periods when codas are being produced by other individuals, perhaps because they can hear better when not vocalizing themselves (Goold and Jones 1995). Because they spend large amounts of time at depth and use low-frequency sound, sperm whales are likely to be susceptible to low frequency sound in the ocean (Croll et al. 1999b).

Recordings of sperm whale vocalizations reveal that they produce a variety of sounds, such as clicks, gunshots, chirrups, creaks, short trumpets, pips, squeals and clangs (Goold 1999b). Sperm whales typically produce short-duration repetitive broadband clicks with frequencies below 100 Hz to >30 kHz (Watkins 1977)and dominant frequencies between 1 kHz to 6 kHz and 10 kHz to 16 kHz. The source levels can reach 236 dB re 1 μPa-m (Mohl et al. 2003). The clicks of neonate sperm whales are very different from typical clicks of adults in that they are of low directionality, long duration, and low-frequency (between 300 Hz and 1.7 kHz) with estimated source levels between 140 to 162 dB re 1 μPa-m (Madsen et al. 2003). Clicks are heard most frequently when sperm whales are engaged in diving and foraging behavior (Miller et al. 2004; Whitehead and Weilgart 1991). Creaks (rapid sets of clicks) are heard most frequently when sperm whales are foraging and engaged in the deepest portion of their dives, with inter-click intervals and source levels being altered during these behaviors (Laplanche et al. 2005; Miller et al. 2004).

When sperm whales are socializing, they tend to repeat series of group-distinctive clicks (codas), which follow a precise rhythm and may last for hours (Watkins and Schevill 1977). Codas are shared between individuals in a social unit and are considered to be primarily for intragroup communication (Rendell and Whitehead 2004; Weilgart and Whitehead 1997a). Recent research in the South Pacific suggests that in breeding areas the majority of codas are produced by mature females (Marcoux et al. 2006). Coda repertoires have also been found to vary geographically and are categorized as dialects, similar to those of killer whales (Pavan et al. 2000; Weilgart and Whitehead 1997a). For example, significant differences in coda repertoire have been observed between sperm whales in the Caribbean and those in the Pacific (Weilgart and Whitehead 1997a). Three coda types used by male sperm whales have recently been described from data collected over multiple years: these include codas associated with dive cycles, socializing, and alarm (Frantzis and Alexiadou 2008).

Direct measures of sperm whale hearing have been conducted on a stranded neonate using the auditory brainstem response technique: the whale showed responses to pulses ranging from 2.5 kHz to 60 kHz and highest sensitivity to frequencies between 5 kHz to 20 kHz (Ridgway and Carder 2001). Other hearing information consists of indirect data. For example, the anatomy of the sperm whale's inner and middle ear indicates an ability to best hear high-frequency to ultrasonic hearing (Ketten 1992). The sperm whale may also possess better low-frequency hearing than other odontocetes, although not as low as many baleen whales (Ketten 1992). Reactions to anthropogenic sounds can provide indirect evidence of hearing capability, and several studies have made note of changes seen in sperm whale behavior in conjunction with these sounds. For example, sperm whales have been observed to frequently stop echolocating in the presence of underwater pulses made by echo-sounders and submarine sonar (Watkins et al. 1985b; Watkins and Schevill 1975a). In the Caribbean, Watkins et al. (1985b) observed that sperm whales exposed to 3.25 kHz to 8.4 kHz pulses (presumed to be from submarine sonar) interrupted their activities and left the area. Similar reactions were observed from artificial noise generated by banging on a boat hull (Watkins et al. 1985b). André et al. (1997)reported that foraging whales exposed to a 10 kHz pulsed signal did not ultimately exhibit any general avoidance reactions: when resting at the surface in a compact group, sperm whales initially reacted strongly, and then ignored the signal completely (André et al. 1997). Thode et al. (2007) observed that the acoustic signal from the cavitation of a fishing vessel's propeller (110 dB re 1 μPa^2 between 250 Hz and 1.0 kHz) interrupted sperm whale acoustic activity and resulted in the animals converging on the vessel. The full range of functional hearing for the sperm whale is estimated to occur between approximately 150 Hz and 160 kHz, placing them among the group of cetaceans that can hear mid-frequency sounds (Southall et al. 2007).

Sperm whales have been observed by marine mammal observers aboard Navy surface ships during training events and detected on the PMRF range hydrophones; however, MFAS was not active so no behavioral response data exists during naval training events. However, a sperm whale was tagged for a controlled exposure experiment during BRS-10. The sperm whale did not appear to demonstrate obvious behavioral changes in dive pattern or production of clicks (Miller et al. 2012; Sivle et al. 2012; Southall et al. 2011b).

4.2.5.9 Status and Trends

Sperm whales were originally listed as endangered in 1970 (35 FR 18319), and this status remained with the inception of the ESA in 1973. Although population structure of sperm whales

is unknown, several studies and estimates of abundance are available. Sperm whale populations probably are undergoing the dynamics of small population sizes, which is a threat in and of itself. In particular, the loss of sperm whales to directed Soviet whaling likely inhibits recovery due to the loss of adult females and their calves, leaving sizeable gaps in demographic and age structuring (Whitehead 2003).

The most comprehensive abundance estimate for sperm whales we are aware of is from Whitehead (2002a), who estimated that there are approximately 76,803 sperm whales in the eastern tropical Pacific, eastern North Pacific, Hawaii, and western North Pacific, and a worldwide population of 360,000 individuals. The tropical Pacific is home to approximately 26,053 sperm whales and the western North Pacific has approximately 29,674 (Whitehead 2002a). There was a dramatic decline in the number of females around the Galapagos Islands during 1985 to 1999 versus 1978 to 1992 levels, likely due to migration to nearshore waters of South and Central America (Whitehead and Mesnick 2003).

Sperm whales are sighted off Oregon in every season except winter (Green et al. 1992). However, sperm whales are found off California year-round (Barlow 1995a; Dohl et al. 1983; Forney et al. 1995a), with peak abundance from April to mid-June and from August to mid-November (Rice 1974b).

Hill and DeMaster (1999) concluded that about 258,000 sperm whales were harvested in the North Pacific between 1947-1987. This estimate does not account for under-reporting by Soviet whalers, who took approximately 31,000 more individuals than were reported (Ivashchenko et al. 2013). Although the IWC protected sperm whales from commercial harvest in 1981, Japanese whalers continued to hunt sperm whales in the North Pacific until 1988 (Reeves and Whitehead 1997). In 2000, the Japanese Whaling Association announced plans to kill 10 sperm whales in the Pacific Ocean for research. Although consequences of these deaths are unclear, the paucity of population data, uncertainly regarding recovery from whaling, and re-establishment of active programs for whale harvesting pose risks for the recovery and survival of this species. Sperm whales are also hunted for subsistence purposes by whalers from Lamalera, Indonesia, where a traditional whaling industry has been reported to kill up to 56 sperm whales per year.

NMFS has designated three stocks of sperm whale for management purposes under the MMPA in the north Pacific: (1) the Hawaii stock, (2) the California/Oregon/Washington stock, and (3) the Alaska stock (Carretta et al. 2013a). Little is known about the stock structure of sperm whales in the Action Area.

Preliminary results of a coda review (Norris et al. 2012) “provide new insights into the sperm whale social units occurring within this region of the western Pacific Ocean.” The presence of the 'short' and 'regular' vocal clans identified from the acoustic encounters in this dataset can be used as putative indicators of sperm whale stock structure for this region (Marcoux et al. 2006). The vocal repertoires identified in the review may provide information on the occurrence of vocal clans in the western Pacific Ocean. The vocal repertoires identified (Norris et al. 2012) suggest a potential cultural and acoustic link to vocal clans found in the eastern tropical Pacific Ocean and greatly extends the known range for the 'regular' and 'short' vocal clans. Whaling records demonstrate sightings year-round in the Action Area (Townsend 1935). There are also at least four stranding records for this area spanning the period from 1962 to 2013 (Eldredge 1991; Eldredge 2003; Kami and Lujan 1976; Kerrigan 2013). During the Navy-funded survey in 2007,

there were multiple sightings that included young calves and large bulls (Fulling et al. 2011). These findings are consistent with an earlier sighting of a group of sperm whales that included a newborn calf off the west coast of Guam (Eldredge 2003). During the 2007 survey, sperm whales were observed in waters 2,670 to 32,584 ft. (809–9,874 m) deep (Fulling et al. 2011). During a small boat survey around Guam and Saipan in February and early March of 2010, there were two sperm whale sightings: (1) a group of nine animals off Orote Point, Guam, inshore from the 1,640 ft. (500 m) isobath; and (2) a group of six animals northwest of Saipan in waters greater than 3,281 ft. (1,000 m) deep (Ligon et al. 2011). A group of 10 sperm whales was also sighted during small boat surveys off western Guam in waters approximately 3,940 ft. deep (1,200 m) in March 2012 (HDR 2012a).

The sperm whale was the most frequently sighted cetacean (21 sightings) during the 2007 survey with acoustic detections almost three times higher (61) than visual detections in the field (Fulling et al. 2011). Post processing of the acoustic data resulted in 91 distinct localizations of individual sperm whales. Based on a preliminary analysis, the distribution of sperm whales appeared to be clustered in three main regions of MIRC, the northeast, central, and southwest portions, with a few others in the trench and offshore regions (Norris et al. 2012). Line-transect abundance estimates derived from these survey data yielded an estimate of 705 (CV = 0.60) sperm whales in the Action Area (Fulling et al. 2011). The Navy's NMSDD estimates 0.00291 sperm whales per km^2 in the MITT Action Area (DoN 2014).

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4.2.5.10 Natural Threats

Sperm whales are known to be occasionally predated upon by killer whales (Jefferson and Baird 1991; Pitman et al. 2001) and large sharks (Best et al. 1984) and harassed by pilot whales (Arnbom et al. 1987; Palacios and Mate 1996; Rice 1989d; Weller et al. 1996; Whitehead 1995). Strandings are also relatively common events, with one to dozens of individuals generally beaching themselves and dying during any single event. Although several hypotheses, such as navigation errors, illness, and anthropogenic stressors, have been proposed (Goold et al. 2002; Wright 2005), direct widespread causes of strandings remain unclear. Calcivirus and papillomavirus are known pathogens of this species (Lambertsen et al. 1987; Smith and Latham 1978).

4.2.5.11 Anthropogenic Threats

Sperm whales historically faced severe depletion from commercial whaling operations. From 1800 to 1900, the IWC estimated that nearly 250,000 sperm whales were killed by whalers, with another 700,000 from 1910 to 1982 (IWC Statistics 1959 to 1983). However, other estimates have included 436,000 individuals killed between 1800 and 1987 (Carretta et al. 2005).

However, all of these estimates are likely underestimates due to illegal and inaccurate killings by Soviet whaling fleets between 1947–1973. In the Southern Hemisphere, these whalers killed an estimated 100,000 whales that they did not report to the IWC (Yablokov et al. 1998), with smaller harvests in the Northern Hemisphere, primarily the North Pacific, that extirpated sperm whales from large areas (Yablokov and Zemsky 2000). Additionally, Soviet whalers disproportionately killed adult females in any reproductive condition (pregnant or lactating) as well as immature sperm whales of either gender.

Following a moratorium on whaling by the IWC, significant whaling pressures on sperm whales were eliminated. However, sperm whales are known to have become entangled in commercial fishing gear and 17 individuals are known to have been struck by vessels (Jensen and Silber 2004). Japan maintains an active whaling fleet, killing up to 10 sperm whales annually (IWC 2008). In 2009, one sperm whale was killed during western North Pacific surveys (Bando et al. 2010).

Whale-watching vessels are known to influence sperm whale behavior (Richter et al. 2006).

In U.S. waters in the Pacific Ocean, sperm whales are known to have been incidentally captured only in drift gillnet operations, which killed or seriously injured an average of nine sperm whales per year from 1991 to 1995 (Barlow et al. 1997b). Interactions between longline fisheries and sperm whales in the Gulf of Alaska have been reported over the past decade (Hill and Demaster 1998b; Rice 1989a). Observers aboard Alaskan sablefish and halibut longline vessels have documented sperm whales feeding on fish caught in longline gear in the Gulf of Alaska. During 1997, the first entanglement of a sperm whale in Alaska's longline fishery was recorded, although the animal was not seriously injured (Hill and Demaster 1998b). The available evidence does not indicate sperm whales are being killed or seriously injured as a result of these interactions, although the nature and extent of interactions between sperm whales and long-line gear is not yet clear. An individual was caught and released from gillnetting, although injured, on Georges Bank during 1990. A second individual was freed, but injured, from gillnetting on George's Bank in 1995. In 1994, a sperm whale was disentangled from gillnet along the coast of Maine. In August 1993, a dead sperm whale, with longline gear wound tightly around the jaw, was found floating ~32 km off Maine. Ten sperm whale entanglements have been observed in U.S. fisheries since 1990 in the Pacific (Carretta and Enriquez 2012). Two additional whales have been found to die from ingestion of fishing gear (Jacobsen et al. 2010b). Overall, it is estimated that 3.8 sperm whales die annually along the U.S. west coast due to fisheries interaction (Carretta et al. 2013b).

Contaminants have been identified in sperm whales, but vary widely in concentration based upon life history and geographic location, with northern hemisphere individuals generally carrying higher burdens (Evans et al. 2004). Contaminants include dieldrin, chlordane, DDT, DDE, PCBs, HCB and HCHs in a variety of body tissues (Aguilar 1983; Evans et al. 2004), as well as several heavy metals (Law et al. 1996). However, unlike other marine mammals, females appear to bioaccumulate toxins at greater levels than males, which may be related to possible dietary differences between females who remain at relatively low latitudes compared to more migratory males (Aguilar 1983; Wise et al. 2009). Chromium levels from sperm whales skin samples worldwide have varied from undetectable to 122.6 μg Cr/g tissue, with the mean (8.8 μg Cr/g

tissue) resembling levels found in human lung tissue with chromium-induced cancer (Wise et al. 2009). Older or larger individuals do not appear to accumulate chromium at higher levels.

Small changes in reproductive parameters, such as the loss of adult females, can significantly alter the population trajectory of sperm whale populations (Chiquet et al. 2013).

Ingestion of marine debris can have fatal consequences even for large whales. In 1989, a stranded sperm whale along the Mediterranean was found to have died from ingesting plastic that blocked its' digestive tract (Viale et al. 1992). A sperm whale examined in Iceland had a lethal disease thought to have been caused by the complete obstruction of the gut with plastic marine debris (Lambertsen 1990). The stomach contents of two sperm whales that stranded separately in California included extensive amounts of discarded fishing netting (NMFS 2009b). A fifth individual from the Pacific was found to contain nylon netting in its stomach when it washed ashore in 2004 (NMFS 2009b). In March 2012, a sperm whale stranded dead, apparently dying as a result of plastic ingestion (de Stephanis et al. 2013).

There have not been any recent documented ship strikes involving sperm whales in the eastern North Pacific, although there are a few records of ship strikes in the 1990s. Two whales described as "possibly sperm whales" are known to have died in U.S. Pacific waters in 1990 after being struck by vessels (Barlow et al. 1997a). There is an anecdotal record from 1997 of a fishing vessel that struck a sperm whale in southern Prince William Sound in Alaska, although the whale did not appear to be injured (Laist et al. 2001). More recently in the Pacific, two sperm whales were struck by a ship in 2005, but it is not known if these ship strikes resulted in injury or mortality (NMFS 2009a). The lack of recent evidence should not lead to the assumption that no mortality or injury from collisions with vessels occurs as carcasses that do not drift ashore may go unreported, and those that do strand may show no obvious signs of having been struck by a ship (NMFS 2009a). Worldwide, sperm whales are known to have been struck 17 times out of a total record of 292 strikes of all large whales, 13 of which resulted in mortality (Jensen and Silber 2003a; Laist et al. 2001). Given the current number of reported cases of injury and mortality, it does not appear that ship strikes are a significant threat to sperm whales (Whitehead 2003).

4.2.5.12 Critical Habitat

The NMFS has not designated critical habitat for sperm whales.

4.2.6 Green Sea Turtle

Green sea turtles (*Chelonia mydas*) are the largest of all the hard-shelled sea turtles, but have a comparatively small head. While hatchlings are just 2 inches (50 mm) long, adults can grow to more than 3 feet (0.91 m) long and weigh 300 to 350 pounds (136 to 159 kg).

Adult green turtles are unique among sea turtles in that they are herbivorous, feeding primarily on sea grasses and algae. This diet is thought to give them greenish colored fat, from which they take their name. A green turtle's carapace (top shell) is smooth and can be shades of black, gray, green, brown, and yellow. Their plastron (bottom shell) is yellowish white.

Scientists estimate green turtles reach sexual maturity anywhere between 20 and 50 years, at which time females begin returning to their natal beaches (i.e., the same beaches where they were born) every two to four years to lay eggs.

4.2.6.1 Populations

The population dynamics of green turtles and all of the other sea turtles we consider in this Opinion are usually described based on the distribution and habit of nesting females, rather than their male counterparts. The spatial structure of male sea turtles and their fidelity to specific coastal areas is unknown; however, we describe sea turtle populations based on the nesting beaches that female sea turtles return to when they mature. Because the patterns of increase or decrease in the abundance of sea turtle nests over time are determined by internal dynamics rather than external dynamics, we make inferences about the growth or decline of sea turtle populations based on the status and trend of their nests.

Primary nesting aggregations of green turtles (i.e. sites with greater than 500 nesting females per year) include: Ascension Island (south Atlantic Ocean), Australia, Brazil, Comoros Islands, Costa Rica, Ecuador (Galapagos Archipelago), Equatorial Guinea (Bioko Island), Guinea-Gissau (Bijagos Archipelago), Iles Eparses Islands (Tromelin Island, Europa Island), Indonesia, Malaysia, Myanmar, Oman, Philippines, Saudi Arabia, Seychelles Islands, Suriname, and United States (Florida; NMFS and USFWS 1998d; Seminoff et al. 2002a).

Smaller nesting aggregations include: Angola, Bangladesh, Bikar Atoll, Brazil, Chagos Archipelago, China, Costa Rica, Cuba, Cyprus, Democratic Republic of Yemen, Dominican Republic, d'Entrecasteaux Reef, French Guiana, Ghana, Guyana, India, Iran, Japan, Kenya, Madagascar, Maldives Islands, Mayotte Archipelago, Mexico, Micronesia, Pakistan, Palmerston Atoll, Papua New Guinea, Primieras Islands, Sao Tome é Principe, Sierra Leone, Solomon Islands, Somalia, Sri Lanka, Taiwan, Tanzania, Thailand, Turkey, Scilly Atoll, United States (Hawaii), Venezuela, and Vietnam.

Molecular genetic techniques have helped researchers gain insight into the distribution and ecology of migrating and nesting green turtles. In the Pacific Ocean, green turtles group into two distinct regional clades: (1) western Pacific and South Pacific islands, and (2) eastern Pacific and central Pacific, including the rookery at French Frigate Shoals, Hawaii. On March 23, 2015 NMFS publishged a proposed rule to list 11 DPSs of green sea turtles (80 FR 15271). The green sea turtles in the Action Area would occur in the endangered Central West Pacific DPS if the rule is finalized as it is currently written. The Central West Pacific DPS would be part of the western Pacific and South Pacific islands regional clade.

4.2.6.2 Distribution

Green turtles are found in the Pacific Ocean, Atlantic Ocean, Indian Ocean, Carribean Sea, and Mediterranean Sea, primarily in tropical or, to a lesser extent, subtropical waters. These regions can be further divided into nesting aggregations within the eastern, central, and western Pacific Ocean; the western, northern, and eastern Indian Ocean; Mediterranean Sea; and eastern, southern, and western Atlantic Ocean, including the Carribean Sea.

Green turtles appear to prefer waters that usually remain around 20 °C in the coldest month. During warm spells (e.g., El Niño), green turtles may be found considerably north of their normal distribution. Stinson (1984a) found green turtles to appear most frequently in U.S. coastal waters with temperatures exceeding 18 °C. Further, green turtles seem to occur preferentially in drift lines or surface current convergences, probably because of the prevalence of cover and higher densities of their food items associated with these oceanic phenomena. Underwater

resting sites include coral recesses, the underside of ledges, and sand bottom areas that are relatively free of strong currents and disturbance from natural predators and humans. Available information indicates that green turtle resting areas are in proximity to their feeding areas (NMFS and USFWS 1998b).

4.2.6.3 Migration and Movement

Green sea turtles are highly mobile and undertake complex movements through geographically disparate habitats during their lifetimes (Musick and Limpus 1997b; Plotkin 2003). The periodic migration between nesting sites and foraging areas by adults is a prominent feature of their life history. After departing as hatchlings and residing in a variety of marine habitats for 40 or more years (Limpus and Chaloupka 1997), green sea turtles make their way back to the same beach from which they hatched (Carr et al. 1978; Meylan et al. 1990). At approximately 20 to 25 cm carapace length, juveniles leave pelagic habitats and enter benthic foraging areas (Bjorndal 1997a). Green sea turtles spend the majority of their lives in coastal foraging grounds (MacDonald et al. 2012). These areas include both open coastline and protected bays and lagoons. While in these areas, green sea turtles rely on marine algae and seagrass as their primary dietary constituents, although some populations also forage heavily on invertebrates. Although green sea turtles in tropical areas seem to undergo a sudden, permanent switch in habitat from oceanic to neritic habitats, individuals in more temperate areas seem to utilize a wider array of habitats dependent upon oceanographic conditions (González Carman et al. 2012). There is some evidence that individuals move from shallow seagrass beds during the day to deeper areas at night (Hazel 2009). However, avoidance of areas of greater than 10 m when moderate depths of 5 to 10 m with sea grass beds has been found, with speed and displacement from capture locations being similar at night as during the daytime (Senko et al. 2010a). East Pacific adults migrate along coastal corridors between Central American nesting and foraging locations (Blanco et al. 2012).

4.2.6.4 Habitat

Green turtles appear to prefer waters that usually remain around 20º C in the coldest month, but may occur considerably north of these regions during warm-water events, such as El Niño. Stinson (1984c) found green turtles to appear most frequently in U.S. coastal waters with temperatures exceeding 18º C. Further, green sea turtles seem to occur preferentially in drift lines or surface current convergences, probably because of the prevalence of cover and higher prey densities that associate with flotsam. For example, in the western Atlantic Ocean, drift lines commonly containing floating *Sargassum* spp. are capable of providing juveniles with shelter (NMFS and USFWS 1998c). Underwater resting sites include coral recesses, the underside of ledges, and sand bottom areas that are relatively free of strong currents and disturbance. Available information indicates that green turtle resting areas are near feeding areas (Bjorndal and Bolten 2000). Strong site fidelity appears to be a characteristic of juveniles green sea turtles along the Pacific Baja coast (Senko et al. 2010b). Recent tagging data from off the northwestern coast of Saipan and the western coast of Tinian also indicate strong site fidelity (Jones and Van Houtan 2014).

4.2.6.5 Growth and Reproduction

Most green sea turtles exhibit particularly slow growth rates, which have been attributed to their largely plant-eating diet (Bjorndal 1982). Growth rates of juveniles vary substantially among populations, ranging from <1 cm/year (Green 1993) to >5 cm/year (McDonald Dutton and

Dutton 1998), likely due to differences in diet quality, duration of foraging season (Chaloupka et al. 2004b), and density of turtles in foraging areas (Balazs and Chaloupka 2004; Bjorndal et al. 2000a; Seminoff et al. 2002b). Hart et al. (2013a) found growth rates of green sea turtles in the U.S. Virgin Islands to range from 0 to 9.5 cm annually (mean of 4.1, SD 2.4). The largest growth rates were in the 30 to 39 cm class. If individuals do not feed sufficiently, growth is stunted and apparently does not compensate even when greater-than-needed resources are available (Roark et al. 2009). In general, there is a tendency for green sea turtles to exhibit monotonic growth (declining growth rate with size) in the Atlantic and non-monotonic growth (growth spurt in mid-size classes) in the Pacific, although this is not always the case (Balazs and Chaloupka 2004; Chaloupka and Musick 1997; Seminoff et al. 2002b). It is estimated that green sea turtles reach a maximum size just under 100 cm in carapace length (Tanaka 2009). A female-bias has been identified from studies of green sea turtles (Wibbels 2003).

Consistent with slow growth, age-to-maturity for green sea turtles appears to be the longest of any sea turtle species and ranges from ~20 to 40 years or more (Balazs 1982; Chaloupka et al. 2004b; Chaloupka and Musick 1997; Frazer and Ehrhart 1985b; Hirth 1997; Limpus and Chaloupka 1997; Seminoff et al. 2002b; Zug et al. 2002; Zug and Glor 1998). Estimates of reproductive longevity range from 17 to 23 years (Carr et al. 1978; Chaloupka et al. 2004b; Fitzsimmons et al. 1995). Considering that mean duration between females returning to nest ranges from 2 to 5 years (Hirth 1997), these reproductive longevity estimates suggest that a female may nest 3 to 11 seasons over the course of her life. Each female deposits 1 to 7 clutches (usually 2 to 3) during the breeding season at 12 to 14 day intervals. Mean clutch size is highly variable among populations, but averages 110 to 115 eggs/nest. Females usually have 2 to 4 or more years between breeding seasons, whereas males may mate every year (Balazs 1983). Based on reasonable means of three nests per season and 100 eggs per nest (Hirth 1997), a female may deposit 9 to 33 clutches, or about 900 to 3,300 eggs, during her lifetime. Nesting sites appear to be related to beaches with relatively high exposure to wind or wind-generated waves (Santana Garcon et al. 2010).

Once hatched, sea turtles emerge and orient towards a light source, such as light shining off the ocean. They enter the sea in a “frenzy” of swimming activity, which decreases rapidly in the first few hours and gradually over the first several weeks (Ischer et al. 2009; Okuyama et al. 2009). Factors in the ocean environment have a major influence on reproduction (Chaloupka 2001; Limpus and Nicholls 1988; Solow et al. 2002). It is also apparent that during years of heavy nesting activity, density dependent factors (beach crowding and digging up of eggs by nesting females) may impact hatchling production (Tiwari et al. 2005; Tiwari et al. 2006). Precipitation, proximity to the high tide line, and nest depth can also significantly affect nesting success (Cheng et al. 2009). Precipitation can also be significant in sex determination, with greater nest moisture resulting in a higher proportion of males (Leblanc and Wibbels 2009). Green sea turtles often return to the same foraging areas following nesting migrations (Broderick et al. 2006; Godley et al. 2002). Once there, they move within specific areas, or home ranges, where they routinely visit specific localities to forage and rest (Godley et al. 2003; Makowski et al. 2006; Seminoff and Jones 2006; Seminoff et al. 2002a; Taquet et al. 2006). It is also apparent that some green sea turtles remain in pelagic habitats for extended periods, perhaps never recruiting to coastal foraging sites (Pelletier et al. 2003).

In general, survivorship tends to be lower for juveniles and subadults than for adults. Adult survivorship has been calculated to range from 0.82 to 0.97 versus 0.58 to 0.89 for juveniles (Chaloupka and Limpus 2005; Seminoff et al. 2003; Troëng and Chaloupka 2007), with lower values coinciding with areas of human impact on green sea turtles and their habitats (Bjorndal et al. 2003; Campbell and Lagueux 2005).

4.2.6.6 Feeding

While offshore and sometimes in coastal habitats, green sea turtles are not obligate plant-eaters as widely believed, and instead consume invertebrates such as jellyfish, sponges, sea pens, and pelagic prey (Godley et al. 1998; Hart et al. 2013b; Hatase et al. 2006b; Heithaus et al. 2002; Parker and Balazs in press; Seminoff et al. 2002a). A shift to a more herbivorous diet occurs when individuals move into neritic habitats, as vegetable mater replaces an omnivorous diet at around 59 cm in carapace length off Mauritania (Cardona et al. 2009). This transition may occur rapidly starting at 30 cm carapace length, but animal prey continue to constitute an important nutritional component until individuals reach about 62 cm (Cardona et al. 2010). Foraging within seagrass ecosystems by green sea turtles can be significant enough to alter habitat and ecological parameters, such as species composition (Lal et al. 2010). Although populations can consume a variety of prey and be considered generalists as a whole, individuals maintain a highly-selective diet over long time frames (Vander Zanden et al. 2013).

4.2.6.7 Diving

Based on the behavior of post-hatchlings and juvenile green turtles raised in captivity, we presume that those in pelagic habitats live and feed at or near the ocean surface, and that their dives do not normally exceed several meters in depth (Hazel et al. 2009; NMFS and USFWS 1998c). Recent data from Australia indicate green sea turtles rarely dive deep, staying in upper 8 m of the water column (Hazel et al. 2009). Daytime dives were shorter and shallower than were nighttime dives (Ballorain et al. 2013; Hazel et al. 2009). Green turtles migrating between the northwestern and main Hawaiian Islands reached a maximum depth greater than 445 ft. (135.6 m) at night (the deepest dives ever recorded for a green turtle) with a mean maximum night dive depth of 115 to 164 ft. (35–50 m) but only 14.1 ft. (4.3 m) during the day (Rice and Balazs 2008b). In their coastal habitat, green turtles typically make dives shallower than 100 ft. (30.5 m) (Hatase et al. 2006a; Hays et al. 2000; Hochscheid et al. 2005; Houghton et al. 2002) and often do not exceed 55 ft. (16.8 m) (Hays et al. 2000; Rice and Balazs 2008a), although they are known to feed and rest at depths of 65 to 165 ft. (19.8–50.3 m) (Balazs 1980; Brill et al. 1995b). Also, time spent resting and dive duration increased significantly with decreases in seasonal water temperatures. Subadults routinely dive to 20 m for 9 to 23 min, with a maximum recorded dive of over 1 h (Brill et al. 1995a; I-Jiunn 2009). Green sea turtles along Taiwan may rest during long, shallow dives (I-Jiunn 2009). Dives by females may be shorter in the period leading up to nesting (I-Jiunn 2009).

4.2.6.8 Vocalization and Hearing

Sea turtles are low-frequency hearing specialists, typically hearing frequencies from 30 Hz to 2,000 Hz, with a range of maximum sensitivity between 100 Hz and 800 Hz (Bartol et al. 1999c; Lenhardt 1994b; Lenhardt 2002; Moein Bartol and Ketten 2006; Ridgway et al. 1969). Piniak et al. (2012) found green sea turtle juveniles capable of hearing underwater sounds at frequencies of 50 Hz to 1,600 Hz (maximum sensitivity at 200 to 400 Hz). Hearing below 80 Hz is less sensitive but still possible (Lenhardt 1994b). Based upon auditory brainstem responses green sea

turtles have been measured to hear in the 50 Hz to 1,600 Hz range (Dow et al. 2008), with greatest response at 300 Hz (Yudhana et al. 2010); a value verified by Moein Bartol and Ketten (2006). Other studies have found greatest sensitivities are 200 to 400 Hz for the green turtle with a range of 100 Hz to 500 Hz (Moein Bartol and Ketten 2006; Ridgway et al. 1969) and around 250 Hz or below for juveniles (Bartol et al. 1999c). However, Dow et al. (2008) found best sensitivity between 50 Hz and 400 Hz.

These hearing sensitivities are similar to those reported for two terrestrial species: pond and wood turtles. Pond turtles respond best to sounds between 200 Hz and 700 Hz, with slow declines below 100 Hz and rapid declines above 700 Hz, and almost no sensitivity above 3,000 Hz (Wever and Vernon 1956). Wood turtles are sensitive up to about 500 Hz, followed by a rapid decline above 1,000 Hz and almost no responses beyond 3,000 or 4,000 Hz (Patterson 1966).

4.2.6.9 Status and Trends

Green turtles are listed as threatened under the ESA (including those within the MITT Action Area), except for breeding populations found in Florida and the Pacific coast of Mexico, which are listed as endangered.

On March 23, 2015 NMFS published a proposed rule to list 11 DPSs of green sea turtles (80 FR 15271). The green sea turtles in the Action Area would occur in the endangered Central West Pacific DPS if the rule is finalized as it is currently written. Green turtle nesting occurs at low levels throughout the geographic distribution of the DPS (approximately 51 sites), with isolated locations having higher nesting activity. Only two populations are known to have >1,000 nesting turtles, with all the rest having fewer than 400 nesting females, for a total number of known nesting females of approximately 6,500 (80 FR 15271). There is insufficient long-term and standardized monitoring information to adequately describe abundance and population trends for many areas of the Central West Pacific DPS. The available information suggests a nesting population decrease in some portions of the DPS like the Marshall Islands, or unknown trends in other areas such as Palau, Papua New Guinea, the Marianas, Solomon Islands, or the FSM (Maison et al. 2010).

Using a precautionary approach, Seminoff (2002) estimates that the global green turtle population has declined by 34 percent to 58 percent over the last three generations (approximately 150 years). Causes for this decline include harvest of eggs, subadults, and adults; incidental capture by fisheries; loss of habitat; and disease.

Based on the mean annual reproductive effort, 108,761 to 150,521 females nest each year among 46 worldwide nesting sites. Overall, of the 26 sites for which data enable an assessment of current trends, 12 nesting populations are increasing, 10 are stable, and four are decreasing. Long-term continuous datasets of 20 years are available for 11 sites, all of which are either increasing or stable. Despite the apparent global increase in numbers, the positive overall trend should be viewed cautiously because trend data are available for just over half of all sites examined and very few data sets span a full green sea turtle generation (Seminoff 2004).

Green turtles are thought to be declining throughout the Pacific Ocean, with the exception of Hawaii, from a combination of overexploitation and habitat loss (Eckert 1993a; Seminoff et al.

2002a). In the western Pacific, the only major (>2,000 nesting females) populations of green turtles occur in Australia and Malaysia, with smaller colonies throughout the area. Indonesian nesting is widely distributed, but has experienced large declines over the past 50 years. Hawaii green turtles are genetically distinct and geographically isolated, and the population appears to be increasing in size despite the prevalence of fibropapillomatosis and spirochidiasis (Aguirre et al. 1998).

The East Island nesting beach in Hawaii is showing a 5.7 percent annual growth rate over >25 years (Chaloupka et al. 2008a). In the Eastern Pacific, mitochondrial DNA analysis has indicated three key nesting populations: Michoacán, Mexico; Galapagos Islands, Ecuador; and Islas Revillagigedos, Mexico (Dutton 2003). The number of nesting females per year exceeds 1,000 females at each site (NMFS and USFWS 2007a). However, historically, >20,000 females per year are believed to have nested in Michoacán alone (Clifton et al. 1982; NMFS and USFWS 2007a). Thus, the current number of nesting females is still far below historical levels. Datasets over 25 years in Chichi-jima, Japan; Heron Island, Australia; and Raine Island, Australia, show increases in abundance (Chaloupka et al. 2008a).

Historically, the Philippines (Turtle Islands) and Turtle Islands Park of Sabah, Malaysia, are two of the most important insular nesting colonies in Southeast Asia (Seminoff et al. 2004). There is evidence to suggest that green turtle populations nesting in Sabah are stable or increasing, with trends from 1993 to 2001 showing a continued upward trend (Bastinal 2002; Seminoff et al. 2004). Nesting in the Philippines has declined over time, although there are over 3,000 nesting females per year (Seminoff et al. 2004). Additionally, there appears to be a robust green turtle nesting population in Yap State, Federated States of Micronesia, with a total of 888 individual nesting green turtles tagged on Gielop Island between 2005 and 2007 (Maison et al. 2010). It is important to note, however, that increases in population abundance at individual nesting sites do not necessarily reflect population-level increases in abundance.

Green turtles have been documented nesting on many beaches in Guam and the surrounding islands (e.g., FWS BO of military buildup; (Brindock 2013)), though long-term information regarding nesting population trends in in the area are not available. There is, however, indication that the Marianas may provide more important foraging nearshore habitat than nesting (Kolinski et al. 2001; Pultz et al. 1999). Aerial surveys conducted by the Guam Division of Aquatic and Wildlife Resources indicate the year-round presence of green sea turtles in Guam's nearshore waters (Kolinski et al. 2001; NMFS and USFWS 1998c; Pultz et al. 1999). Aggregations of foraging and resting green turtles are often seen in close proximity to Guam's well-developed seagrass beds and reef flats, which are found in Cocos Lagoon, Apra Harbor, along Tarague Beach and Hila'an; in deeper waters south of Falcona Beach; and at several other locations throughout the island's shelf (DON 2003b). Guam Division of Aquatic and Wildlife Resources aerial surveys have identified turtles within Agat Bay, and stranded sea turtles have been recovered from the bay (including one with spear gun injuries). In August 2013, PIFSC researchers conducted snorkeling and boat surveys in Guam's Cocos Lagoon and observed 9 green turtles over the two days of surveys. All individuals observed were juveniles (Jones and Houtan 2014).

On Tinian, green turtle abundance and densities are highest along the island's relatively uninhabited east coast. The most recent estimate of the number of green turtles inhabiting the

nearshore waters around Tinian was 832 turtles in 2001 (Kolinski et al. 2006) and densities of approximately 11.8 animals per km^2. Between November 2013 and March 2014 the CNMI Department of Lands and Natural Resources captured 54 unique green sea turtles (and 3 recaptures), 44 around Saipan and 10 around Tinian. Catch per unit effort for all sea turtles was 3.75 turtle catches per dive-hour (Palacios et al. 2014). In August 2013, a PIFSC researcher conducted snorkeling and boat surveys off the northwestern coast of Saipan and the western coast of Tinian. The team captured four sub-adult green turtles over a four day period (Jones and Houtan 2014).

Green turtles are not as abundant at FDM as they are at some of the larger islands of the Marianas chain. At FDM, at least 9 green turtles were observed during underwater surveys in both 1999 and 2000, at least 12 green turtles were observed during surveys in 2001, and 4 were observed at the northern end of the island in 2003 (DoN 2005a). Annual diver surveys between 2005 and 2012 observed between three (2005) and nine (2009) green sea turtles at FDM (DoN 2013a). Most green turtles at FDM were found either swimming over the reef platform or resting in holes or caves (DoN 2005a) . Due to strong current and tidal conditions, the beaches at FDM are very susceptible to inundation and are highly unsuitable for nesting (DoN 2003a). Also, seagrasses and benthic algae are relatively sparse around the island and can probably support no more than a few green turtles at a time (NMFS and USFWS 1998c). Seven sea turtles were documented in 2006 and 19 in 2007 during monthly monitoring (helicopter surveys) of FDM (DoN 2010c). Monthly observations are usually low (between one and three turtle sightings); however, 12 turtles were observed in waters off FDM on 13 November 2007 (DoN 2010c). Identifying sea turtles to the species level is not possible due to safe flying heights of the helicopter, although due to the higher abundance of green sea turtles relative to hawksbill turtles, the majority of sea turtle observations are assumed to be green sea turtles (DoN 2010c).

Based on the above information, green turtles are expected to occur year round in all shelf waters of the Action Area from FDM to Guam. Around the larger islands, green turtle occurrence is concentrated in waters less than 328 ft. (100.01 m) deep, approximately 11.8 animals per km^2 (4.6 $mi.^2$). It is at these water depths where green turtle foraging and resting habitats (e.g., fringing reefs, reef flats, and seagrass beds) are usually found. Although there may not be long-term data available for Guam or CNMI, data from other Pacific regions show that green sea turtles exhibit strong site fidelity to nearshore foraging habitats for extended periods of time (Balazs 1995; Balazs and Chaloupka 2004). The Navy's NMSDD estimates 0.2968, 11.8, and 0.000391 green sea turtles per km^2 in the nearshore Guam, nearshore Tinian and other islands, and pelagic portions of the MITT Action Area, respectively (DoN 2014). Nesting females and early juveniles are known to move through oceanic waters of the Marianas chain during their reproductive and developmental migrations (Kolinski et al. 2006), but likely do not do so in large numbers.

4.2.6.10 Natural Threats

Herons, gulls, dogfish, and sharks prey upon hatchlings. Adults face predation primarily by sharks and to a lesser extent by killer whales. All sea turtles except leatherbacks can undergo "cold stunning" if water temperatures drop below a threshold level, which can be lethal. For unknown reasons, the frequency of a disease called fibropapillomatosis is much higher in green sea turtles than in other species and threatens a large number of existing subpopulations. Extremely high incidence has been reported in Hawaii, where affliction rates peaked at 47–69

percent in some foraging areas (Murakawa et al. 2000). A to-date unidentified virus may aid in the development of fibropapillomatosis (Work et al. 2009). Predators (primarily of eggs and hatchlings) also include dogs, pigs, rats, crabs, sea birds, reef fishes, and groupers (Bell et al. 1994; Witzell 1981). Green sea turtles with an abundance of barnacles have been found to have a much greater probability of having health issues (Flint et al. 2009). The fungal pathogens *Fusarium falciforme* and *F. keratoplasticum* an kill in excess of 90 percent of sea turtle embryos they infect and may constitute a major threat to nesting productivity under some conditions (Sarmiento-Ramırez et al. 2014).

4.2.6.11 Anthropogenic Threats

Major anthropogenic impacts to the nesting and marine environment affect green sea turtle survival and recovery (Patino-Martinez 2013). At nesting beaches, green sea turtles rely on intact dune structures, native vegetation, and normal beach temperatures for nesting (Ackerman 1997). Structural impacts to nesting habitat include the construction of buildings and pilings, beach armoring and renourishment, and sand extraction (Bouchard et al. 1998; Lutcavage et al. 1997). These factors may directly, through loss of beach habitat, or indirectly, through changing thermal profiles and increasing erosion, serve to decrease the amount of nesting area available to nesting females, and may evoke a change in the natural behaviors of adults and hatchlings (Ackerman 1997; Witherington et al. 2003; Witherington et al. 2007). On the Pacific coast of Mexico in the mid-1970s, >70,000 green turtle eggs were harvested every night. Hundreds of mostly immature green sea turtles were killed between 2006 and 2008 due to bycatch and direct harvest along Baja California Sur (Senko et al. 2014). The presence of lights on or adjacent to nesting beaches alters the behavior of nesting adults (Witherington 1992) and is often fatal to emerging hatchlings as they are attracted to light sources and drawn away from the water (Witherington and Bjorndal 1991b). In addition to impacting the terrestrial zone, anthropogenic disturbances also threaten coastal marine habitats, particularly areas rich in seagrass and marine algae. These impacts include contamination from herbicides, pesticides, oil spills, and other chemicals, as well as structural degradation from excessive boat anchoring and dredging (Francour et al. 1999; Lee Long et al. 2000; Waycott et al. 2005). Ingestion of plastic and other marine debris is another source of morbidity and mortality (Stamper et al. 2009). Green sea turtles stranded in Brazil were all found to have ingested plastics or fishing debris (n = 34), although mortality appears to have resulted in three cases (Tourinho et al. 2009). Low-level bycatch has also been documented in longline fisheries (Petersen et al. 2009). Further, the introduction of alien algae species threatens the stability of some coastal ecosystems and may lead to the elimination of preferred dietary species of green sea turtles (De Weede 1996). Very few green sea turtles are bycaught in U.S. fisheries (Finkbeiner et al. 2011). However, a legal fishery operates in Madagascar that harvested about 10,000 green turtles annually in the mid-1990s. Green sea turtles are killed because they are seen as competitors for fishery resources in parts of India (Arthur et al. 2013). Between 1991 and 2011, an average of 8,169 green sea turtles were harvested annually along the Caribbean coast of Nicaragua (over 171,000 over this period); a rate that has been in decline potentially due to population depletion (Lagueux et al. 2014).

Sea level rise may have significant impacts upon green turtle nesting on Pacific atolls. These low-lying, isolated locations could be inundated by rising water levels associated with global warming, eliminating nesting habitat (Baker et al. 2006; Fuentes et al. 2010). Fuentes et al. (2010) predicted that rising temperatures would be a much greater threat in the long term to the hatching success of sea turtle turtles in general and green sea turtles along northeastern Australia

particularly. Green sea turtles emerging from nests at cooler temperatures likely absorb more yolk that is converted to body tissue than do hatchlings from warmer nests (Ischer et al. 2009). Predicted temperature rises may approach or exceed the upper thermal tolerance limit of sea turtle incubation, causing widespread failure of nests (Fuentes et al. 2010). Although the timing of loggerhead nesting depends upon sea-surface temperature, green sea turtles do not appear to be affected (Pike 2009).

Green sea turtles have been found to contain the organochlorines chlordane, lindane, endrin, endosulfan, dieldrin, DDT and PCB (Gardner et al. 2003; Miao et al. 2001). Levels of PCBs found in eggs are considered far higher than what is fit for human consumption (Van de Merwe et al. 2009). The heavy metals copper, lead, manganese, cadmium, and nickel have also been found in various tissues and life stages (Barbieri 2009). Arsenic also occurs in very high levels in green sea turtle eggs (Van de Merwe et al. 2009). These contaminants have the potential to cause deficiencies in endocrine, developmental, and reproductive health, and depress immune function in loggerhead sea turtles (Keller et al. 2006a; Storelli et al. 2007b). Exposure to sewage effluent may also result in green sea turtle eggs harboring antibiotic-resistant strains of bacteria (Al-Bahry et al. 2009). DDE has not been found to influence sex determination at levels below cytotoxicity (Keller and McClellan-Green 2004; Podreka et al. 1998). To date, no tie has been found between pesticide concentration and susceptibility to fibropapillomatosis, although degraded habitat and pollution have been tied to the incidence of the disease (Aguirre et al. 1994; Foley et al. 2005). Flame retardants have been measured from healthy individuals (Hermanussen et al. 2008). It has been theorized that exposure to tumor-promoting compounds produced by the cyanobacteria *Lyngbya majuscule* could promote the development of fibropapillomatosis (Arthur et al. 2008). It has also been theorized that dinoflagellates of the genus *Prorocentrum* that produce the tumorogenic compound okadoic acid may influence the development of fibropapillomatosis (Landsberg et al. 1999).

The primary, human-related threats to green turtles in Guam and the CNMI include direct harvesting of sea turtles and eggs as well as habitat loss due to rapidly expanding tourism, including increased coastal development on nesting beaches (NMFS and USFWS 1998c). The impacts of vessel strikes in the Central West Pacific are unknown, but not thought to be of great consequence, except possibly in Palau where high speed skiffs constantly travel throughout the lagoon south of the main islands (NMFS and USFWS 1998c). However, green turtles have been documented as occasionally being hit by boats in Guam and CNMI (e.g., unpublished data from Tammy Mae Summers; personal communication; April 7, 2015).

4.2.6.12 Critical Habitat

On September 2, 1998, critical habitat for green sea turtles was designated in coastal waters surrounding Culebra Island, Puerto Rico (63 FR 46693). Aspects of these areas that are important for green sea turtle survival and recovery include important natal development habitat, refuge from predation, shelter between foraging periods, and food for green sea turtle prey. No critical habitat is designated within the MITT Action Area for this species.

4.2.7 Hawksbill Sea Turtle

The hawksbill turtle (*Eretmochelys imbricata*) is a small to medium-sized sea turtle; adults typically range between 65 and 90 cm (26 to 35 in) in carapace length and weigh around 80 kg (176 lb) (Witzell 1983). Hawksbills are distinguished from other sea turtles by their hawk-like

beaks, posteriorly overlapping carapace scutes, and two pairs of claws on their flippers (NMFS and USFWS 1993). The carapace of this species is often brown or amber with irregularly radiating streaks of yellow, orange, black, and reddish-brown.

4.2.7.1 Populations

Hawksbill sea turtles, like other sea turtles, are divided into regional groupings that represent major oceans or seas: the Atlantic Ocean, Pacific Ocean, Indian Ocean, Caribbean Sea and Mediterranean Sea. In these regions, the population structure of hawksbill turtles are usually based on the distribution of their nesting aggregations.

4.2.7.2 Distribution

Hawksbill sea turtles occur in tropical and subtropical seas of the Atlantic, Pacific and Indian Oceans. Hawksbill sea turtles occupy different habitats depending on their life history stage. After entering the sea, hawksbill turtles occupy pelagic waters and occupy weed-lines that accumulate at convergence points. When they grow to about 20 to 25 cm carapace length, hawksbill turtles re-enter coastal waters where they inhabit and forage in coral reefs as juveniles, sub-adults and adults. Hawksbill sea turtles also occur around rocky outcrops and high energy shoals, where sponges grow and provide forage, and they are known to inhabit mangrove-fringed bays and estuaries, particularly along the eastern shore of continents where coral reefs are absent.

Hawksbills are considered the most coastal of the sea turtles that inhabit the Action Area, with juveniles and adults preferring coral reef habitats (NMFS 2013). Reefs provide shelter for resting hawksbills day and night, and they are known to visit the same resting spot repeatedly. Hawksbills are also found around rocky outcrops and high-energy shoals—optimum sites for sponge growth—as well as in mangrove-lined bays and estuaries (NMFS and USFWS 2013).

Hatchling and early juvenile hawksbills have also been found in the open ocean, in floating mats of seaweed (Musick and Limpus 1997a). Although information about foraging areas is largely unavailable due to research limitations, juvenile and adult hawksbills may also be present in open ocean environments (NMFS and USFWS 2007a). Hawksbills were once thought to be a nonmigratory species because of the proximity of suitable nesting beaches to coral reef feeding habitats and the high rates of marked turtles recaptured in these areas; however, tagging studies have shown otherwise. For example, a post-nesting female traveled 995 miles (1,601 km) from the Solomon Islands to Papua New Guinea (Meylan 1995), indicating that adult hawksbills can migrate distances comparable to those of green and loggerhead turtles.

4.2.7.3 Migration and Movement

Upon first entering the sea, neonatal hawksbills in the Caribbean are believed to enter an oceanic phase that may involve long distance travel and eventual recruitment to nearshore foraging habitat (Boulon Jr. 1994). In the marine environment, the oceanic phase of juveniles (i.e., the "lost years") remains one of the most poorly understood aspects of hawksbill life history, both in terms of where turtles occur and how long they remain oceanic. Nesting site selection in the southwest Pacific appears to favor sites with higher wind and wave exposure, possibly as a means to aid hatchling dispersal (Garcon et al. 2010). Adults along the Pacific coast of Central America exhibit highly restrictive, inshore ranges between foraging and nesting locations, most of which was mangrove estuaries (Gaos et al. 2012a). Subadult hawksbill sea turtles captured satellite tracked in the Dry Tortugas National Park showed high-degrees of site fidelity for

extended periods, although all three eventually moved to other areas outside the park (Hart et al. 2012). The same trend was found for adults tracked after nesting in the Dominican Republic, with some remaining for extended periods in the nesting area and other migrating to Honduras and Nicaragua (Hawkes et al. 2012). Satellite tracking for these individuals showed repeated returns to the same Dominican and Central American areas (Hawkes et al. 2012). Hawksbills dispersing from nesting areas along Brazil moved along coastal areas until they reached foraging areas (Marcovaldi et al. 2012). Here, genetically-identified hawksbill-loggerhead hybrids dispersed more broadly than pure-bred hawksbills (Marcovaldi et al. 2012). Home ranges tend to be small (a few square kilometers)(Berube et al. 2012). Recent tagging data from off the coast of Tinian, indicated that one subadult hawksbill remained in the area in which it was tagged for 51 days following capture, and then traveled 286 km, eventually taking up residency in the deeper waters outside of Cocos Lagoon, Guam (Jones and Houtan 2014).

4.2.7.4 Habitat

Hawksbill sea turtles are highly migratory and use a wide range of broadly separated localities and habitats during their lifetimes (Musick and Limpus 1997b; Plotkin 2003). Small juvenile hawksbills (5 to 21 cm straight carapace length) have been found in association with *Sargassum* spp. in both the Atlantic and Pacific oceans (Musick and Limpus 1997b) and observations of newly hatched hawksbills attracted to floating weeds have been made (Hornell 1927; Mellgren and Mann 1996; Mellgren et al. 1994). Post-oceanic hawksbills may occupy a range of habitats that include coral reefs or other hard-bottom habitats, sea grass, algal beds, mangrove bays and creeks (Bjorndal and Bolten 2010; Musick and Limpus 1997b), and mud flats (R. von Brandis, unpublished data in NMFS and USFWS 2007d). Eastern Pacific adult females have recently been tracked in saltwater mangrove forests along El Salvador and Honduras, a habitat that this species was not previously known to occupy (Gaos et al. 2011). Individuals of multiple breeding locations can occupy the same foraging habitat (Bass 1999; Bowen et al. 1996; Bowen et al. 2007; Diaz-Fernandez et al. 1999; Velez-Zuazo et al. 2008). As larger juveniles, some individuals may associate with the same feeding locality for more than a decade, while others apparently migrate from one site to another (Blumenthal et al. 2009a; Mortimer et al. 2003; Musick and Limpus 1997b). Larger individuals may prefer deeper habitats than their smaller counterparts (Blumenthal et al. 2009a). Nesting sites appear to be related to beaches with relatively high exposure to wind or wind-generated waves (Santana Garcon et al. 2010).

4.2.7.5 Growth and Reproduction

The best estimate of age at sexual maturity for hawksbill sea turtles is 20 to 40 years (Chaloupka and Limpus 1997; Crouse 1999). Reproductive females undertake periodic (usually non-annual) migrations to their natal beaches to nest. Movements of reproductive males are less well known, but are presumed to involve migrations to their nesting beach or to courtship stations along the migratory corridor (Meylan 1999). Females nest an average of 3 to 5 times per season (Meylan and Donnelly 1999; Richardson et al. 1999). Clutch size can be up to 250 eggs; larger than that of other sea turtles (Hirth 1980). Reproductive females may exhibit a high degree of fidelity to their nest sites.

The life history of hawksbills consists of a pelagic stage that lasts from hatching until they are approximately 22 to 25 cm in straight carapace length (Meylan 1988; Meylan and Donnelly 1999), followed by residency in coastal developmental habitats. Growth accelerates early on until turtles reach 65 to 70 cm in curved carapace length, after which it slows to negligible

amounts after 80 cm (Bell and Pike 2012). As with other sea turtles, growth is variable and likely depends upon nutrition available (Bell and Pike 2012). Juvenile hawksbills along the British Virgin Islands grow at a relatively rapid rate of roughly 9.3 cm per year and gain 3.9 kg annually (Hawkes et al. 2014).

4.2.7.6 Feeding

Dietary data from oceanic stage hawksbills are limited, but indicate a combination of plant and animal material (Bjorndal 1997b). Sponges and octocorals are common prey off Honduras (Berube et al. 2012; Hart et al. 2013b).

4.2.7.7 Diving

Hawksbill diving ability varies with age and body size. As individuals increase with age, diving ability in terms of duration and depth increases (Blumenthal et al. 2009b). Studies of hawksbills in the Caribbean have found diurnal diving behavior, with dive duration nearly twice as long during nighttime (35 to 47 min) compared to daytime (19-26 min Blumenthal et al. 2009b; Van Dam and Diez 1997). Daytime dives averaged 5 m, while nighttime dives averaged 43 m (Blumenthal et al. 2009b). However, nocturnal differences were not observed in the eastern Pacific (Gaos et al. 2012b).

Hawksbills have long dive durations, although dive depths are not particularly deep. Adult females along St. Croix reportedly have average dive times of 56 min, with a maximum time of 73.5 min (Starbird et al. 1999). Average day and night dive times were 34 to 65 and 42 to 74 min, respectively. Immature individuals have much shorter dives of 8.6 to 14 min to a mean depth of 4.7 m while foraging (Van Dam and Diez 1997).

4.2.7.8 Vocalization and Hearing

Sea turtles are low-frequency hearing specialists, typically hearing frequencies from 30 Hz to 2,000 Hz, with a range of maximum sensitivity between 100 Hz and 800 Hz (Bartol et al. 1999c; Lenhardt 1994b; Lenhardt 2002; Moein Bartol and Ketten 2006; Ridgway et al. 1969). Piniak et al. (2012) found hawksbill hatchlings capable of hearing underwater sounds at frequencies of between 50 and 1,600 Hz (maximum sensitivity at 200 to 400 Hz). Hearing below 80 Hz is less sensitive but still possible (Lenhardt 1994b).

4.2.7.9 Status and Trends

Hawksbill turtles were listed as endangered throughout their range under the ESA in 1970. Under the Convention on International Trade in Endangered Species of Wild Fauna and Flora, hawksbill turtles are identified as "critically endangered" (IUCN 2010).

The Hawksbill Sea Turtle (*Eretmochelys imbricata*) 5-year Review: Summary and Evaluation (NMFS and USFWS 2013) assessed nesting abundance and nesting trends in all regions that the hawksbill turtles inhabit. Where possible, historical population trends were determined, and most showed declines for the 20 to 100 year period of evaluation. Recent trends for 42 of the sites indicated that 69 percent were decreasing, seven percent were stable, and that 24 percent were increasing. Seven of the 83 sites occur in the central Pacific Ocean and one occurs in the eastern Pacific Ocean (Baja California, Mexico), all with decreasing long-term population trends; only the Hawaii site has a recent increasing trend. Although no historical records of abundance are known, hawksbill sea turtles are considered to be severely depleted due to the fragmentation and

low use of current nesting beaches (NMFS and USFWS 2007d). Worldwide, an estimated 21,212 to 28,138 hawksbills nest each year among 83 sites. Among the 58 sites with historic trends, all show a decline during the past 20 to 100 years.

American Samoa and Western Samoa host fewer than 30 females annually (Grant et al. 1997; Tuato'o-Bartley et al. 1993). In Guam, only 5 to 10 females are estimated to nest annually (G. Balazs, NMFS, in litt. to J. Mortimer 2007; G. Davis, NMFS, in litt. to J. Mortimer 2007) and the same is true for Hawaii, but there are indications that this population is increasing (G. Balazs, pers. comm. in NMFS and USFWS 2007d). Additional populations are known from the eastern Pacific (potentially extending from Mexico through Panama), northeastern Australia, and Malaysia (Hutchinson and Dutton 2007). El Salvador is now known to host the majority of hawksbill turtle nesting activity in the eastern Pacific, with 79.6 percent (n = 5430) of all nesting observation records, and Mexico hosting the majority of records of hawksbill turtles at sea, with 60.3 percent (n = 544) of all in-water observation records (Gaos et al. 2010). Total number of nesting females for the Central Pacific hawksbill population was estimated at 940 to 1,200 females annually for the last few years, with an overall downward trend (NMFS and USFWS 2007b). In August 2013, a PIFSC researcher and his crew captured two sub-adult hawksbills over a four days survey period off the northwestern coast of Saipan and the western coast of Tinian (Jones and Houtan 2014). Between November 2013 and March 2014 the CNMI Department of Lands and Natural Resources captured three hawksbill sea turtles, two around Tinian and one around Saipan (Palacios et al. 2014). The Navy's NMSDD estimates 1.0734, 0.1342, and 0.000024 hawksbill sea turtles per km^2 in the nearshore FDM, nearshore other islands, and pelagic portions of the MITT Action Area, respectively (DoN 2014).

4.2.7.10 Natural Threats

Sea turtles face predation primarily by sharks and to a lesser extent by killer whales. All sea turtles except leatherbacks can undergo "cold stunning" if water temperatures drop below a threshold level, which can be lethal. The only other significant natural threat to hawksbill sea turtles is from hybridization of hawksbills with other species of sea turtles. This is especially problematic at certain sites where hawksbill numbers are particularly low (Mortimer and Donnelly in review). Predators (primarily of eggs and hatchlings) include dogs, pigs, rats, crabs, sea birds, reef fishes, groupers, feral cats, and foxes (Bell et al. 1994; Ficetola 2008). In some areas, nesting beaches can be almost completely destroyed and all nests can sustain some level of depredation (Ficetola 2008). The fungal pathogens *Fusarium falciforme* and *F. keratoplasticum* an kill in excess of 90 percent of sea turtle embryos they infect and may constitute a major threat to nesting productivity under some conditions (Sarmiento-Ramırez et al. 2014).

4.2.7.11 Anthropogenic Threats

Threats to hawksbill sea turtles are largely anthropogenic, both historically and currently. Impacts to nesting beaches include the construction of buildings and pilings, beach armoring and renourishment, and sand extraction (Bouchard et al. 1998; Lutcavage et al. 1997). Because hawksbills prefer to nest under vegetation (Horrocks and Scott 1991; Mortimer 1982), they are particularly impacted by beachfront development and clearing of dune vegetation (Mortimer and Donnelly in review). The presence of lights on or adjacent to nesting beaches alters the behavior of nesting adults (Witherington 1992) and is often fatal to emerging hatchlings as they are attracted to light sources and drawn away from the water (Witherington and Bjorndal 1991b).

One of the most detrimental human threats to hawksbill sea turtles is the intensive harvest of eggs from nesting beaches. Between 1950 and 1992, approximately 1.3 million hawksbill shells were collected to supply tortoiseshell to the Japanese market, the world's largest. Before the U.S. certified Japan under the Pelly Amendment, Japan had been importing about 20 metric tons of hawksbill shell per year, representing approximately 19,000 turtles. Japan stopped importing tortoiseshell in 1993 in order to comply with CITES (Limpus and Miller 2008). Until recently, tens of thousands of hawksbills were captured and killed each year to meet demand for jewelry, ornamentation, and whole stuffed turtles (Eckert 1993c). In 1988, Japan's imports from Jamaica, Haiti and Cuba represented some 13,383 hawksbills: it is extremely unlikely that this volume could have originated solely from local waters (Eckert 1993c). Large numbers of nesting and foraging hawksbill sea turtles are captured and killed for trade in Micronesia, the Mexican Pacific coast, southeast Asia and Indonesia (NMFS and USFWS 1998e).

In addition to impacting the terrestrial zone, anthropogenic disturbances also threaten coastal marine habitats. These impacts include contamination from herbicides, pesticides, oil spills, and other chemicals, as well as structural degradation from excessive boat anchoring and dredging (Francour et al. 1999; Lee Long et al. 2000; Waycott et al. 2005). Hawksbills are typically associated with coral reefs, which are among the world's most endangered marine ecosystems (Wilkinson 2000). Although primarily spongivorous, bycatch of hawksbill sea turtles in the swordfish fishery off South Africa occurs (Petersen et al. 2009). Finkbeiner et al. (2011) estimated that annual bycatch interactions total at least 20 individuals annually for U.S. Atlantic fisheries (resulting in less than ten mortalities) and no or very few interactions in U.S. Pacific fisheries.

Future impacts from climate change and global warming may result in significant changes in hatchling sex ratios. The fact that hawksbill turtles exhibit temperature-dependent sex determination (Wibbels 2003) suggests that there may be a skewing of future hawksbill cohorts toward strong female bias (since warmer temperatures produce more female embryos).

4.2.7.12 Critical Habitat

On September 2, 1998, the NMFS established critical habitat for hawksbill sea turtles around Mona and Monito Islands, Puerto Rico (63 FR 46693). Aspects of these areas that are important for hawksbill sea turtle survival and recovery include important natal development habitat, refuge from predation, shelter between foraging periods, and food for hawksbill sea turtle prey. No critical habitat is designated within the MITT Action Area for this species.

4.2.8 Leatherback Sea Turtle

The leatherback turtle (*Dermochelys coriacea*) is the largest turtle and the largest living reptile in the world. Mature males and females can be as long as six and a half feet (2 m) and weigh almost 2000 lbs. (900 kg). The leatherback is the only sea turtle that lacks a hard, bony shell. A leatherback's carapace is approximately 1.5 inches (4 cm) thick and consists of leathery, oil saturated connective tissue overlaying loosely interlocking dermal bones. The carapace has seven longitudinal ridges and tapers to a blunt point. Adult leatherbacks are primarily black with a pinkish white mottled ventral surface and pale white and pink spotting on the top of the head. The front flippers lack claws and scales and are proportionally longer than in other sea turtles; back flippers are paddle-shaped. The ridged carapace and large flippers are characteristics that make the leatherback uniquely equipped for long distance foraging migrations.

Female leatherbacks lay clutches of approximately 100 eggs on sandy, tropical beaches. Females nest several times during a nesting season, typically at 8 to 12 day intervals. After 60 to 65 days, leatherback hatchlings with white striping along the ridges of their backs and on the margins of the flippers emerge from the nest. Leatherback hatchlings are approximately 50 to 77 cm (2 to 3 inches) in length, with fore flippers as long as their bodies, and weigh approximately 40 to 50 grams (1.4 to 1.8 ounces).

Leatherbacks lack the crushing chewing plates characteristic of sea turtles that feed on hard-bodied prey (Pritchard 1971a) Instead, they have pointed tooth-like cusps and sharp edged jaws that are perfectly adapted for a diet of soft-bodied pelagic (open ocean) prey, such as jellyfish and salps.

4.2.8.1 Populations

Leatherbacks break into four nesting aggregations: Pacific, Atlantic, and Indian oceans, and the Caribbean Sea. Detailed population structure is unknown, but is likely dependent upon nesting beach location.

Leatherbacks are found from tropical waters north to Alaska within the North Pacific and is the most common sea turtle in the eastern Pacific north of Mexico (Eckert 1993b; Stinson 1984b; Wing and Hodge 2002). The west coast of Central America and Mexico hosts nesting from September-March, although Costa Rican nesting peaks during April-May (Chacón-Chaverri and Eckert 2007; LGL Ltd. 2007). Leatherback sea turtles disappeared from India before 1930, have been virtually extinct in Sri Lanka since 1994, and appear to be approaching extinction in Malaysia (Spotila et al. 2000). In Fiji, Thailand, and Australia, leatherback sea turtles have only been known to nest in low densities and scattered sites. Leatherback nesting aggregations occur widely in the Pacific, including China, Malaysia, Papua New Guinea, Indonesia, Thailand, Australia, Fiji, the Solomon Islands, and Central America (Dutton et al. 2007; Limpus 2002). Significant nesting also occurs along the Central American coast (Márquez 1990). Although not generally known to nest on Japanese shores, two nests were identified in the central Ryukyu Islands in 2002 (Kamezaki et al. 2002a).

Nesting beaches also occur in Mexico and Costa Rica (nesting occurs October through March) are a separate population from the western Pacific beaches (Benson et al. 2007a; summary in NMFS and USFWS 2007d; Spotila 2004b). In Costa Rica, leatherbacks nest at Playa Naranjo in Santa Rosa National Park, the second-most important nesting beach on the Pacific coast (Yañez et al. 2010), Rio Oro on the Osa Peninsula, and at various beaches in Las Baulas National Park, which includes Playa Langosta and Playa Grande and contains the largest colony of leatherbacks in the Pacific (Spotila 2004b). Females typically lay six clutches per season (average nine days between nests), which incubate for 58–65 days (Lux et al. 2003). Limited nesting also occurs along Nicaragua, Panama, El Salvador, Vanuatu, and Guatemala.

In the Pacific Ocean, genetic studies have identified three distinct populations (referred to also as genetic stocks or Management Units; see (Wallace et al. 2010a)) of leatherback turtles: (1) Mexico and Costa Rica, which are genetically homogenous but distinct from the western populations; (2) Papua Barat in Indonesia, Papua New Guinea, Solomon Islands, and Vanuatu, which comprise a metapopulation representing a single genetic stock; and (3) Malaysia (Barragan and Dutton 2000; Dutton et al. 1999; Dutton 2005-2006; Dutton et al. 2000b; Dutton

et al. 2006; Dutton 2007). The genetically distinct Malaysia nesting population likely is extirpated (Chan and Liew 1996a; Dutton et al. 1999; Dutton 2005-2006).

4.2.8.2 Distribution

Leatherback turtles are widely distributed throughout the oceans of the world. The species is found in four main regions of the world: the Pacific, Atlantic, and Indian Oceans, and the Caribbean Sea. Leatherbacks also occur in the Mediterranean Sea, although they are not known to nest there. The four main regional areas may further be divided into nesting aggregations. Leatherback turtles are found on the western and eastern coasts of the Pacific Ocean, with nesting aggregations in Mexico and Costa Rica (eastern Pacific) and Malaysia, Indonesia, Australia, the Solomon Islands, Papua New Guinea, Thailand, and Fiji (western Pacific). In the Atlantic Ocean, leatherback nesting aggregations have been documented in Gabon, Sao Tome and Principe, French Guiana, Suriname, and Florida. In the Caribbean, leatherbacks nest in the U.S. Virgin Islands and Puerto Rico. In the Indian Ocean, leatherback nesting aggregations are reported in India and Sri Lanka and KwaZulu Natal, South Africa.

Leatherback turtles are highly migratory, exploiting convergence zones and upwelling areas in the open ocean, along continental margins, and in archipelagic waters (Eckert and Eckert 1988; Eckert 1999b; Morreale et al. 1994b). In a single year, a leatherback may swim more than 10,000 kilometers (Eckert 1998b). In the North Atlantic Ocean, leatherback turtles regularly occur in deep waters (>328 ft), and an aerial survey study in the north Atlantic sighted leatherback turtles in water depths ranging from 3 to 13,618 ft, with a median sighting depth of 131.6 ft (CETAP 1982). This same study found leatherbacks in waters ranging from 7 to 27.2 °C. In the Pacific Ocean, leatherback turtles have the most extensive range of any living reptile and have been reported in all pelagic waters of the Pacific between 71° N and 47° S latitude and in all other major pelagic ocean habitats (NMFS and USFWS 1998a). Leatherback turtles lead a completely pelagic existence, foraging widely in temperate waters except during the nesting season, when gravid females return to tropical beaches to lay eggs. Males are rarely observed near nesting areas, and it has been hypothesized that leatherback turtles probably mate outside of tropical waters, before females swim to their nesting beaches (Eckert and Eckert 1988).

Few quantitative data are available concerning the seasonality, abundance, or distribution of leatherbacks in the central northern Pacific Ocean. Satellite tracking studies and occasional incidental captures of the species in the Hawaii-based longline fishery indicate that deep ocean waters are the preferred habitats of leatherback turtles in the central Pacific Ocean (NMFS and USFWS 2007c). The primary migration corridors for leatherbacks are across the North Pacific Subtropical Gyre, with the eastward migration route possibly to the north of the westward migration.

The primary data available for leatherbacks in the North Pacific Transition Zone come from longline fishing bycatch reports, as well as several satellite telemetry data sets (Benson et al. 2007b). Leatherbacks from both eastern and western Pacific Ocean nesting populations migrate to northern Pacific Ocean foraging grounds, where longline fisheries operate (Dutton et al. 1998a). Leatherbacks from nesting beaches in the Indo-Pacific region have been tracked migrating thousands of kilometers through the North Pacific Transition Zone to summer foraging grounds off the coast of northern California (Benson et al. 2007b). Genetic sampling of 18 leatherback turtles caught in the Hawaiian longline fishery indicated that about 94 percent

originated from western Pacific Ocean nesting beaches (NMFS and USFWS 2007c). The remaining six percent of the leatherback turtles found in the open ocean waters north and south of the Hawaiian Islands represent nesting groups from the eastern tropical Pacific Ocean.

4.2.8.3 Migration and Movement

Leatherback sea turtles migrate throughout open ocean convergence zones and upwelling areas, along continental margins, and in archipelagic waters (Eckert 1998a; Eckert 1999a; Morreale et al. 1994a). In a single year, a leatherback may swim more than 9,600 km to nesting and foraging areas throughout ocean basins (Benson et al. 2007a; Benson et al. 2007c; Eckert 1998a; Eckert 2006; Eckert et al. 2006; Ferraroli et al. 2004; Hays et al. 2004; Sale et al. 2006). Much of this travel may be due to movements within current and eddy features, moving individuals along (Sale and Luschi 2009). Return to nesting beaches may be accomplished by a form of geomagnetic navigation and use of local cues (Sale and Luschi 2009). Leatherback females will either remain in nearshore waters between nesting events, or range widely, presumably to feed on available prey (Byrne et al. 2009; Fossette et al. 2009a).

Fossette et al. (2009b) identified three main migratory strategies in leatherbacks in the North Atlantic (almost all of studied individuals were female). One involved 12 individuals traveling to northern latitudes during summer/fall and returning to waters during winter and spring. Another strategy used by six individuals was similar to this, but instead of a southward movement in fall, individuals overwintered in northern latitudes (30–40º N, 25–30º W) and moved into the Irish Sea or Bay of Biscay during spring before moving south to between 5 and 10º in winter, where they remained or returned to the northwest Atlantic. A third strategy, which was followed by three females remaining in tropical waters for the first year subsequent to nesting and moving to northern latitudes during summer/fall and spending winter and spring in latitudes of 40–50º N. Individuals nesting in Caribbean Islands migrate to foraging areas off Canada (Richardson et al. 2012).

Females tracked from nesting beaches in Brazil stayed in waters off Brazil, Uruguay, and Argentina (Almeida et al. 2011). Adult and subadult leatherbacks caught in fisheries operating in southern waters off Uruguay (Fossette et al. 2010a; Lopez-Mendilaharsu et al. 2009) and Brazil (Almeida et al. 2011) remained in the southwestern Atlantic Ocean.

Genetic studies support the satellite telemetry data indicating a strong difference in migration and foraging fidelity between the breeding populations in the northern and southern hemispheres of the Atlantic Ocean (Dutton et al. 2013; Stewart et al. 2013). Genetic analysis of rookeries in Gabon and Ghana confirm that leatherbacks from West African rookeries migrate to foraging areas off South America (Dutton et al. 2013). Foraging adults off Nova Scotia, Canada, mainly originate from Trinidad and none are from Brazil, Gabon, Ghana, or South Africa (Stewart et al. 2013).

Leatherbacks occur along the southeastern U.S. year-round, with peak abundance in summer (TEWG 2007). In spring, leatherback sea turtles appear to be concentrated near the coast, while other times of the year they are spread out at least to the Gulf Stream. From August 2009 through August 2010 off Jacksonville, Florida, surveys sighted 48 leatherback sea turtles, while simultaneous vessel surveys sighted four leatherback sea turtles (U.S. Department of the Navy 2010).

Leatherback sea turtles feed, rest, and migrate regularly in the northern Gulf of Mexico, inhabiting deep offshore waters in the vicinity of DeSoto Canyon (Davis et al. 2000a; Landry and Costa 1999). Leatherback sea turtles feed in shallow waters on the continental shelf waters along the Florida Panhandle, the Mississippi River Delta, and the Texas coast on dense aggregations of (Collard 1990).

Satellite tracking data reveal that leatherback females leaving Mexican and Central American nesting beaches migrate towards the equator and into Southern Hemisphere waters, some passing the Galápagos Islands, and disperse south of 10º S (Dutton et al. 2006; Shillinger et al. 2010a). However, observations of leatherbacks in the Galápagos Islands are rare (Zárate et al. 2010).

Nesting site selection in the southwest Pacific appears to favor sites with higher wind and wave exposure, possibly as a means to aid hatchling dispersal (Garcon et al. 2010). Individuals nesting in Malaysia undergo migrations to tropical feeding areas, taking 5–7 months to arrive there from nesting locations (Benson et al. 2011b). Additional foraging occurs in temperate locations, including across the Pacific basin along the U.S. west coast; individuals take 10–12 months to migrate here (Benson et al. 2011b). Individuals nesting during the boreal summer move to feeding areas in the North China Sea, while boreal winter nesters moved across the Equator to forage in the Southern Hemisphere (Benson et al. 2011b).

4.2.8.4 Habitat

Leatherbacks occur throughout marine waters, from nearshore habitats to oceanic environments (Grant and Ferrell 1993; Schroeder and Thompson 1987; Shoop and Kenney 1992; Starbird et al. 1993). Movements are largely dependent upon reproductive and feeding cycles and the oceanographic features that concentrate prey, such as frontal systems, eddy features, current boundaries, and coastal retention areas (Benson et al. 2011b; Collard 1990; Davenport and Balazs 1991; Frazier 2001; HDLNR (Hawai'i Department of Land and Natural Resources) 2002). Cool, shallow, productive waters are areas where leatherbacks concentrate during late fall, winter, and early spring, where their dives become shallower and shorter, presumeably associated with foraging opportunities (Dodge et al. 2014). Aerial surveys off the western U.S. support continental slope waters as having greater leatherback occurrence than shelf waters (Bowlby et al. 1994; Carretta and Forney 1993; Green et al. 1992; Green et al. 1993). Nesting sites appear to be related to beaches with relatively high exposure to wind or wind-generated waves (Santana Garcon et al. 2010).

Areas above 30º N in the Atlantic appear to be popular foraging locations (Fossette et al. 2009b). Northern foraging areas were proposed for waters between 35º and 50º N along North American, Nova Scotia, the Gulf of Saint-Laurent, in the western and northern Gulf Stream, the Northeast Atlantic, the Azores front and northeast of the Azores Islands, north of the Canary Islands. Southern foraging was proposed to occur between 5º and 15º N in the Mauritania upwelling, south of the Cape Verde islands, over the Guinea Dome area, and off Venezuela, Guyana and Suriname.

For the western Pacific population, seven ecoregions (South China/Sulu and Sulawesi Seas, Indonesian Seas, East Australian Current Extension, Tasman Front, Kuroshio Extension, equatorial Eastern Pacific, and California Current Extension) were identified as important seasonal foraging areas (Benson et al. 2011a). Off the U.S. west coast, two areas were identified

as essential ("critical") habitat for leatherbacks in 2012. One includes the nearshore waters between Cape Flattery, Washington, and Cape Blanco, Oregon extending offshore to the 2000 meter isobaths. This area was identified as the principal Oregon/Washington foraging area and included important habitat associated with the Columbia River Plume, and Heceta Bank, Oregon. Here, great densities of primary prey species, brown sea nettle, occur seasonally north of Cape Blanco (Brodeur et al. 2005; Reese 2005; Shenker 1984). The second area identified as "critical habitat" includes offshore waters between the 200 and 3000 meter isobaths from Point Arena to Point Sur, California and waters between the coastline and the 3000 meter isobath from Point Sur to Point Arguello, California.

In the eastern Pacific Ocean, post-nesting females from Playa Grande, Costa Rica, commonly forage offshore in the South Pacific Gyre in upwelling areas of cooler, deeper water and high productivity (Shillinger et al. 2011). During the nesting season, they stay within the shallow, highly productive, continental shelf waters (Shillinger et al. 2010b).

4.2.8.5 Growth and Reproduction

It has been thought that leatherbacks reach sexual maturity somewhat faster than other sea turtles (except Kemp's ridley), with an estimated range of 3–6 years (Rhodin 1985) to 13–14 years (Zug and Parham 1996). However, recent research suggests otherwise, with western North Atlantic leatherbacks possibly not maturing until as late as 29 years of age (Avens and Goshe 2007; Avens and Goshe 2008; Avens et al. 2009). Female leatherbacks nest frequently (up to 13, average of 5–7 nests per year and about every 2-3 years)(Eckert et al. 2012). The average number of eggs per clutch varies by region: Atlantic Ocean (85 eggs), western Pacific Ocean (85 eggs), eastern Pacific Ocean (65 eggs) and Indian Ocean (>100 eggs (Eckert et al. 2012). However, up to ~30 percent of the eggs can be infertile. Thus, the actual proportion of eggs that can result in hatchlings is less than this seasonal estimate. The eggs incubate for 55–75 days before hatching.

4.2.8.6 Sex Ratio

A significant female bias exists in all leatherback populations thus far studied. An examination of strandings and in-water sighting data from the U.S. Atlantic and Gulf of Mexico coasts indicates that 60 percent of individuals were female. Studies of Suriname nesting beach temperatures suggest a female bias in hatchlings, with estimated percentages of females hatched over the course of each season at 75.4, 65.8, and 92.2 percent in 1985, 1986, and 1987, respectively (Plotkin 1995). Binckley et al. (1998) found a heavy female bias upon examining hatchling gonad histology on the Pacific coast of Costa Rica, and estimated male to female ratios over three seasons of 0:100, 6.5:93.5, and 25.7:74.3. James et al. (2007) also found a heavy female bias (1.86:1) as well as a primarily large sub-adult and adult size distribution. Leatherback sex determination is affected by nest temperature, with higher temperatures producing a greater proportion of females (Mrosovsky 1994; Witzell et al. 2005).

4.2.8.7 Feeding

Leatherbacks may forage in high-invertebrate prey density areas formed by favorable features (Eckert 2006; Ferraroli et al. 2004). Although leatherbacks forage in coastal waters, they appear to remain primarily pelagic through all life stages (Heppell et al. 2003). The location and abundance of prey, including medusae, siphonophores, and salpae, in temperate and boreal latitudes likely has a strong influence on leatherback distribution in these areas (Plotkin 1995).

Leatherback prey are frequently found in the deep-scattering layer in the Gulf of Alaska (Hodge and Wing 2000). North Pacific foraging grounds contain individuals from both eastern and western Pacific rookeries, although leatherbacks from the eastern Pacific generally forage in the Southern Hemisphere along Peru and Chile (Dutton 2005-2006; Dutton et al. 2000a; Dutton et al. 1998b). Mean primary productivity in all foraging areas of western Atlantic females is 150 percent greater than in eastern Pacific waters, likely resulting in twice the reproductive output of eastern Pacific females (Saba et al. 2007). Leatherbacks have been observed feeding on jellyfish in waters off Washington State and Oregon (Eisenberg and Frazier 1983; Stinson 1984b).

4.2.8.8 Diving

Leatherbacks are champion deep divers among sea turtles with a maximum recorded dive of over 4,000 m (Eckert et al. 1989; López-Mendilaharsu et al. 2009). Dives are typically 50 to 84 m and 75 to 90 percent of time duration is above 80 m (Standora et al. 1984). Leatherbacks off South Africa were found to spend <1 percent of their dive time at depths greater than 200 m (Hays et al. 2009). Dive durations are impressive, topping 86 min, but routinely 1 to 14 min (Eckert et al. 1989; Eckert et al. 1996; Harvey et al. 2006; López-Mendilaharsu et al. 2009). Most of this time is spent traveling to and from maximum depths (Eckert et al. 1989). Dives are continual, with only short stays at the surface (Eckert et al. 1989; Eckert et al. 1986; Southwood et al. 1999). Off Playa Grande, Costa Rica, adult females spent 57–68 percent of their time underwater, diving to a mean depth of 19 m for 7.4 min (Southwood et al. 1999). Off St. Croix, adult females dove to a mean depth of 61.6 m for an average of 9.9 min, and spent an average of 4.9 min at the surface (Eckert et al. 1989). During shallow dives in the South China Sea, dives averaged 6.9 to 14.5 min, with a maximum of 42 min (Eckert et al. 1996). Off central California, leatherbacks dove to 20 to 30 m with a maximum of 92 m (Harvey et al. 2006). This corresponded to the vertical distribution if their prey (Harvey et al. 2006). Leatherback prey in the Gulf of Alaska are frequently concentrated in the deep-scattering layer (Hodge and Wing 2000). Mean dive and surface durations were 2.9 and 2.2 min, respectively (Harvey et al. 2006). In a study comparing diving patterns during foraging versus travelling, leatherbacks dove shallower (mean of 53.6 m) and moved more slowly (17.2 km/day) while in foraging areas while travelling to or from these areas (81.8 m and 51.0 km/day) (Fossette et al. 2009b).

4.2.8.9 Vocalization and Hearing

Sea turtles are low-frequency hearing specialists, typically hearing frequencies from 30 to 2,000 Hz, with a range of maximum sensitivity between 100 and 800 Hz (Bartol et al. 1999c; Lenhardt 1994b; Lenhardt 2002; Moein Bartol and Ketten 2006; Ridgway et al. 1969). Piniak et al. (2012) found leatherback hatchlings capable of hearing underwater sounds at frequencies of 50 to 1,200 Hz (maximum sensitivity at 100 to 400 Hz). Hearing below 80 Hz is less sensitive but still possible (Lenhardt 1994b).

These hearing sensitivities are similar to those reported for two terrestrial species: pond and wood turtles. Pond turtles respond best to sounds between 200 and 700 Hz, with slow declines below 100 Hz and rapid declines above 700 Hz, and almost no sensitivity above 3 kHz (Wever and Vernon 1956). Wood turtles are sensitive up to about 500 Hz, followed by a rapid decline above 1 kHz and almost no responses beyond 3 or 4 kHz (Patterson 1966).

4.2.8.10 Status and Trends

Leatherback sea turtles received protection on June 2, 1970 (35 FR 8491) under the Endangered Species Conservation Act and, since 1973, have been listed as endangered under the ESA, but declines in nesting have continued worldwide. Consideration of the status of populations outside of the Action Area is important under the present analysis to determine the risk to the affected population(s) bears on the status of the species as a whole. Breeding females were initially estimated at 29,000 to 40,000, but were later refined to approximately 115,000 (Pritchard 1971b; Pritchard 1982). Spotila et al. (1996) estimated 34,500 females, but later issued an update of 35,860 (Spotila 2004a). The species as a whole is declining and local populations are in danger of extinction (NMFS 2001a; NMFS 2001b).

Reliable estimates of survival or mortality at different life history stages are not easily obtained. The annual survival rate for leatherbacks that nested at Playa Grande, Costa Rica, was estimated to be 0.654 for 1993 and 1994 and 0.65 for those that nested in 1994 and 1995 (Spotila et al. 2000). Rivalan et al. (2005) estimated the mean annual survival rate of adult leatherbacks in French Guiana to be 0.91. Pilcher and Chaloupka (2013) used capture-mark-recapture data for 178 nesting leatherbacks tagged at Lababia beach, Kamiali, on the Huon Coast of Papua New Guinea over a 10-year austral summer nesting period (2000-2009). Annual survival probability (ca. 0.85) was constant over the 10-year period. Annual survival was lower than those estimated for Atlantic rookeries (Dutton et al. 2005; Rivalan et al. 2005). For the St. Croix, U.S. Virgin Islands population, the annual survival rate was approximately 0.893 (confidence interval = 0.87 to 0.92) for adult female leatherbacks at St. Croix (Dutton et al. 2005). Annual juvenile survival rate for St. Croix was estimated to be approximately 0.63, and the total survival rate from hatchling to first year of reproduction for a female hatchling was estimated to be between 0.004 and 0.02, given assumed age at first reproduction between 9 and 13 (Eguchi *et al*. 2006). In Florida, annual survival for nesting females was estimated to be 0.956 (Stewart 2007). Spotila et al. (1996) estimated the first year (from hatching) of survival for the global population to be 0.0625.

Heavy declines have occurred at all major Pacific basin rookeries, as well as Mexico, Costa Rica, Malaysia, India, Sri Lanka, Thailand, Trinidad, Tobago, and Papua New Guinea. This includes a nesting decline of 23 percent between 1984 to 1996 at Mexiquillo, Michoacán, Mexico (Sarti et al. 1996). According to reports from the late 1970s and early 1980s, three beaches on the Pacific coast of Mexico supported as many as half of all leatherback turtle nests for the eastern Pacific. Leatherback sea turtles appear to be in a critical state of decline in the North Pacific Ocean. The leatherback population that nests along the Pacific Ocean was estimated to be over 91,000 adults in 1980 (Spotila et al. 1996) or greater than 39,000 nests (NMFS USFWS 2013), but is now estimated to number 3,172 total nests (NMFS USFWS 2013). Leatherback turtles have experienced major declines at all major Pacific basin rookeries. Since the early 1980s, the eastern Pacific Mexican population of adult female leatherback turtles has declined to slightly more than 200 individuals during 1998 to 1999 and 1999 to 2000 (Sarti et al. 2000). Spotila et al. (2000) reported the decline of the leatherback turtle population at Playa Grande, Costa Rica, which had been the fourth largest nesting colony in the world. Between 1988 and 1999, the nesting colony declined from 1,367 to 117 female leatherback turtles. Based on their models, Spotila et al. (2000) estimated that the colony could fall to less than 50 females by 2003 to 2004. Fewer than 1,000 females nested on the Pacific coast of Mexico from 1995 to 1996 and fewer than 700 females are estimated for Central America (Spotila et al. 2000). The number of leatherback

turtles nesting in Las Baulas National Park declined rapidly during the 1990s, from about 1,500 females during the 1988 to 1989 nesting season, to about 800 in 1990 to 1991 and 1991 to 1992 to 193 in 1993 to 1994 (Williams et al. 1996) and 117 in 1998 to 1999 (Spotila et al. 2000). Spotila (2004b) reported that between 59 and 435 leatherbacks nest at Las Baulas each year depending on the El Niño–La Niña cycle.

There are 28 known nesting sites for the western Pacific Ocean stock, with 5,000 to 9,100 leatherback nests laid annually across the western tropical Pacific Ocean, from Australia and Melanesia (Papua New Guinea, Solomon Islands, Fiji, and Vanuatu) to Indonesia, Thailand, and China (Chaloupka et al. 2004a; Dutton 2006; Hirth et al. 1993; Hitipeuw et al. 2007; Suarez et al. 2000). The largest extant leatherback nesting assemblage in the Indo-Pacific lies on the northern Vogelkop coast of Irian Jaya (West Papua), Indonesia, with roughly 3,000 nests recorded annually (Dutton et al. 2007; Putrawidjaja 2000; Suárez et al. 2000). The Western Pacific leatherback metapopulation harbors the last remaining nesting aggregation of significant size in the Pacific with approximately 2700 to 4500 breeding females (Dutton et al. 2007; Hitipeuw et al. 2007). The total number of nests per year for the Jamursba-Medi leatherback nesting population ranged between a high of 6,373 nests in 1996 and a low of 1,537 nests in 2010 (Hitipeuw et al. 2007) and 1,596 in 2011 (Tapilatu et al. 2013). Nesting at Terengganu, Malaysia is 1 percent of that in 1950s (Chan and Liew 1996b). The South China Sea and East Pacific nesting colonies have undergone catastrophic collapse. Overall, Pacific populations have declined from an estimated 81,000 individuals to < 3,000 total adults and subadults (Spotila et al. 2000). The number of nesting leatherbacks has declined by an estimated 95 percent over the past 20 years in the Pacific (Gilman 2009). Drastic overharvesting of eggs and mortality from fishing activities is likely responsible for this tremendous decline (Eckert 1997; Sarti et al. 1996). The most recent overall estimate for Papua Barat, Indonesia, Papua New Guinea, and Solomon Islands is 5,000 to 10,000 nests per year (Nel 2012).

Of the three sea turtle species that have been sighted around Guam and the CNMI during marine surveys, the leatherback turtle is the least common (DON 2003b). This species is occasionally encountered in the deep, pelagic waters of the Marianas archipelago, although only a few occurrence records exist (Eckert et al. 1999). Recent National Oceanic and Atmospheric satellite tracking of leatherback turtles indicates sea turtles departing from regional nesting habitats and transiting through MITT waters (Benson et al. 2007a; Benson et al. 2011a). As for nearshore waters, Eldredge (2003)noted a rescue in 1978 of a 249 lb (112.9 kg) leatherback from waters southeast of Cocos Island, Guam. From 1987 to 1989, divers reported seeing leatherbacks in the waters off Harmon Point, Rota; however, none have been seen in the area in recent times (DoN 2010c). Leatherbacks do not nest at any of the islands in Micronesia. As a result, the occurrence of leatherback turtles would be considered rare throughout the year in nearshore waters of the Action Area. Since leatherback occurrences in the waters off Guam and the CNMI would most likely involve individuals in transit, occurrence is not expected in coastal (i.e., shelf) waters around any of the islands in the Action Area. The Navy's NMSDD estimates 0.00022 leatherback sea turtles per km^2 in the MITT Action Area (DoN 2014).

4.2.8.11 Natural Threats

Sea turtles face predation primarily by sharks and to a lesser extent by killer whales (Pitman and Dutton 2004). Hatchlings are preyed upon by herons, gulls, dogfish, and sharks. Leatherback hatching success is particularly sensitive to nesting site selection, as nests that are overwashed

have significantly lower hatching success and leatherbacks nest closer to the high-tide line than other sea turtle species (Caut et al. 2009a). The fungal pathogens *Fusarium falciforme* and *F. keratoplasticum* an kill in excess of 90 percent of sea turtle embryos they infect and may constitute a major threat to nesting productivity under some conditions (Sarmiento-Ramırez et al. 2014). Lost timber on beaches and beachcast logs acan trap adult females nesting on Gabon beaches, resulting in mortality (Ikaran 2013).

4.2.8.12 Anthropogenic Threats

Leatherback nesting and marine environments are facing increasing impacts through widespread development and tourism along nesting beaches (Hamann et al. 2006; Hernandez et al. 2007; Maison 2006; Santidrián Tomillo et al. 2007). Structural impacts to beaches include building and piling construction, beach armoring and renourishment, and sand extraction (Bouchard et al. 1998; Lutcavage et al. 1997). In some areas, timber and marine debris accumulation as well as sand mining reduce available nesting habitat (Bourgeois et al. 2009; Chacón Chaverri 1999; Formia et al. 2003; Laurance et al. 2008). Lights on or adjacent to nesting beaches alter nesting adult behavior and is often fatal to emerging hatchlings as they are drawn to light sources and away from the sea (Bourgeois et al. 2009; Cowan et al. 2002; Deem et al. 2007; Witherington 1992; Witherington and Bjorndal 1991b). Leatherbacks are much more likely to emerge and not nest on developed beaches and much more likely to emerge and nest on undeveloped stretches (Roe et al. 2013). Plastic ingestion is very common in leatherbacks and can block gastrointestinal tracts leading to death (Mrosovsky et al. 2009). Along the coast of Peru, 13 percent of 140 leatherback carcasses were found to contain plastic bags and film (Fritts 1982). A leatherback found stranded along the northern Adriatic had been weakened by plastic ingestion, likely leading to an infection that ultimately killed the individual (Poppi et al. 2012). Although global warming may expand foraging habitats into higher latitude waters, increasing temperatures may increase feminization of nests (Hawkes et al. 2007b; James et al. 2006; McMahon and Hays 2006b; Mrosovsky et al. 1984). Rising sea levels may also inundate nests on some beaches. Egg collection is widespread and attributed to catastrophic declines, such as in Malaysia. Harvest of females along nesting beaches is of concern worldwide.

Bycatch, particularly by longline fisheries, is a major source of mortality for leatherback sea turtles (Crognale et al. 2008; Fossette et al. 2009a; Gless et al. 2008; Petersen et al. 2009). Wallace et al. (2010) estimated that between 1990 and 2008, at least 85,000 sea turtles were captured as bycatch in fisheries worldwide. This estimate is likely at least two orders of magnitude low, resulting in a likely bycatch of nearly half a million sea turtles annually (Wallace et al. 2010c); many of these turtles are expected to be leatherbacks.

Spotila (2000) concluded that a conservative estimate of annual leatherback fishery-related mortality (from longlines, trawls and gillnets) in the Pacific Ocean during the 1990s is 1,500 animals. He estimates that this represented about a 23 percent mortality rate (or 33 percent if most mortality was focused on the East Pacific population). In the Pacific Ocean, between 1,000 and 1,300 leatherback sea turtles are estimated to have been captured and killed in longline fisheries in 2000 (Lewison et al. 2004). Shallow-set longline fisheries based out of Hawaii are estimated to have captured and killed several hundred leatherback sea turtles before they were closed in 2001. When they were re-opened in 2004, with substantial modifications to protect sea turtles, these fisheries were estimated to have captured and killed about 1 or 2 leatherback sea

turtles each year. Between 2004 and 2008, shallow-set fisheries based out of Hawaii are estimated to have captured about 19 leatherback sea turtles, killing about 5 of these sea turtles.

Donoso and Dutton (2010) found that 284 leatherbacks were bycaught between 2001 and 2005 as part of the Chilean longline fishery, with two individuals observed dead; leatherbacks were the most frequently bycaught sea turtle species. Between 8 and 17 leatherback turtles likely died annually between 1990 and 2000 in interactions with the California/Oregon drift gillnet fishery; 500 leatherback turtles are estimated to die annually in Chilean and Peruvian fisheries; 200 leatherback turtles are estimated to die in direct harvests in Indonesia; and, before 1992, the North Pacific driftnet fisheries for squid, tuna, and billfish captured an estimated 1,000 leatherback turtles each year, killing about 111 of them each year. Currently, the U.S. tuna and swordfish longline fisheries managed under the Highly Migratory Species Fishery Management Plan (HMS FMP) are estimated to capture 1,764 leatherbacks (no more than 252 mortalities) for each 3-year period starting in 2007 (NMFS 2004). In 2010, there were 26 observed interactions between leatherback sea turtles and longline gear used in the HMS fishery (Garrison and Stokes 2011). All leatherbacks were released alive, with all gear removed for the majority of captures. While 2010 total estimates are not yet available, in 2009, 285.8 (95 percent CI: 209.6 to 389.7) leatherback sea turtles are estimated to have been taken in the longline fisheries managed under the HMS FMP based on the observed takes (Garrison and Stokes 2010). Lewison et al. (2004) estimated that 30,000 to 60,000 leatherbacks were taken in all Atlantic longline fisheries in 2000 (including the U.S. Atlantic tuna and swordfish longline fisheries, as well as others). Use of circle versus traditional J hooks can severely curtail bycatch (Santos et al. 2012) and new regulations are being developed and implemented in several countries around the world for their use. Finkbeiner et al. (2011) estimated that annual bycatch interactions total 1,400 individuals annually for U.S. Atlantic fisheries (resulting in roughly 40 mortalities) and one hundred interactions in U.S. Pacific fisheries (resulting in about ten mortalities). Garrison and Stokes estimated 597 interactions between leatherbacks and the U.S. Atlantic longline fishery in 2012, mostly with hooks embedded (Garrison and Stokes 2013). Mortality of leatherbacks in the U.S. shrimp fishery is now estimated at 54 turtles per year. Data collected by the NEFSC Fisheries Observer Program from 1994 through 1998 (excluding 1997) indicate that a total of 37 leatherbacks were incidentally captured (16 lethally) in drift gillnets set in offshore waters from Maine to Florida during this period. Observer coverage for this period ranged from 54 to 92 percent. Trinidad and Tobago's Institute for Marine Affairs estimated that more than 3,000 leatherbacks were captured incidental to gillnet fishing in the coastal waters of Trinidad in 2000. Half or more of the gravid turtles in Trinidad and Tobago waters may be killed (Lee Lum 2003), though many of the turtles do not die as a result of drowning, but rather because the fishermen butcher them in order to get them out of their nets (NMFS 2001a).

Egg collection occurs in many countries around the world (e.g., (Billes and Fretey 2004; Brautigam and Eckert 2006; Fretey et al. 2007; Hilterman and Goverse 2007; Kinan 2002; Maison et al. 2010; Santidrián Tomillo et al. 2007; Tomillo et al. 2008). For example, during the 2012 nesting season, 55% (283 of 514) of leatherback nests were poached on Pacuare Playa, Costa Rica (Fonseca and Chacon 2012). Egg harvest has been attributed to catastrophic declines such as in Malaysia. Despite conservation efforts, egg harvest continues at certain levels in Indonesia, Papua New Guinea, Solomon Islands and Vanuatu (Committee 2008). We know little about the effects of contaminants on leatherback sea turtles. The metals arsenic, cadmium, copper, mercury, selenium, and zinc bioaccumulate, with cadmium in highest concentration in

leatherbacks versus any other marine vertebrate (Caurant et al. 1999; Gordon et al. 1998). A diet of primarily jellyfish, which have high cadmium concentrations, is likely the cause (Caurant et al. 1999). Organochlorine pesticides have also been found (McKenzie et al. 1999). PCB concentrations are reportedly equivalent to those in some marine mammals, with liver and adipose levels of at least one congener being exceptionally high (PCB 209: 500-530 ng/g wet weight Davenport et al. 1990; Oros et al. 2009).

4.2.8.13 Critical Habitat

On March 23, 1979, leatherback critical habitat (See Figure Below) was identified adjacent to Sandy Point, St. Croix, U.S.V.I. from the 183 m isobath to mean high tide level between 17° 42'12" N and 65° 50'00" W (44 FR 17710). This habitat is essential for nesting, which has been increasingly threatened since 1979, when tourism increased significantly, bringing nesting habitat and people into close and frequent proximity. However, studies do not currently support significant critical habitat deterioration.

On January 26, 2012, the NMFS designated critical habitat for leatherback sea turtles in waters along Washington State and Oregon (Cape Flattery to Cape Blanco; 64,760 km^2) and California (Point Arena to Point Arguello; 43,798 km^2). The primary constituent element of these areas includes the occurrence of prey species, primarily scyphomedusae of the order Semaeostomeae (*Chrysaora, Aurelia, Phacellophora,* and *Cyanea*), of sufficient condition, distribution, diversity, abundance and density necessary to support individual as well as population growth, reproduction, and development of leatherbacks. No critical habitat is designated within the MITT Action Area for this species.

4.2.9 Loggerhead Sea Turtle

Loggerhead turtles (*Caretta caretta*) were named for their relatively large heads, which support powerful jaws and enable them to feed on hard-shelled prey, such as whelks and conch. The carapace (top shell) is slightly heart-shaped and reddish-brown in adults and sub-adults, while the plastron (bottom shell) is generally a pale yellowish color. The neck and flippers are usually dull brown to reddish brown on top and medium to pale yellow on the sides and bottom. Mean straight carapace length of adults in the southeastern U.S. is approximately 36 in (92 cm); corresponding weight is about 250 lbs (113 kg).

Loggerheads reach sexual maturity at around 35 years of age. In the southeastern U.S., mating occurs in late March to early June and females lay eggs between late April and early September. Females lay three to five nests, and sometimes more, during a single nesting season. The eggs incubate approximately two months before hatching sometime between late June and mid-November.

Hatchlings vary from light to dark brown to dark gray dorsally and lack the reddish-brown coloration of adults and juveniles. Flippers are dark gray to brown above with white to white-gray margins. The coloration of the plastron is generally yellowish to tan. At emergence, hatchlings average 1.8 in (45 mm) in length and weigh approximately 0.04 lbs (20 g).

4.2.9.1 Populations

Five groupings represent loggerhead sea turtles by major sea or ocean basin: Atlantic, Pacific, and Indian oceans, as well as Caribbean and Mediterranean seas. As with other sea turtles,

populations are frequently divided by nesting aggregation (Hutchinson and Dutton 2007). On September 22, 2011, the NMFS designated nine distinct population segments (DPSs) of loggerhead sea turtles: South Atlantic Ocean and southwest Indian Ocean as threatened as well as Mediterranean Sea, North Indian Ocean, North Pacific Ocean, northeast Atlantic Ocean, northwest Atlantic Ocean, South Pacific Ocean, and southeast Indo-Pacific Ocean as endangered (75 FR 12598). Recent ocean-basin scale genetic analysis supports this conclusion, with additional differentiation apparent based upon nesting beaches (Shamblin et al. 2014).

Pacific Ocean rookeries are limited to the western portion of the basin. These sites include Australia, New Caledonia, New Zealand, Indonesia, Japan, and the Solomon Islands.

Population structure in the Pacific is comprised of a northwestern Pacific nesting aggregation in Japan and a smaller southwestern nesting aggregation in Australia and New Caledonia (NMFS 2006e). Genetics of Japanese nesters suggest that this subpopulation is comprised of genetically distinct nesting colonies (Hatase et al. 2002a). Almost all loggerheads in the North Pacific seem to stem from Japanese nesting beaches (Bowen et al. 1995a; Resendiz et al. 1998a). The fidelity of nesting females to their nesting beach allowed differentiation of these subpopulations and the loss of nesting at a beach means a significant loss of diversity and the beach is unlikely to be recolonized (NMFS 2006e).

4.2.9.2 Distribution

Loggerheads are circumglobal, inhabiting continental shelves, bays, estuaries, and lagoons in temperate, subtropical, and tropical waters. Major nesting grounds are generally located in temperate and subtropical regions, with scattered nesting in the tropics (NMFS and USFWS 1998f). The majority of loggerhead nesting is at the western rims of the Atlantic and Indian Oceans. Nesting aggregations occur in the eastern Atlantic at Cape Verde, Greece, Libya, Turkey and along the West African Coast. The western Atlantic and Caribbean hosts nesting aggregations along the U.S. east coast from Virginia through the Florida peninsula, the Dry Tortugas and Northern Gulf of Mexico, the Bahamas, the Yucatan Peninsula, Central America and the Caribbean and into South America. Within the Indian Ocean, nesting aggregations occur at Oman, Yemen, Sri Lanka and Madagascar and South Africa. Pacific Ocean nesting sites include western and eastern Australia and Japan.

Adult loggerheads are known to make considerable migrations from nesting beaches to foraging grounds (TEWG 2009); and evidence indicates turtles entering the benthic environment undertake routine migrations along the coast that are limited by seasonal water temperatures. Small juveniles are found in pelagic waters (e.g., of the North Atlantic and the Mediterranean Sea); and the transition from oceanic to neritic juvenile stages can involve trans-oceanic migrations (Bowen et al. 2004b). Loggerhead nesting is confined to lower latitudes, concentrated in temperate zones and subtropics; the species generally does not nest in tropical areas (NMFS and USFWS 1991; NRC 1990b; Witherington et al. 2006). Loggerhead turtles travel to northern waters during spring and summer as water temperatures warm, and southward and offshore toward warmer waters in fall and winter; loggerheads are noted to occur year round in offshore waters of sufficient temperature.

4.2.9.3 Migration and Movement

Loggerhead hatchlings migrate offshore and become associated with *Sargassum* spp. habitats, driftlines, and other convergence zones (Carr 1986). After 14 to 32 years of age, they shift to a

benthic habitat, where immature individuals forage in the open ocean and coastal areas along continental shelves, bays, lagoons, and estuaries (Bowen et al. 2004a; NMFS 2001a). Adult loggerheads make lengthy migrations from nesting beaches to foraging grounds (TEWG 1998a). In the Gulf of Mexico, larger females tend to disperse more broadly after nesting than smaller individuals, which tend to stay closer to the nesting location (Girard et al. 2009). In the North Atlantic, loggerheads travel north during spring and summer as water temperatures warm and return south in fall and winter, but occur offshore year-round assuming adequate temperature. As water temperatures drop from October to December, most loggerheads emigrate from their summer developmental habitats to warmer waters south of Cape Hatteras, where they winter (Morreale and Standora 1998). For immature individuals, this movement occurs in two patterns: a north-south movement over the continental shelf with migration south of Cape Hatteras in winter and movement north along Virginia for summer foraging, and a not-so-seasonal oceanic dispersal into the Gulf Stream as far north as the 10 to 15˚ C isotherm (Mansfield et al. 2009). Wallace et al. (2009) suggested differences in growth rate based upon these foraging strategies. Long Island Sound, Core Sound, Pamlico Sound, Cape Cod Bay, and Chesapeake Bay are the most frequently used juvenile developmental habitats along the Northeast United States Continental Shelf Large Marine Ecosystem (Burke et al. 1991; Delannoy et al. 2013; Epperly et al. 1995a; Epperly et al. 1995b; Epperly et al. 1995c; Hoffman et al. 2013; Mansfield 2006). There is conflicting evidence that immature loggerheads roam the oceans in currents and eddies and mix from different natal origins or distribute on a latitudinal basis that corresponds with their natal beaches (Monzon-Arguello et al. 2009; Wallace et al. 2009). McCarthy et al. (2010) found that movement patterns of loggerhead sea turtles were more convoluted when sea surface temperatures were higher, ocean depths shallower, ocean currents stronger, and chlorophyll a levels lower. Satellite tracking of loggerheads from southeastern U.S. nesting beaches supports three dispersal modes to foraging areas: one northward along the continental shelf to the northeastern U.S., broad movement through the southeastern and mid-Atlantic U.S., and residency in areas near breeding areas (Reina et al. 2012).

Aerial surveys sponsored by the U.S. Navy January to August 2009 sighted 193 loggerhead turtles off the coast of Jacksonville, Florida, while line-transect surveys off North Carolina during the same period sighted 41 loggerhead sea turtles (Arbelo et al. 2012). Aerial observations in Onslow Bay from August 2009 through August 2010 sighted 495 loggerhead sea turtles, while vessel surveys during the same period sighted 47 loggerhead sea turtles (Ramsey 2013). Aerial surveys conducted between August 2009 and August 2010 off Jacksonville, Florida, sighted 716 loggerhead sea turtles, while vessel surveys during the same period sighted 47 loggerhead sea turtles (Ramsey 2013).

Individuals in the western Pacific also show wide-ranging movements. Loggerheads hatched on beaches in the southwest Pacific have been found to range widely in the southern portion of the basin, with individuals from populations nesting in Australia found as far east as Peruvian coast foraging areas still in the juvenile stage (Boyle et al. 2009). Individuals hatched along Japanese coasts have been found to migrate to waters off Baja California via the North Pacific Subtropical Gyre (and the Kuroshio Extension) to feed for several years before migrating back to western Pacific waters to breed (Bowen et al. 1995b; Nichols 2005; Polovina et al. 2006; Polovina et al. 2000; Resendiz et al. 1998b). Adult loggerheads also reside in oceanic waters off Japan (Hatase et al. 2002b). Habitat use off Japan may further be partitioned by sex and size (Hatase et al. 2002b; Hatase and Sakamoto 2004; Hatase et al. 2002c). Loggerheads returning to Japanese

waters seem to migrate along nutrient-rich oceanic fronts (Kobayashi et al. 2008; Nichols et al. 2000; Polovina et al. 2000). Individuals bycaught and satellite tracked in Hawaii longline fisheries show individual movement north and south within a thermal range of 15-25º C, or 28-40º N, with juveniles following the 17 to 20º C isotherm (Kobayashi et al. 2008; Nichols et al. 2000; Polovina et al. 2004). The Transition Zone Chlorophyll Front and Kuroshio Extension Current are likely important foraging areas for juvenile loggerheads (Polovina et al. 2004). The Kuroshio Current off Japan may be significant for juvenile and adult loggerheads as a wintering areas for those individuals not migrating south (Hatase et al. 2002c).

Sighting and stranding records support loggerhead sea turtles to be common, year-round residents of the Gulf of Mexico, although their abundance is much greater in the northeastern region versus the northwestern (Davis et al. 2000b; Fritts et al. 1983; Landry and Costa 1999). An estimated 12 percent of all western North Atlantic Ocean loggerhead sea turtles reside in the eastern Gulf of Mexico, with the vast majority in western Florida waters (Davis et al. 2000a; TEWG 1998b) . Loggerheads may occur in both offshore habitats (particularly around oil platforms and reefs, where prey and shelter are available; (Davis et al. 2000b; Fritts et al. 1983; Gitschlag and Herczeg 1994; Lohoefener et al. 1990; Rosman et al. 1987), as well as shallow bays and sounds (which may be important developmental habitat for late juveniles in the eastern Gulf of Mexico (Davis et al. 2000b; Lohoefener et al. 1990; USAF 1996). Offshore abundance in continental slope waters increases during the winter in the eastern Gulf of Mexico, as cooler inshore waters force individuals into warmer offshore areas (Davis et al. 2000b).

Hatchlings dispersing from Libyan shores preferentially move into the eastern Mediterranean and eventually transition into a neritic phase along southern Tunisia (Saied et al. 2012). Positive North Atlantic Oscillation phases tend to promote loggerhead presence in the western Mediterranean (Baez et al. 2014).

4.2.9.4 Growth and Reproduction

Loggerhead nesting is confined to lower latitudes temperate and subtropic zones but absent from tropical areas (NMFS and USFWS 1991b; NRC 1990a; Witherington et al. 2006b). The life cycle of loggerhead sea turtles can be divided into seven stages: eggs and hatchlings, small juveniles, large juveniles, subadults, novice breeders, first year emigrants, and mature breeders (Crouse et al. 1987). Hatchling loggerheads migrate to the ocean (to which they are drawn by near ultraviolet light Kawamura et al. 2009), where they are generally believed to lead a pelagic existence for as long as 7 to 12 years (NMFS 2005b). Based on growth rate estimates, the duration of the open-ocean juvenile stage for North Atlantic loggerhead sea is roughly 8.2 years (Bjorndal et al. 2000b). Loggerheads in the Mediterranean, similar to those in the Atlantic, grow at roughly 11.8 cm/yr for the first six months and slow to roughly 3.6 cm/yr at age 2.5 to 3.5. As adults, individuals may experience a secondary growth pulse associated with shifting into neritic habitats, although growth is generally monotypic (declines with age Casale et al. 2009a; Casale et al. 2009b). Individually-based variables likely have a high impact on individual-to-individual growth rates (Casale et al. 2009b). At 15 to 38 years, loggerhead sea turtles become sexually mature, although the age at which they reach maturity varies widely among populations (Casale et al. 2009b; Frazer and Ehrhart 1985a; Frazer et al. 1994; NMFS 2001a; Witherington et al. 2006b). However, based on new data from tag returns, strandings, and nesting surveys, NMFS (2001a) estimated ages of maturity ranging from 20 to 38 years and a benthic immature stage lasting from 14 to 32 years. Notably, data from several studies showed decreased growth rates of

loggerheads in U.S. Atlantic waters from 1997 to 2007, corresponding to a period of 43 percent decline in Florida nest counts (Bjorndal et al. 2013).

Loggerhead mating likely occurs along migration routes to nesting beaches, as well as offshore from nesting beaches several weeks prior to the onset of nesting (Dodd 1988a; NMFS and USFWS 1998d). Females usually breed every 2 to 3 years, but can vary from 1 to 7 years (Dodd 1988a; Richardson et al. 1978). Females lay an average of 4.1 nests per season (Murphy and Hopkins 1984) , although recent satellite telemetry from nesting females along southwest Florida support 5.4 nests per female per season, with increasing numbers of eggs per nest during the course of the season (Tucker 2009). The authors suggest that this finding warrants revision of the number of females nesting in the region. The western Atlantic breeding season is March-August. Nesting sites appear to be related to beaches with relatively high exposure to wind or wind-generated waves (Santana Garcon et al. 2010).

The Japanese rookeries are the most significant nesting sites for loggerheads in the North Pacific, with nesting occurring on the Japanese mainland, except for Hokkaido, as well as the Ryukyu Islands to the south (Kamezaki 1989; Kamezaki et al. 2003; Sea Turtle Association of Japan 2010; Uchida and Nishiwaki 1995). Nesting generally occurs through summer and fall (April-August, peaking in July), with females returning every two to three years (Iwamoto et al. 1985). Nesting females lay at least three nests of 60 to 115 eggs per nest each season, with roughly two weeks between nests (Eckert 1993a; Iwamoto et al. 1985; Nishimura 1994). Between nests, females appear to swim offshore into the Kuroshio Current, possibly to speed egg development (NMFS and USFWS 1998g; Sato et al. 1998).

Nesting in the Gulf of Mexico does occur, although primarily in Florida, with rare nesting along North and South Padre Island in Texas from April through September, with a peak in June and July (Dodd 1988b; Dodd Jr. 1988a; Hildebrand 1983; Weishampel et al. 2006; Williams-Walls et al. 1983).

4.2.9.5 Gender, Age, and Survivorship

Although information on males is limited, several studies identified a female bias, although a single study has found a strong male bias to be possible (Dodd 1988a; NMFS 2001a; Rees and Margaritoulis 2004). Nest temperature seems to drive sex determination. Along Florida, males primarily derive from earlier-season (LeBlanc et al. 2012). Here, nests ranged from an average sex ratio of 55 percent female to 85 percent between 2000 and 2004 (LeBlanc et al. 2012). Juvenile and adult age classes have a slight female bias in the central Mediterranean Sea of 51.5 percent (Casale et al. 2014).

Additionally, little is known about longevity, although Dodd (1988a) estimated the maximum female life span at 47 to 62 years. Heppell et al. (2003a) estimated annual survivorship to be 0.81 (southeast U.S. adult females), 0.78 to 0.91 (Australia adult females), 0.68–0.89 (southeast U.S. benthic juveniles, and 0.92 (Australia benthic juveniles). Another recent estimate suggested a survival rate of 0.41 or 0.60 (CIs 0.20 to 0.65 and 0.40 to 0.78, respectively), depending upon assumptions within the study (Sasso et al. 2011). Survival rates for hatchlings during their first year are likely very low (Heppell et al. 2003a; Heppell et al. 2003). Higher fecundity is associated with warmer February and lower May temerperatures for loggerheads on the northern Gulf of Mexico (Lamont and Fujisaki 2014).

4.2.9.6 Feeding

Loggerhead sea turtles are omnivorous and opportunistic feeders through their lifetimes (Parker et al. 2005). Hatchling loggerheads feed on macroplankton associated with *Sargassum* spp. communities (NMFS and USFWS 1991b). Pelagic and benthic juveniles forage on crabs, mollusks, jellyfish, and vegetation at or near the surface (Dodd 1988a; Wallace et al. 2009). Loggerheads in the deep, offshore waters of the western North Pacific feed on jellyfish, salps, and other gelatinous animals (Dodd Jr. 1988b; Hatase et al. 2002b). Sub-adult and adult loggerheads prey on benthic invertebrates such as gastropods, mollusks, and decapod crustaceans in hard-bottom habitats, although fish and plants are also occasionally eaten (NMFS and USFWS 1998d). Stable isotope analysis and study of organisms on turtle shells has recently shown that although a loggerhead population may feed on a variety of prey, individuals composing the population have specialized diets (Reich et al. 2010; Vander Zanden et al. 2010).

4.2.9.7 Diving

Loggerhead diving behavior varies based upon habitat, with longer surface stays in deeper habitats than in coastal ones. Off Japan, dives were shallower than 30 m (Sakamoto et al. 1993). Routine dives can last 4–172 min (Byles 1988; Renaud and Carpenter 1994; Sakamoto et al. 1990). The maximum-recorded dive depth for a post-nesting female was over 230 m, although most dives are far shallower (9–21 m (Sakamoto et al. 1990). Loggerheads tagged in the Pacific over the course of 5 months showed that about 70 percent of dives are very shallow (<5 m) and 40 percent of their time was spent within 1 m of the surface (Polovina et al. 2003; Spotila 2004b). During these dives, there were also several strong surface temperature fronts that individuals were associated with, one of 20° C at 28° N latitude and another of 17° C at 32° N latitude. In the Mediterranean, dives of over 300 min have been recorded in association with depressed water temperatures and are proposed as an overwintering strategy (Luschi et al. 2013).

4.2.9.8 Vocalization and Hearing

Sea turtles are low-frequency hearing specialists, typically hearing frequencies from 30 to 2,000 Hz, with a range of maximum sensitivity between 100 and 800 Hz (Bartol et al. 1999c; Lenhardt 1994b; Lenhardt 2002; Moein Bartol and Ketten 2006; Ridgway et al. 1969). Hearing below 80 Hz is less sensitive but still possible (Lenhardt 1994b). Bartol et al. (1999c) reported effective hearing range for juvenile loggerhead turtles is from at least 250 to 750 Hz. Both yearling and two-year old loggerheads had the lowest hearing threshold at 500 Hz (yearling: about 81 dB re 1 µPa and two-year-olds: about 86 dB re 1 µPa), with thresholds increasing rapidly above and below that frequency (Moein Bartol and Ketten 2006). Underwater tones elicited behavioral responses to frequencies between 50 and 800 Hz and auditory evoked potential responses between 100 Hz and 1,131 Hz in one adult loggerhead (Martin et al. 2012). The lowest threshold recorded in this study was 98 dB re: 1 µPa at 100 Hz. Lavender et al. (2014) found post-hatchling loggerheads responded to sounds in the range of 50 Hz to 800 Hz while juveniles responded to sounds in the range of 50 Hz to 1,000 Hz. Post-hatchlings had the greatest sensitivity to sounds at 200 Hz while juveniles had the greatest sensitivity at 800 Hz (Lavender et al. 2014).

These hearing sensitivities are similar to those reported for two terrestrial species: pond and wood turtles. Pond turtles respond best to sounds between 200 and 700 Hz, with slow declines below 100 Hz and rapid declines above 700 Hz, and almost no sensitivity above 3000 Hz (Wever

and Vernon 1956). Wood turtles are sensitive up to about 500 Hz, followed by a rapid decline above 1000 Hz and almost no responses beyond 3000 or 4000 Hz (Patterson 1966).

4.2.9.9 Status and Trends

The North Pacific DPS of loggerhead sea turtles was listed as endangered in 2011 (76 FR 58868). The global abundance of nesting female loggerhead turtles is estimated at 43,320 to 44,560 (Spotila 2004a). All loggerheads inhabiting the North Pacific Ocean are derived primarily, if not entirely, from Japanese beaches (although low level nesting may occur in areas around the South China Sea) (Chan et al. 2007). Along the Japanese coast, nine major nesting beaches (greater than 100 nests per season) and six "submajor" beaches (10 to 100 nests per season) were identified. Using information collected from these nine beaches Kamezaki et al. (2003) found a substantial decline (50 to 90 percent) in the size of the annual loggerhead nesting population over the last half of the 20th century. Also, nest count data for the last two decades suggests that the North Pacific population is "small" and lacks a robust gene pool when compared to the larger northwest Atlantic and north Indian Ocean loggerhead populations. Small populations are more susceptible to demographic variability which increases their probability of extinction. Available evidence indicates that due to loss of adult and juvenile mortalities from fishery bycatch and, to a lesser degree the loss of nesting habitat, the North Pacific loggerhead population is declining.

Snover (2008) combined nesting data from the Sea Turtle Association of Japan and data from Kamezaki et al. (2002b) to analyze an 18-year time series of nesting data from 1990 through 2007. Nesting declined from an initial peak of approximately 6,638 nests in 1990 and 1991, followed by a steep decline to a low of 2,064 nests in 1997. During the past decade, nesting increased gradually to 5,167 nests in 2005, declined and then rose again to a high of just under 11,000 nests in 2008. Estimated nest numbers for 2009 were on the order of 7,000 to 8,000 nests. While nesting numbers have gradually increased in recent years and the number for 2009 was similar to the start of the time series in 1990, historical evidence from Kamouda Beach (census data dates back to the 1950s) indicates that there has been a substantial decline over the last half of the 20th century (Kamezaki et al. 2003) and that current nesting represents a fraction of historical nesting levels.

In addition, loggerheads uncommonly occur in U.S. Pacific waters, and there were no documented strandings of loggerheads on the Hawaiian Islands in nearly 20 years (1982 to 1999 stranding data). There are very few records of loggerheads nesting on any of the many islands of the central Pacific, and the species is considered rare or vagrant in this region (USFWS 1998). Overall, Gilman (2009) estimated that the number of loggerheads nesting the Pacific has declined by 80 percent in the past 20 years.

The Navy's NMSDD estimates 0.000022 loggerhead sea turtles per km^2 in the MITT Action Area (DoN 2014).

4.2.9.10 Natural Threats

Sea turtles face predation primarily by sharks and to a lesser extent by killer whales. All sea turtles except leatherbacks can undergo "cold stunning" if water temperatures drop below a threshold level, which can pose lethal effects. In January 2010, an unusually large cold-stunning event occurred throughout the southeast U.S., with well over 3,000 sea turtles (mostly greens but

also hundreds of loggerheads) found cold-stunned. Most survived, but several hundred were found dead or died after being discovered in a cold-stunned state. Eggs are commonly eaten by raccoons and ghost crabs along the eastern U.S. (Barton and Roth 2008). In the water, hatchlings are hunted by herons, gulls, dogfish, and sharks. Heavy loads of barnacles are associated with unhealthy or dead stranded loggerheads (Deem et al. 2009). Brevetoxin-producing algal blooms can result in loggerhead sea turtle death and pathology, with nearly all stranded loggerheads in affected areas showing signs of illness or death resulting from exposure (Fauquier et al. 2013). The fungal pathogens *Fusarium falciforme* and *F. keratoplasticum* an kill in excess of 90 percent of sea turtle embryos they infect and may constitute a major threat to nesting productivity under some conditions (Sarmiento-Ramırez et al. 2014).

4.2.9.11 Anthropogenic Threats

Anthropogenic threats impacting loggerhead nesting habitat are numerous: coastal development and construction, placement of erosion control structures, beachfront lighting, vehicular and pedestrian traffic, sand extraction, beach erosion, beach nourishment, beach pollution, removal of native vegetation, and planting of non-native vegetation (Baldwin 1992; Margaritoulis et al. 2003; Mazaris et al. 2009b; USFWS 1998). Surprisingly, beach nourishment also hampers nesting success, but only in the first year post-nourishment before hatching success increases (Brock et al. 2009). Loggerhead sea turtles face numerous threats in the marine environment as well, including oil and gas exploration, marine pollution, trawl, purse seine, hook and line, gill net, pound net, longline, and trap fisheries, underwater explosions, dredging, offshore artificial lighting, power plant entrapment, entanglement in debris, ingestion of marine debris, marina and dock construction and operation, boat collisions, and poaching. At least in the Mediterannean Sea, Anthorpogenic threats appear to disproportionally impact larger (more fecund) loggerheads (Bellido et al. 2010).

The major factors inhibiting their recovery include mortalities caused by fishery interactions and degradation of the beaches on which they nest. Shrimp trawl fisheries account for the highest number of captured and killed loggerhead sea turtles. Along the Atlantic coast of the U.S., the NMFS estimated that shrimp trawls capture almost 163,000 loggerhead sea turtles each year in the Gulf of Mexico, of which 3,948 die. However, more recent estimates from suggest interactions and mortality has decreased from pre-regulatory periods, with a conservative estimate of 26,500 loggerheads captured annually in U.S. Atlantic fisheries causing mortality up to 1,400 individuals per year (Finkbeiner et al. 2011). Commercial gillnet fisheries are estimated to have killed 52 loggerheads annually along the U.S. mid-Atlantic (Murray 2013). Pacific bycatch is much less, with about 400 individuals bycaught annually in U.S. fisheries resulting in at least 20 mortalities (Finkbeiner et al. 2011). Each year, various fisheries capture about 2,000 loggerhead sea turtles in Pamlico Sound, of which almost 700 die. As a result of the 2006 and 2007 tri-national fishermen's exchanges in 2007 a prominent Baja California Sur fleet retired its bottom-set longlines (Peckham et al. 2008). Prior to this closure, the longline fleet interacted with an estimated 1,160 to 2,174 loggerheads annually, with nearly all (89 percent) of the takes resulting in mortalities (Peckham et al. 2008).

Offshore longline tuna and swordfish longline fisheries are also a serious concern for the survival and recovery of loggerhead sea turtles and appear to affect the largest individuals more than younger age classes (Aguilar et al. 1995; Bolten et al. 1994; Carruthers et al. 2009; Howell et al. 2008; Marshall et al. 2009; Petersen et al. 2009; Tomás et al. 2008). In the Pacific Ocean,

between 2,600 and 6,000 loggerhead sea turtles are estimated to have been captured and killed in longline fisheries in 2000 (Lewison et al. 2004). Shallow-set Hawaii based longline fisheries are estimated to have captured and killed several hundred loggerhead sea turtles before they were closed in 2001. When they were re-opened in 2004, with substantial modifications to protect sea turtles, these fisheries were estimated to have captured and killed about fewer than 5 loggerhead sea turtles each year. Between 2004 and 2008, shallow-set fisheries based out of Hawaii are estimated to have captured about 45 loggerhead sea turtles, killing about 10 of these sea turtles. Longline hooking along Hawaii and California suggests a 28 percent mortality rate for hooked and released loggerheads, with no significant difference between shallow- versus deep-hooked individuals (Swimmer et al. 2013). Deliberate hunting of loggerheads for their meat, shells, and eggs has declined from previous exploitation levels, but still exists and hampers recovery efforts (Lino et al. 2010). (Lino et al. 2010). Roughly 10,000 loggerheads are bycaught by longline fisheries in the southwestern Mediterranean annually (Àlvarez de Quevedo et al. 2013). Of these, from 30 to 40 percent are expected to die, resulting in 3,400-4,000 deaths per year, or about 10 percent of the loggerheads present in the region (Àlvarez de Quevedo et al. 2013). In the Pacific, loggerhead turtles are captured, injured, or killed in numerous Pacific fisheries including Japanese longline fisheries in the western Pacific Ocean and South China Seas direct harvest and commercial fisheries off Baja California, Mexico commercial and artisanal swordfish fisheries off Chile, Columbia, Ecuador, and Peru purse seine fisheries for tuna in the eastern tropical Pacific Ocean California/Oregon drift gillnet fisheries (NMFS 2006e). Wallace et al. (2010) estimated that between 1990 and 2008, at least 85,000 sea turtles were captured as bycatch in fisheries worldwide. This estimate is likely at least two orders of magnitude low, resulting in a likely bycatch of nearly half a million sea turtles annually (Wallace et al. 2010c); many of these are expected to be loggerhead sea turtles.

Marine debris ingestion can be a widespread issue for loggerhead sea turtles. More than one-third of loggerheads found stranded or bycaught had ingested marine debris in a Mediterranean study, with possible mortality resulting in some cases (Lazar and Gračan 2010). Another study in the Tyrrhenian Sea found 71 percent of stranded and bycaught sea turtles had plastic debris in their guts (Campani et al. 2013). Another threat marine debris poses is to hatchlings on beaches escaping to the sea. Two thirds of loggerheads contacted marine debris on their way to the ocean and many became severely entangled or entrapped by it (Triessnig et al. 2012).

Climate change may also have significant implications on loggerhead populations worldwide. In addition to potential loss of nesting habitat due to sea level rise, loggerhead sea turtles are very sensitive to temperature as a determinant of sex while incubating. Ambient temperature increase by just 1 to 2º C can potentially change hatchling sex ratios to all or nearly all female in tropical and subtropical areas (Hawkes et al. 2007a). Over time, this can reduce genetic diversity, or even population viability, if males become a small proportion of populations (Hulin et al. 2009). Sea surface temperatures on loggerhead foraging grounds correlate to the timing of nesting, with higher temperatures leading to earlier nesting (Mazaris et al. 2009a; Schofield et al. 2009). Increasing ocean temperatures may also lead to reduced primary productivity and eventual food availability. This has been proposed as partial support for reduced nesting abundance for loggerhead sea turtles in Japan; a finding that could have broader implications for other populations in the future if individuals do not shift feeding habitat (Chaloupka et al. 2008c). Warmer temperatures may also decrease the energy needs of a developing embryo (Reid et al. 2009). Pike (2014) estimated that loggerhead populations in tropical areas produce about 30

percent fewer hatchlings than do populations in temperate areas. Historical climactic patterns have been attributed to the decline in loggerhead nesting in Florida, but evidence for this is tenuous (Reina et al. 2013).

Tissues taken from loggerheads sometimes contain very high levels of organochlorines chlorobiphenyl, chlordanes, lindane, endrin, endosulfan, dieldrin, PFOS, PFOA, DDT, and PCB (Alava et al. 2006; Corsolini et al. 2000; Gardner et al. 2003; Keller et al. 2005; Keller et al. 2004a; Keller et al. 2004b; McKenzie et al. 1999; Monagas et al. 2008; Oros et al. 2009; Perugini et al. 2006; Rybitski et al. 1995; Storelli et al. 2007a). It appears that levels of organochlorines have the potential to suppress the immune system of loggerhead sea turtles and may affect metabolic regulation (Keller et al. 2004c; Keller et al. 2006b; Oros et al. 2009). These contaminants could cause deficiencies in endocrine, developmental, and reproductive health (Storelli et al. 2007a). It is likely that the omnivorous nature of loggerheads makes them more prone to bioaccumulating toxins than other sea turtle species (Godley et al. 1999; McKenzie et al. 1999). PAH pollution from petroleum origins has been found in Cape Verde loggerheads, where oil and gas extraction is not undertaken in the marine environment (Camacho et al. 2012).

Heavy metals, including arsenic, barium, cadmium, chromium, iron, lead, nickel, selenium, silver, copper, zinc, and manganese, have also been found in a variety of tissues in levels that increase with turtle size (Anan et al. 2001; Fujihara et al. 2003; Garcia-Fernandez et al. 2009; Gardner et al. 2006; Godley et al. 1999; Saeki et al. 2000; Storelli et al. 2008). These metals likely originate from plants and seem to have high transfer coefficients (Anan et al. 2001; Celik et al. 2006; Talavera-Saenz et al. 2007). Elevated mercury levels are associated with deformities in hatchlings versus healthy individuals (Trocini 2013). Loggerhead sea turtles have higher mercury levels than any other sea turtle studied, but concentrations are an order of magnitude less than many toothed whales (Godley et al. 1999; Pugh and Becker 2001). Arsenic occurs at levels several fold more concentrated in loggerhead sea turtles than marine mammals or seabirds.

Also of concern is the spread of antimicrobial agents from human society into the marine environment. Loggerhead sea turtles may harbor antibiotic-resistant bacteria, which may have developed and thrived as a result of high use and discharge of antimicrobial agents into freshwater and marine ecosystems (Foti et al. 2009).

4.2.9.12 Critical Habitat

On July 10, 2014, NMFS designated critical habitat for loggerhead sea turtles along the U.S. Atlantic and Gulf of Mexico coasts from North Carolina to Mississippi (79 FR 39856). No critical habitat is designated within the MITT Action Area for this species.

4.2.10 Scalloped Hammerhead Shark – Indo-West Pacific DPS

Scalloped hammerhead sharks are moderately large sharks with a flat, laterally extended head with a scalloped anterior margin. Unless otherwise noted, the information presented below was obtained from the Status Review Report for the Scalloped Hammerhead Shark (*Sphyrna lewini*) (Miller et al. 2014).

4.2.10.1 Populations

On July, 3, 2014 NMFS issued the final determination to list the Central and Southwest (SW) Atlantic Distinct Population Segment (DPS) and the Indo-West Pacific DPS of scalloped

hammerhead shark (*Sphyrna lewini*) as threatened species under the Endangered Species Act (ESA) (79 FR 38213). NMFS also issued a final determination to list the Eastern Atlantic DPS and Eastern Pacific DPS of scalloped hammerhead sharks as endangered species under the ESA (79 FR 38213). Populations are generally delineated by ocean basins based on discrete differences in genetic structure and limited transoceanic migrations of this species.

4.2.10.2 Distribution

The scalloped hammerhead shark can be found in coastal warm temperate and tropical seas worldwide. In the western Atlantic Ocean the scalloped hammerhead range extends from the northeast coast of the United States to Brazil, including the Gulf of Mexico and the Caribbean Sea. In the eastern Atlantic, it can be found from the Mediterranean to Namibia. Populations in the Indian Ocean are found from South Africa to Pakistan, India and Myanmar. In the western Pacific the scalloped hammerhead can be found from Japan and China to New Caledonia, including throughout the Philippines, Indonesia, Australia, and the U.S. territorial islands. In the eastern Pacific the scalloped hammerhead can be found southern California to Peru, including the Gulf of California. In the central pacific the scalloped hammerhead can be found in Hawaii and Tahiti.

4.2.10.3 Migration and movement

Scalloped hammerhead sharks are highly mobile and partly migratory. Along continental margins and between oceanic islands in tropical waters migration is common. Adult migratory movements are generally less than 200 km but this species is also capable of moving much greater distances up to approximately 2,000 km. Juvenile movements are likely much shorter. Juveniles and adults occur as solitary individuals, pairs, or in schools and there is evidence of site fidelity to known hot spots.

4.2.10.4 Habitat

Scalloped hammerhead sharks primarily occur over continental and insular shelves and rarely in waters cooler than 22° C. It ranges from surface waters to depths of 512 m with occasional dives to deeper water up to 1000 m. It is also known to occur in bays and estuaries. Neonates and juveniles aggregations are more common in nearshore nursery habitats that may provide valuable refuge from predation. Anecdotal information suggests that Guam's inner Apra Harbor could provide nursery habitat for this species (Miller et al. 2014). Scalloped hammerhead sharks appear to prefer areas with stronger currents, greater turbidity, and higher sedimentation and nutrient flow.

4.2.10.5 Growth and reproduction

The scalloped hammerhead shark is viviparous (i.e., give birth to live young), with a gestation period of 9 to 12 months. Females attain sexual maturity at 200 to 250 cm total length (TL) while males reach maturity at 128 to 200 cm TL. Maturity times vary regionally but can range from 4 to 15 years for females and 3.8 to 10 years for males. Parturition likely occurs inshore with peak neonate abundance occurring during the spring and summer. Females give birth to litter sizes up to 41 live pups measuring 31 to 59 cm TL. Maximum size for females and males is over 3 m TL and a maximum age up to 30 years.

4.2.10.6 Feeding

Scalloped hammerhead sharks are high trophic level predators and opportunistic feeders with a diet including teleosts, cephalopods, crustaceans, and rays. Juvenile sharks in Kāneohe Bay, Hawaii were observed to feed primarily at night. Feeding occurs both at reef sites and in pelagic waters.

4.2.10.7 Vocalization and hearing

Scalloped hammerhead sharks, like all fish, have an inner ear capable of detecting high-frequency sounds and a lateral line capable of detecting water motion caused by low frequencies (Hastings and Popper 2005; Popper and Schilt 2009). Data for cartilaginous fish suggest detection of sounds from 20 Hz to 1000 Hz with the highest sensitivity to sounds at the lower ranges (Casper et al. 2003; Casper and Mann 2006; Myrberg Jr. 2001).

4.2.10.8 Status and trends

The Final Rule to list the Central SW Atlantic DPS, Eastern Atlantic DPS, Indo-West Pacific DPS, and the Eastern Pacific DPS (79 FR 38213) and the Status Review Report (Miller et al. 2014) provide detailed discussion of the status of each DPS. Logistic and Fox modeling efforts using the best available data suggest a decrease in global abundance from 142,000 and 169,000 individuals (respectively by model) in 1981 to 24,850 and 27,900 individuals (respectively) in 2005. This represents an 83 percent decrease in global abundance based on both the logistic and Fox models over a 15 year period.

The Indo-West Pacific DPS of scalloped hammerhead sharks is listed as threatened and no take prohibitions have been implemented (79 FR 38213). For the Indo-West Pacific DPS, commercial and artisanal fisheries were identified as a high risk to the extinction due to targeted catch and bycatch. The inadequacy of current regulatory mechanisms was also identified as a moderate risk, with illegal fishing significantly contributing to the DPS' risk of extinction. Multiple Regional Fishery Management Organizations (RFMO) cover the Indo-West Pacific DPS area with requirements of full utilization of any retained catches of sharks and regulations that onboard fins cannot weigh more than 5 percent of the weight of the sharks. These regulations are aimed at curbing the practice of shark finning, but do not prohibit the fishing of sharks. In addition, these regulations may not even be effective in stopping finning of scalloped hammerhead sharks, as a recent study found the scalloped hammerhead shark to have an average wet-fin-to-round-mass ratio of only 2.13 percent (n = 81; (Biery and Pauly 2012). This ratio suggests that fishing vessels operating in these RFMO convention areas would be able to land more scalloped hammerhead shark fins than bodies and still pass inspection. There are no scalloped hammerhead-specific RFMO management measures in place for this region, even though this DPS is heavily fished. Consequently, this species has seen population declines off the coasts of South Africa and Australia, so much so that in 2012, New South Wales, Australia, listed it as an endangered species.

Few countries within this DPS' range have regulations aimed at controlling the exploitation of shark species. Oman, Seychelles, Australia, South Africa, Taiwan, and most recently India all have measures to prevent the waste of shark parts and discourage finning. The Maldives have designated their waters as a shark sanctuary. A number of Pacific Island countries (including U.S. territories) have also created shark sanctuaries, prohibited shark fishing, or have strong management measures to control the exploitation of sharks in their respective waters, including

Tokelau, Palau, Marshall Islands, American Samoa, CNMI, Cook Islands, and French Polynesia, although effective enforcement of these regulations is an issue for some of the countries. Additionally, many of the top shark fishing nations and world's exporters of fins are also located within the range of this DPS, and have little to no regulation (or enforcement) of their expansive shark fisheries. For example, off northern Madagascar, where there is an active artisanal fin fishery, sharks are an open access resource, with no restrictions on gear, established quotas, or fishing area closures (Robinson and Sauer 2011). Indonesia, which is the top shark fishing nation in the world, does not currently have restrictions pertaining to shark fishing or finning. Indonesian small-scale fisheries, which account for around 90 percent of the total fisheries production, are not required to have fishing permits (Varkey et al. 2010), nor are their vessels likely to have insulated fish holds or refrigeration units (Tull 2009), increasing the incentive for shark finning by this sector (Lack and Sant 2012). Ultimately, their fishing activities remain largely unreported (Varkey et al. 2010), which suggests that the estimates of Indonesian shark catches are greatly underestimated. In fact, in Raja Ampat, an archipelago in Eastern Indonesia, Varkey et al. (2010)estimated that 44 percent of the total shark catch in 2006 was unreported (including small-scale and commercial fisheries' unreported catch and illegal, unregulated, and unreported (IUU) fishing). Although Indonesia adopted an FAO recommended shark conservation plan (National Plan of Action—Shark) in 2010, due to budget constraints, it can only focus its implementation of key conservation actions in one area, East Lombok (Satria et al. 2011). Due to this historical and current absence of shark management measures, especially in the small-scale fisheries sector, many of the larger shark species in Indonesian waters have already been severely overfished (Field et al. 2009).

In addition to the largely unregulated fishing of this DPS, illegal fishing, especially for shark fins, has been identified as a significant contributor to the extinction risk of this DPS. Scalloped hammerhead sharks are valued for their large fins, which fetch a high commercial value in the Asian shark fin trade (Abercrombie et al. 2005)and comprise the second most traded fin category in the Hong Kong market (Clarke et al. 2006). Due to this profit incentive, there have been many reports of finning and seizures of illegally gained shark fins throughout the range of this DPS, including inwaters of Australia (Field et al. 2009), Mozambique, South Africa, Bay of Bengal, Arabian Gulf, Palau, the Federated States of Micronesia (FSM) (Paul 2009), and Somalia (Force 2006). Agnew et al. (2009)provided regional estimates of illegal fishing (using FAO fishing areas as regions) and found the Western Central Pacific (Area 71) and Eastern Indian Ocean (Area 57) regions to have relatively high levels of illegal fishing (compared to the rest of the regions), with illegal and unreported catch constituting 34 and 32 percent of the region's catch, respectively.

Off the coast of Oman, scalloped hammerhead sharks experienced a notable decline in abundance in 2003 and is apparently being replaced by smaller elasmobranch species and smaller individuals of the same species, a trend that may be occurring in other areas as well (Henderson et al. 2007). Declines in abundance in Indonesia may also be occurring as catch in longline fisheries has decreased from 15 to 2 percent from 2001 to 2011 (FAO 2013). In contrast, catch off of the coast of India suggest a potential increase in abundance, although scalloped hammerhead shark size appears to be decreasing (CITES 2012). Data from Australia indicates a decline of 58 to 76 percent from 1996 to 2005 along Northern Australia (Heupel and McAuley 2007) and a decline of more than 90 percent from 1973 to 2008 along New South Wales (Reid

and Krogh 1992; Williamson 2011). In the coastal waters of Papau New Guinea scalloped hammerhead catch decreased by 43 percent from 2011 to 2012 (De Young 2006).

Although the number of shark management and conservation measures for this DPS is on the rise, the NMFS Extinction Risk Analysis team noted that the current protections that they afford the Indo-West Pacific DPS may be minimal if illegal fishing is not controlled. We agree and conclude that the inadequacy of current regulatory mechanisms, in the form of ineffective enforcement of current regulations or lack of existing regulatory measures, in combination with illegal fishing, is contributing significantly to the risk of extinction of this DPS.

4.2.10.9 Natural threats

While not actually threats, natural factors such as the lengthy age to sexual maturity, relatively small maximum size, and obligate ram ventilation systems of this species makes them particularly vulnerable to depletion and slow recovery from anthropogenic threats.

4.2.10.10 Anthropogenic threats

The Final Rule to list the Central SW Atlantic DPS, Eastern Atlantic DPS, Indo-West Pacific DPS, and the Eastern Pacific DPS (79 FR 38213) and the Status Review Report (Miller et al. 2014) provide detailed discussion of the threats to each DPS. As described in the Rule, the primary factors responsible for the decline of these four DPSs are overutilization, due to both catch and bycatch of these sharks in fisheries, and inadequate regulatory mechanisms for protecting these sharks, with illegal fishing identified as a significant problem.

4.2.10.11 Critical habitat

The NMFS has not designated critical habitat for scalloped hammerhead sharks.

4.2.11 Acropora globiceps

Colonies of *Acropora globiceps* have finger-like branches. The size and appearance of branches depend on degree of exposure to wave action but are always closely compacted. Colonies exposed to strong wave action have pyramid-shaped branchlets. Colonies can be uniform blue, cream, brown, or fluorescent green in color. *Acropora globiceps* can easily be confused with other *Acropora* species due to both colony and branch morphology, as colonies often appear similar to *Acropora gemmifera*, and in strong wave action colonies appear similar to *Acropora monticulosa*. In addition, *Acropora globiceps*' branch thickness and colony shape are similar to that of *Acropora humilis*, and its branch shape and radial corallite morphology is similar to that of *Acropora samoensis*. It appears that this species has often been mistaken for *A. humilis* (Fenner 2014). However, Veron (2014) states that *Acropora globiceps* is distinctive, and the final rule concluded that it can be identified by experts (79 FR 53852).

4.2.11.1 Distribution and Abundance

Acropora globiceps is distributed from the oceanic west Pacific to the central Pacific as far east as the Pitcairn Islands. Veron (2014) reported that *Acropora globiceps* is confirmed in 22 of his 133 Indo-Pacific ecoregions, and strongly predicted to be found in an additional 16. Wallace (1999a) reports its occurrence in seven of her 29 Indo-Pacific areas, many of which are significantly larger than Veron's ecoregions. The map presented in Wallace (1999a) shows it from a smaller area than Veron (Veron, 2000; Veron, 2014). Based on the Wallace (1999a) range, *Acropora globiceps* has a relatively small range, estimated at 5 million km^2 (Richards

2009). Within U.S. waters, this species is confirmed in American Samoa, Guam, CNMI, and PRIAs (http://www.fpir.noaa.gov/PRD/prd_coral.html).

Veron (2014) reports that *Acropora globiceps* occupied 3.2 percent of 2,984 dive sites sampled in 30 ecoregions of the Indo-Pacific, and had a mean abundance rating of 1.95 on a 1 to 5 rating scale at those sites in which it was found. Based on this semi-quantitative system, the species' abundance was characterized as ''uncommon.'' Overall abundance was described as ''sometimes common.'' Veron did not infer trends in abundance from these data. According to the Final Rule (79 FR 53852) *Acropora globiceps*' absolute abundance is at least tens of millions of colonies at the time of listing.

Within the Mariana Islands, *Acropora globiceps* is confirmed in both Guam and CNMI (NMFS 2015 "Listed Corals in the Indo-Pacific: *Acropora globiceps*, 4 p." [this is a species report posted on our coral page]). On Guam, a recent review of available coral survey data from numerous sites around the island showed *Acropora globiceps* at dozens of locations around the island. Several surveys were conducted within Apra Harbor, but the species was not found there (NMFS/PIRO/HCD Guam coral database, 2015). In CNMI, coral survey data shows *Acropora globiceps* on reef slopes around Rota, Tinian, Saipan, Pagan, Anatahan, and Maug (Doug Fenner, personal communication, 2015). It has also been observed in low abundances around FDM (DoN 2005a). *Acropora globiceps* is by far the most common ESA-listed coral species in the Mariana Islands.

4.2.11.2 Habitat

Acropora globiceps inhabits intertidal, upper reef slopes and reef flats (Veron 2000). It is reported from depths of 0 to 8 m (Veron 2000).

4.2.11.3 Reproduction and Growth

Acropora are sessile colonies that spawn their gametes into the water column, and the azooxanthellate larvae can survive in the planktonic stage from 4 to 209 days. All species of the genus *Acropora* studied to date are simultaneous hermaphrodites, with a gametogenic cycle in which eggs develop over a period of about 9 months and testes over about 10 weeks. Fecundity in *Acropora* colonies is generally described as ranging from 3.6 to 15.8 eggs per polyp. Mature eggs of species of *Acropora* are large when compared with those of other corals, ranging from 0.53 to 0.90 mm in mean diameter. For five *Acropora* species, the minimum reproductive size ranged from 4 to 7 cm, and the estimated ages ranged from 3 to 5 years (Brainard et al. 2011b).

Acropora globiceps is a hermaphroditic spawner with lecithotrophic (yolk-sac) larvae (79 FR 53852). *Acropora* spp. release gametes as egg-sperm bundles that float to the sea surface, each polyp releasing all its eggs and sperm in one bundle. Fertilization takes place after the bundles break open at the sea surface. Sperm concentrations of 10^6 ml^{-1} have been found to be optimal for fertilization in the laboratory, and concentrations of this order have been recorded in the field during mass spawning events. Self-fertilization, although possible, is infrequent. Gametes remain viable and achieve high fertilization rates for up to 8 hours after spawning. Embryogenesis takes place over several hours, and further development leads to a planula that is competent to settle in 4 to 5 days after fertilization. *Acropora* spp. can show a high degree of hybridization, which can complicate taxonomic classification but allow persistence of the genus if the hybrids are reproductively viable (Brainard et al. 2011).

Larvae presumably experience considerable mortality (up to 90 percent or more) from predation or other factors prior to settlement and metamorphosis (NMFS 2014). Such mortality cannot be directly observed, but is inferred from the large amount of eggs and sperm spawned versus the much smaller number of recruits observed later. Coral larvae are relatively poor swimmers; therefore, their dispersal distances largely depend on the duration of the pelagic phase and the speed and direction of water currents transporting the larvae. The potential for long-term dispersal of coral larvae, at least for some species, may be substantially greater than previously understood and may partially explain the large geographic ranges of many species (NMFS 2014).

The tissue thickness of *Acropora* species is 1 to 2 mm thick, considerably thinner than many coral species, which allows them to grow quicker (Loya et al. 2001). The smaller reserve of nutrients in the thin layer of tissue also makes *Acropora* species more susceptible to environmental distrurbance (Grottoli et al. 2004; Rodrigues and Grottoli 2007; Rodrigues et al. 2008). *Acropora* species generally reach sexual maturity at 4 to 7 cm or roughly 3 to 5 years of age (Wallace 1985).

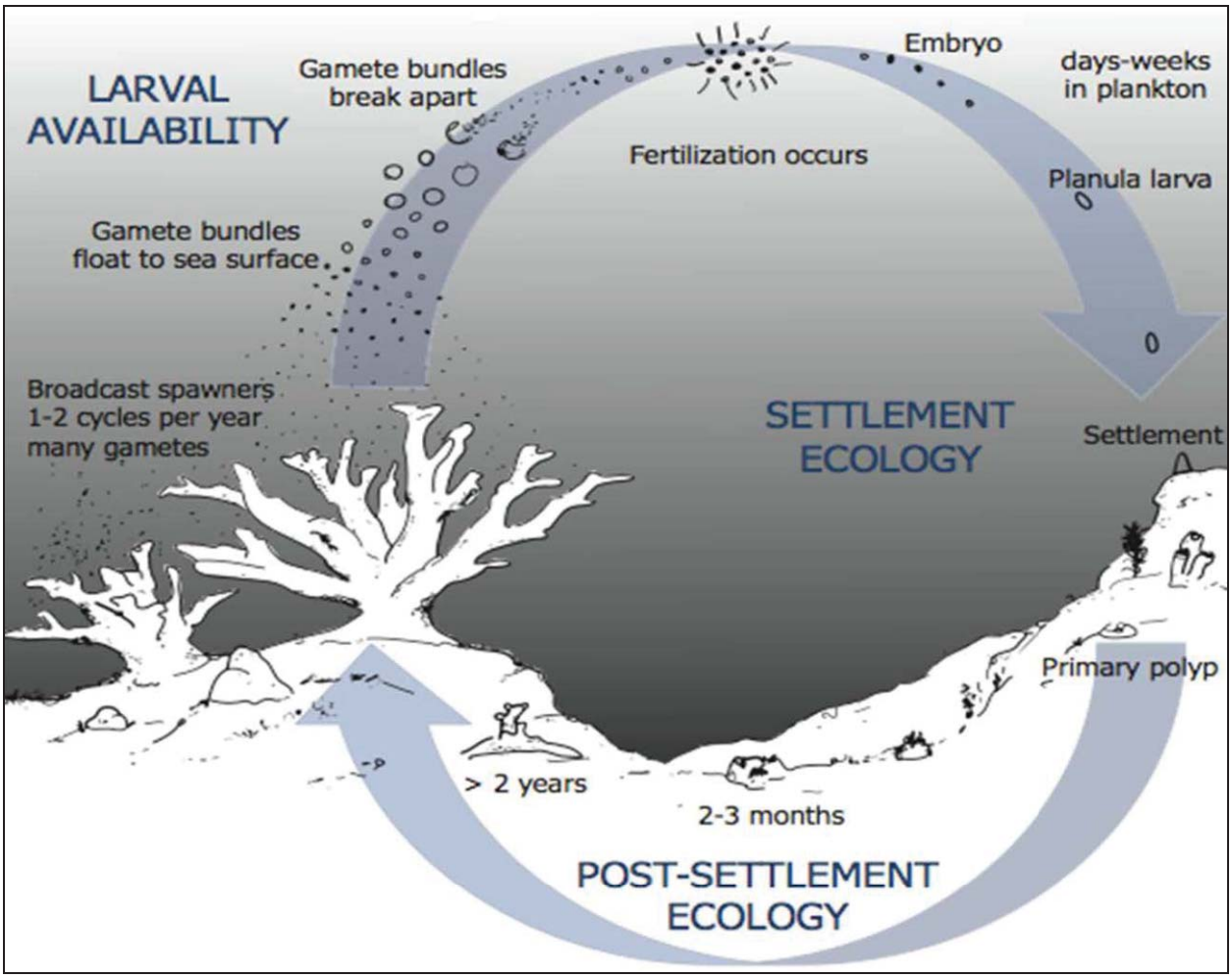

Figure 15. Typical Life Cycle of Broadcast Spawning Corals

4.2.11.4 Status and trends

Acropora globiceps was listed as threatened on September 10, 2014 (79 FR 53851). The abundance of *Acropora globiceps* has likely declined over the past 50 to 100 years although a

precise quantification is not possible based on the limited species specific information. The species is highly susceptible to ocean warming, and is susceptible to coral disease, ocean acidification, trophic effects of fishing, nutrients over-enrichment, and predation, all of which have increased in the past 50 to 100 years, and continue to increase throughout much of its range. *Acropora globiceps*' geographic distribution includes the Coral Triangle, but also includes many coral reef ecoregions in the western and central Pacific Ocean, as far east as the Pitcairn Islands. Its depth range is at least zero to 8 meters in upper reef slopes, reef flats, and adjacent habitats. Its absolute abundance is at least tens of millions of colonies across its range. While spatial variability of threats such as ocean warming and acidification across the species' range moderates vulnerability because many colonies are either not exposed to threats or do not negatively respond to a threat at any given point in time, the threats are increasing and will continue to increase in the foreseeable future, thus the species is expected to continue to decline. However, there is inadequate data to quantify current and future population status and trends on any spatial scale, let alone across the range of the speces (79 FR 53852).

4.2.11.5 Natural threats

Of the nine primary threats to reef-building corals (ocean warming, coral disease, ocean acidification, sedimentation, nutrients, trophic effects of fishing, sea-level rise, predation, and collection and trade), only predation is considered a natural threat. Due to the lack of species-specific information on the susceptibility of *Acropora globiceps* to predation, we summarize the available information on this threat to *Acropora* species in general: The studies cited in the Status Review Report (Brainard et al. 2011b) and Final Rule (79 FR 53852) on predation in *Acropora* report that predators such as crown-of-thorns starfish and *Drupella* snails prefer to eat *Acropora* over other genera. Thus, the available information suggests that *Acropora globiceps* is likely to have some susceptibility to predation (79 FR 53852).

4.2.11.6 Anthropogenic threats

Of the nine primary threats to reef-building corals (ocean warming, coral disease, ocean acidification, sedimentation, nutrients, trophic effects of fishing, sea-level rise, predation, and collection and trade), all but predation are considered anthropogenic threats. Due to the lack of species-specific information on the susceptibilities of *Acropora globiceps* to these threats, we summarize the available information for *Acropora* species in general.

Based on the information from the Status Review Report (Brainard et al. 2011b) and Final Rule (79 FR 53852), we make the following inferences regarding the susceptibilities of an unstudied *Acropora* species to these eight anthropogenic threats. For ocean warming, nearly all the studies cited on thermal stress in *Acropora* report high levels of bleaching in response to warming events. Thus, it is possible to predict that an unstudied *Acropora* species is likely to be highly susceptible to warming-induced bleaching, as long as some considerations are kept in mind: (1) Despite high overall susceptibility within the genus to warming-induced bleaching, there can be high variability between species and habitats (Done et al. 2003); (2) colonies that bleach do not necessarily die (in general, *Acropora* species have higher post-bleaching mortality than corals as a whole, but there is high variability in response throughout the genus); (3) recovery from bleaching provides the mechanism for acclimatization; and (4) while most *Acropora* species readily bleach in response to warming events, most also have the capacity to reestablish local populations relatively quickly through their rapid growth and asexual reproduction capacity.

Diseases are generally more common in *Acropora* than other coral genera, although there are numerous documented exceptions, depending on location. These studies also demonstrate high variability in disease susceptibility across *Acropora* species, depending on growth form, with wide divergence of disease susceptibilities among colony morphological groups under the same conditions. Thus, it is possible to predict that an unstudied *Acropora* species is likely to have some susceptibility to disease. The studies cited above on ocean acidification in *Acropora* report impacts on skeletal growth rates. Thus, it is possible to predict that an unstudied *Acropora* species is likely to have some susceptibility to ocean acidification in terms of impacts on skeletal growth. Most studies on the effects of land-based sources of pollution suggest that an unstudied *Acropora* species is likely to have some susceptibility to sedimentation and nutrient enrichment. The trophic effects of fishing alters trophic interactions by reducing herbivory on algae by removal of herbivorous fish from coral reef systems by fishing, thereby providing a competitive advantage for space to algae over coral. An unstudied *Acropora* species is likely to have some susceptibility to the trophic effects of fishing. Because *Acropora* are not generally sediment-tolerant and are faster growing species, an unstudied *Acropora* species is likely to have some susceptibility to sea-level rise. Because *Acropora* species are some of the most popular coral species to collect and trade, an unstudied *Acropora* species is likely to have some susceptibility to collection and trade.

According to the Status Review Report (Brainard et al. 2011b) and Final Rule (79 FR 53852), there is little if any species-specific information on the susceptibilities of *Acropora globiceps* to threats. However, based on genus-level information, we infer that *Acropora globiceps* is likely to be highly susceptible to ocean warming and to have some susceptibility to disease, acidification, sedimentation, nutrients, trophic effects of fishing, sea-level rise, and collection and trade (79 FR 53852).

4.2.11.7 Critical habitat

The NMFS has not designated critical habitat for *Acropora globiceps*.

5 ENVIRONMENTAL BASELINE

By regulation, environmental baselines for biological opinions include the past and present impacts of all state, Federal, or private actions and other human activities in the Action Area, the anticipated impacts of all proposed Federal projects in the Action Area that have already undergone formal or early section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process (50 CFR § 402.02). The environmental baseline for this Opinion includes the effects of several activities that affect the survival and recovery of ESA-listed resources in the Action Area.

The following information summarizes the principal natural and human-caused phenomena in the MITT Action Area believed to affect the survival and recovery of these species in the wild.

5.1 Climate Change

The latest Assessment Synthesis Report from the Working Groups on the Intergovernmental Panel on Climate Change (IPCC) concluded climate change is unequivocal (IPCC 2014). The Report concludes oceans have warmed, with ocean warming the greatest near the surface (e.g., the upper 75 m have warmed by 0.11 ^{o}C per decade over the period 1971 to 2010) (IPCC 2014).

Global mean sea level rose by 0.19 m between 1901 and 2010, and the rate of sea-level rise since the mid-19th century has been greater than the mean rate during the previous two millennia (IPCC 2014). Additional consequences of climate change include increased ocean stratification, decreased sea-ice extent, altered patterns of ocean circulation, and decreased ocean oxygen levels (Doney et al. 2012). Further, ocean acidity has increased by 26 percent since the beginning of the industrial era (IPCC 2014) and this rise has been linked to climate change. Climate change is also expected to increase the frequency of extreme weather and climate events including, but not limited to, cyclones, heat waves, and droughts. (IPCC 2014) Climate change has the potential to impact species abundance, geographic distribution, migration patterns, timing of seasonal activities (IPCC 2014), and species viability into the future. Though predicting the precise consequences of climate change on highly mobile marine species, such as many of those considered in this Opinion, is difficult (Simmonds and Isaac 2007), recent research has indicated a range of consequences already occurring.

Marine species ranges are expected to shift as they align their distributions to match their physiological tolerances under changing environmental conditions (Doney et al. 2012). Hazen et al. (2012) examined top predator distribution and diversity in the Pacific Ocean in light of rising sea surface temperatures using a database of electronic tags and output from a global climate model. He predicted up to a 35 percent change in core habitat area for some key marine predators in the Pacific Ocean, with some species predicted to experience gains in available core habitat and some predicted to experience losses. Notably, leatherback sea turtles were predicted to gain core habitat area, whereas loggerhead sea turtles and blue whales were predicted to experience losses in available core habitat. McMahon and Hays (2006a) predicted increased ocean temperatures would expand the distribution of leatherback sea turtles into more northern latitudes. The authors noted this is already occurring in the Atlantic Ocean. MacLeod (2009) estimated, based upon expected shifts in water temperature, 88 percent of cetaceans would be affected by climate change, with 47 percent likely to be negatively affected.

Similarly, climate-mediated changes in important prey species populations are likely to affect predator populations. For example, blue whales, as predators that specialize in eating krill, are likely to change their distribution in response to changes in the distribution of krill (Clapham et al. 1999; Payne et al. 1986; Payne et al. 1990). (Pecl and Jackson 2008) predicted climate change will likely result in squid that hatch out smaller and earlier, undergo faster growth over shorter life-spans, and mature younger at a smaller size. This could have significant negative consequences for species such as sperm whales, whose diets can be dominated by cephalopods. For ESA-listed species that undergo long migrations, if either prey availability or habitat suitability is disrupted by changing ocean temperature regimes, the timing of migration can change or negatively impact population sustainability (Simmonds and Eliott. 2009).

Changes in global climatic patterns are expected to have profound effects on coastlines worldwide, potentially having significant consequences for the species considered in this Opinion that are partially dependent on terrestrial habitat areas (i.e., sea turtles). For example, rising sea levels are projected to inundate some sea turtle nesting beaches (Caut et al. 2009b; Wilkinson and Souter 2008), change patterns of coastal erosion and sand accretion that are necessary to maintain those beaches, and increase the number of turtle nests destroyed by tropical storms and hurricanes (Wilkinson and Souter 2008). The loss of nesting beaches may have catastrophic effects on global sea turtle populations if they are unable to colonize new

beaches, or if new beaches do not provide the habitat attributes (e.g., sand depth, temperature regimes, refuge) necessary for egg survival. Additionally, increasing temperatures in sea turtle nests, as is expected with climate change, alters sex ratios, reduces incubation times (producing smaller hatchlings), and reduces nesting success due to exceeded thermal tolerances (Fuentes et al. 2009a; Fuentes et al. 2010; Fuentes et al. 2009b; Glen et al. 2003). All of these temperature related impacts have the potential to significantly impact sea turtle reproductive success and ultimately, long-term species viability. Poloczanska et al. (2009) noted that extant marine turtle species have survived past climatic shifts, including glacial periods and warm events, and therefore may have the ability to adapt to ongoing climate change (e.g., by finding new nesting beaches). However, the authors also suggested since the current rate of warming is very rapid, expected changes may outpace sea turtles' ability to adapt.

Previous warming events (e.g., El Niño, the 1977 through 1998 warm phase of the Pacific Decadal Oscillation) may illustrate the potential consequences of climate change. Off the U.S. west coast, past warming events have reduced nutrient input and primary productivity in the California Current, which also reduced productivity of zooplankton through upper-trophic level consumers (Doney et al. 2012; Sydeman et al. 2009; Veit et al. 1996). In the past, warming events have resulted in reduced food supplies for marine mammals along the U.S. west coast (Feldkamp et al. 1991; Hayward 2000; Le Boeuf and Crocker 2005). Some marine mammal distributions may have shifted northward in response to persistent prey occurrence in more northerly waters during El Niño events (Benson et al. 2002; Danil and Chivers 2005; Lusseau et al. 2004; Norman et al. 2004b; Shane 1994; Shane 1995). Low reproductive success and body condition in humpback whales may have resulted from the 1997/1998 El Niño (Cerchio et al. 2005).

In the NMFS's final rule to list 20 coral species as threatened (79 FR 53851), ocean warming and acidification, associated wtih climate change, were identified as two of the most important threats to the current or expected future extinction risk of reef building corals. Reef building organisms, such as the four coral species considered in this Opinion, are predicted to decrease the rate at which they deposit $CaCO_3$ in response to increased ocean acidity and warmer water temperatures (Raymundo et al. 2008). Further, the most severe coral bleaching events observed to date have typically been accompanied by ocean warming events such as the El Niño-Southern Oscillation (Glynn 2001). Bleaching episodes result in substantial loss of coral cover, and result in the loss of important habitat for associated reef fishes and other biota (e.g., sea turtles). Corals can typically withstand mild to moderate bleaching, but severe or prolonged bleaching events can lead to coral colony death (79 FR 53851). While the susceptibility to ocean warming and acidication associated with climate change is expected to vary by species and specific coral colony (based on latitude, depth, bathymetry, etc), climate change is expected to have major impacts on the coral species considered in this Opinion. Specifically, the final listing rule identified *Acropora globiceps* as having high vulnerability to the effects of ocean warming and moderate vulnerability to the effects of ocean acidification (79 FR 53851).

This is not an exhaustive review of all available literature regarding the potential impacts of climate change to the species considered in this Opinion. However, this review provides some examples of impacts that may occur. While it is difficult to accurately predict the consequences of climate change to the species considered in this Opinion, a range of consequences are

expected, ranging from beneficial to catastrophic. With the exception of corals, given a lack of available information within the context of the temporal scale of the action, specific climate change related impacts on the species evaluated in this Opinion are speculative, cannot be meaningfully assessed, and will not be considered further.

5.2 Coastal development and pollution

Coastal development intensifies use of coastal resources, resulting in potential impacts on water quality, marine habitat, and air quality. Development impacts coastal resources through point and nonpoint source pollution, increased sedimentation, concentrated recreational use, and intensive ship traffic using major port facilities. The Action Area coastline also includes coastal tourism development (e.g., hotels, resorts, restaurants, food industry, vacation homes) and the infrastructure supporting coastal development (e.g., retail businesses, marinas, fishing tackle stores, dive shops, fishing piers, recreational boating harbors, beaches, recreational fishing facilities). Coastal development is regulated by states and territories through the Coastal Zone Management Act and associated state and local programs.

Habitat degradation issues associated with development, such as poor water quality, invasive species, and disease, can alter ecosystems, limiting food availability and altering survival rates. For example, on Saipan, golf course, hotel and tourism-related development has severely impacted most of the historical sea turtle nesting areas on the western portion of the island and residential development threatens the eastern portion of the island. On Rota, turtle nesting beaches appear limited to undeveloped private land due to heavy recreational use and shoreside tourist developments. On Tinian, the majority of the nesting beaches are on military-leased land where no construction is presently expected.

Pollution of the marine environment is a pervasive problem throughout Guam and the inhabited Mariana Islands. Portions of the nearshore marine environment around Guam were severely degraded by impacts from intense combat during World War II (WWII); sunken ships still rest on the sea floor at several locations throughout Apra Harbor on Guam, as does metallic wreckage and other debris. Since WWII, the health of Guam's marine environment has been affected by the recreational, industrial and commercial operations associated with an increasing population. More recently, sedimentation (from illegal wildfires, improper development, and upland erosion), stormwater runoff and associated pollutants such as fertilizers and oil (from inadequate protections during coastal development and insufficient stormwater management practices and infrastructure) have been identified as the most serious threats to the health of Guam's nearshore marine environment. Increases in soil erosion can lead to sediment loading in coastal waters which directly impact reef building corals and indirectly impact sea turtles by altering habitat including coral reefs and sea grass beds.

The most common direct effect of sedimentation is deposition of sediment on coral surfaces as it settles out from the water column. Corals with certain morphologies (e.g., mounding) can passively reject settling sediments or corals can actively displace sediment by ciliary action or mucous production, both of which require energetic expenditures (Bak and Elgershuizen 1976; Dallmeyer et al. 1982; Lasker 1980; Stafford-Smith 1993; Stafford-Smith and Ormond 1992). Corals that are unsuccessful in removing sediment will be smothered and die (Golbuu et al. 2003; Riegl and Branch 1995; Rogers 1983). Sediment can also induce sublethal effects, such as reductions in tissue thickness (Flynn et al. 2006) and excess mucus production (Marszalek 1981).

In addition, suspended sediment can reduce the amount of light in the water column, making lessenergy available for coral photosynthesis and growth (Anthony and Hoegh Guldberg 2003; Bak 1978; Rogers 1979). While some corals may be more tolerant of short-term elevated levels of sedimentation, sediment stress and turbidity can induce bleaching (Philipp and Fabricius 2003; Rogers 1979). Finally, sediment impedes fertilization of spawned gametes (Gilmour 2002; Humphrey et al. 2008) and reduces larval settlement, as well as the survival of recruits and juveniles (Birrell et al. 2005; Fabricius et al. 2003).

The effects of chemical pollution on marine mammals are just starting to be understood (Aguilar Soto et al. 2008). Recently, the 5.5-year expedition of the *Odyssey* collected 955 biopsy samples from sperm whales around the world to provide a consistent baseline database of ocean contamination and to measure future effects (Ocean Alliance 2010). Chemical pollutants found in pesticides and other substances flow into the marine environment from human use on land and are absorbed into the bodies of marine mammals, accumulating in their blubber, internal organs, or are transferred to the young from mother's milk (Fair et al. 2010). Important factors that determine the levels of pesticides, heavy metals, and industrial pollutants that accumulate in marine mammals are gender (i.e., adult males have no way to transfer pesticides whereas females may pass pollutants to their calves through milk), habitat, and diet. Living closer to the source of pollutants and feeding on higher-level organisms increase the potential to accumulate toxins (Moon et al. 2010). The buildup of human-made persistent compounds in marine mammals not only increases their likelihood of contracting diseases or developing tumors but also compromises the function of their reproductive systems (Fair et al. 2010).

In addition to the effects of sediment-laden and polluted runoff, Guam's nearshore waters have been impacted by years of poorly treated wastewater effluent discharges around the island. In 1986, the U.S. Environmental Protection Agency issued permits under the National Pollutant Discharge Elimination System (NPDES) that allowed Guam Waterworks Authority to discharge wastewater effluent into the nearshore marine environment following primary treatment of wastewater. Primary treatment follows coarse screening and grit settlement, and removes only about 60 percent of the suspended solids in the wastewater by allowing the water to rest in settlement tanks that are used to remove material that floats or settles out (Mancl 1996). Following that, chlorination is normally employed to reduce pathogens. However, the NPDES permits expired in 1991 and were not reissued due to GWA's inability to meet the required standards (Guam 2003).

The lack of adequate wastewater treatment on Guam has contributed to nutrient inputs to nearshore waters. A 2010 assessment by GEPA determined that while most of the 24 assessed bays met water quality guidelines for recreational activities and harvesting, 11 of the bays were impaired. Over 700 swimming advisories due to bacterial counts in marine waters were issued in 2009, likely stemming from faulty septic tanks and non-compliance by treatment facilities with NPDES regulations for various parameters.

The overall health of Guam's coral reefs has declined over time; while it is difficult to assign the causes of this decline to local versus global causes, increased sedimentation and pollutant runoff are known stressors to reef-building corals. The average live coral cover in Guam's nearshore waters was approximately 50 percent in the 1960s, but dwindled to less than 25 percent by the 1990s, with only a few areas having over 50 percent live cover.

5.2.1 Light Pollution

The east end of Apra Harbor is highly developed and brightly illuminated at night. The existing lights from the commercial port are particularly bright and may be clearly visible to nesting turtles and hatchlings in the water, and on the beach, at Spanish Steps. Sea turtle hatchlings are strongly attracted to light (Witherington and Bjorndal 1991a), and use light wavelengths and shape patterns to find the ocean after emerging from the nest (Lohmann et al. 1997; Witherington 1992). Lighting from the commercial port in Apra Harbor, is clearly visible from Spanish Steps (Kevin Brindock, personal communication to Julie Rivers: 29 Oct. 2014); this light pollution may have the potential to impact green turtle reproductive success at the Spanish Steps.

5.3 Marine Debris

Debris can be introduced into the marine environment by its improper disposal, accidental loss, or natural disasters (Watters et al. 2010), and can include plastics, glass, derelict fishing gear, derelict vessels, or military expendable materials. Despite debris removal and outreach to heighten public awareness, marine debris in the environment has not been reduced (Academies 2008) and continues to accumulate in the ocean and along shorelines within the Action Area. Marine debris affects marine habitats and marine life worldwide, primarily by entangling or choking individuals that encounter it. Entanglement in marine debris can lead to injury, infection, reduced mobility, increased susceptibility to predation, decreased feeding ability, fitness consequences, and mortality for all listed species in the Action Area. Entanglement can also result in drowning for air breathing marine species including sea turtles, cetaceans, and pinnipeds. Marine debris ingestion can lead to intestinal blockage which can impact feeding ability and lead to death. Data on marine debris in the Action Area is largely lacking; therefore it is difficult to draw conclusions as the extent of the problem and its impacts on populations of listed species.

Sea turtles can mistake plastic bags for jellyfish, which are eaten by many turtle species in early life phases, and exclusively by leatherback turtles throughout their lives. One study found plastic in 37 percent of dead leatherbacks and determined that 9 percent of those deaths were a direct result of plastic ingestion (Mrosovsky et al. 2009). Other marine debris, including derelict fishing gear and cargo nets, can entangle and drown turtles of all life stages. In studying ingestion in 115 green and hawksbill sea turtles stranded in Queensland, Schuyler et al. (2012) found that the probability of debris ingestion was inversely correlated with size (curved carapace length), and when broken down into size classes, smaller pelagic turtles were significantly more likely to ingest debris than larger benthic feeding turtles. Parker et al. (2005) conducted a diet analysis of 52 loggerhead sea turtles collected as bycatch from 1990 to 1992 in the high seas drift gillnet fishery in the central north Pacific. The authors found that 34.6 percent of the individuals sampled had anthropogenic debris in their stomachs (e.g., plastic, Styrofoam, paper, rubber, etc). Similarly, a study of green sea turtles found that 61 percent of those observed stranded had ingested some form of marine debris, including rope or string, which may have originated from fishing gear (Bugoni et al. 2001). In 2008, two sperm whales stranded along the California coast, with an assortment of fishing related debris (e.g., net scraps, rope) and other plastics inside their stomachs (Jacobsen et al. 2010a). One whale was emaciated, and the other had a ruptured stomach. It was suspected that gastric impaction was the cause of both deaths. (Jacobsen et al. 2010a) speculated that the debris likely accumulated over many years, possibly in the North Pacific gyre that would carry derelict Asian fishing gear into eastern Pacific waters.

Plastic debris is a major concern because it degrades slowly and many plastics float. The floating debris is transported by currents throughout the oceans and has been discovered accumulating in oceanic gyres (Law et al. 2010). Additionally, plastic waste in the ocean chemically attracts hydrocarbon pollutants such as PCB and DDT. Fish, marine mammals and sea turtles can mistakenly consume these wastes containing elevated levels of toxins instead of their prey. In the North Pacific Subtropical Gyre it is estimated that the fishes in this area are ingesting 12,000 to 24,000 U.S. tons (10,886,216 to 21,772,433 kilograms [kg]) of plastic debris a year (Davison and Asch 2011).

In December 2013 a distressed juvenile hawksbill turtle was found entangled in marine debris in Garapan Lagoon, Saipan; a nylon rope tied in a loop had caught around the turtle's carapace and the turtle's body had apparently distorted around the restricting rope as it grew (Figure 16). The rope was removed and the turtle was released alive.



Figure 16: Juvenile hawksbill turtle entangled in marine debris recovered in Garapan Lagoon, Saipan, December 2013. Image: CNMI Department of Lands & Natural Resources.

Between October 2004 and September 2008, the American Samoa Department of Marine and Wildlife Resources (DMWR) necropsied four green turtles that stranded on Tutuila. Of those four, 2 had plastic and aluminum in their guts (Tagarino et al. 2008). However, because only a small percent of dead or dying sea turtles strand, little information is available to adequately quantify the impacts on sea turtles that may result from marine debris in the Action Area. Accumulated marine debris on sea turtle nesting beaches can also impede nesting success by altering nest excavation and through potential entrapment of hatchlings under debris that is inadvertently buried over them when the nesting female covers the clutch. The nesting beaches in the Spanish Steps area on Guam heavily impacted by accumulated marine debris and non-native plants.

5.4 Fisheries

Fisheries constitute an important and widespread use of the ocean resources throughout the Action Area. Fisheries can adversely affect fish populations, other species, and habitats. Direct effects of fisheries interactions include entanglement and entrapment which can lead to fitness consequences or mortality as a result of injury or drowning. Indirect effects include reduced prey availability and destruction of habitat. Potential impacts of fisheries include overfishing of targeted species and bycatch, both of which negatively affect fish stocks and other marine

resources. Bycatch is the capture of fish, marine mammals, sea turtles, marine birds, and other nontargeted species that occurs incidental to normal fishing operations. Use of mobile fishing gear, such as bottom trawls, disturbs the seafloor and reduces structural complexity. Indirect impacts of trawls include increased turbidity, alteration of surface sediment, removal of prey (leading to declines in predator abundance), removal of predators, ghost fishing (i.e., lost fishing gear continuing to ensnare fish and other marine animals), and generation of marine debris. Lost gill nets, purse seines, and long-lines may foul and disrupt bottom habitats and have the potential to entangle or be ingested by marine mammals.

Fisheries can have a profound influence on fish populations. In a study of retrospective data, Jackson et al. (2001) analyzed paleoecological records of marine sediments from 125,000 years ago to present, archaeological records from 10,000 years before the present, historical documents, and ecological records from scientific literature sources over the past century. Examining this longer-term data and information, Jackson et al. (2001) concluded that ecological extinction caused by overfishing precedes all other pervasive human disturbance of coastal ecosystems, including pollution and anthropogenic climatic change. Fisheries bycatch has been identified as a primary driver of population declines in several groups of marine species, including sharks, mammals, marine birds, and sea turtles (Wallace et al. 2010b).

Fisheries in the Action Area range from relatively small-scale, nearshore fisheries around Guam and the Commonwealth of the Northern Mariana Islands, to large-scale longline and purse seine fisheries prosecuted further offshore. Nearshore fisheries in the Action Area are based out of Guam or CNMI and operate from shore or out of small boats with little distinction among commercial, subsistence, or recreation trips (Council 2011), whereas the offshore fishery in the Action Area is primarily a commercial fishery, and includes high seas fishing activity from foreign vessels. Domestic fisheries based in Guam and the CNMI likely represent only a small percentage of the total fishing effort in the Action Area. International fleets, mainly from Asian nations, operate offshore and target pelagic species such as tunas, sharks and mahimahi.

Domestic fisheries based in Guam are divided into two basic categories: offshore and inshore fishing. Offshore fishing typically involves small boats (12–48 feet in length) that engage in one to two day trolling and bottom fishing trips to nearby banks, isles and pelagic areas. Inshore fishing is usually conducted without the use of a boat and consists mainly of casting (rod & reel fishing), throw-netting, and spearfishing. Data from the NOAA Pacific Islands Fishery Science Center indicates that the top fisheries in Guam in 2012, by weight, included skipjack tuna, mahimahi, wahoo, and marlins, as well as reef fish such as parrotfish and unicornfish.

The domestic commercial fishery of the CNMI is mainly a small boat troll fishery. Most fishing vessels are outboard-powered vessels less than 24 feet in length that make trolling trips of generally a day or less in duration. There are a few larger boats that have been used in recent years for bottom fishing around the islands north of Saipan in addition to trolling. Reef fishes make up a significant portion of the total commercial catch and are an important component of the local diet. While the vast majority of the domestic catch is consumed locally, there have been some intermittent exports to Guam, Hawaii, and Japan. Data from the NOAA Pacific Islands Fishery Science Center indicates that the top fisheries in Guam in 2012, by weight, included skipjack tuna, yellowfin tuna, mahimahi, wahoo, and reef fish.

Harvest from small-scale fisheries in the tropical Pacific in general is usually underestimated in official statistics due to the difficulty and costs of quantifying these very spatially diverse fisheries (Zeller et al. 2007). Zeller et al. (2005) re-estimated harvest of reef and bottom fishery catches in Guam and CNMI. The authors used estimated human consumption rates of the local population, and estimated values of exported/imported catches to estimate more representative catch numbers. The authors indicated a 2.5-fold underreporting of catches in Guam from 1965-2002, and a 2.2-fold underreporting of catches in CNMI from 1983 to 2002.

5.4.1 Bycatch

The term "bycatch" refers to any fisheries capture that is incidental to the intended or targeted species and can encompass all unwanted, unmanaged, or discarded animals captured. Bycatch in the Action Area occurs both as a result of nearshore fisheries based in Guam and CNMI as well as large-scale offshore fisheries operated by foreign fishing fleets. Bycatch is likely the most impactful problem presently facing cetaceans worldwide and may account for the deaths of more marine mammals than any other cause (Geijer and Read 2013; Hamer et al. 2010; Northridge 2008; Read 2008). Cetaceans are prone to bycatch in longline, trawl and purse seine fisheries, and large whales are prone to entanglement in trap or pot fisheries. Entanglement may also make whales more vulnerable to additional dangers, such as predation and ship strikes, by restricting agility and swimming speed. Wallace et al. (2010c) estimated that worldwide, 447,000 turtles are killed each year from bycatch in commercial fisheries. It is likely that the majority of individual sea turtles and marine mammals that are killed by commercial fishing gear are never detected, making it very difficult to accurately determine the number and frequency of mortalities.

Fisheries in the Action Area are likely result in the incidental capture and mortality of green, loggerhead, leatherback and hawksbill sea turtles, though data on sea turtle bycatch in the region are lacking. As greens and hawksbills nest on Guam and the CNMI, they are more likely to be encountered in nearshore waters are therefore more likely to be affected by nearshore fisheries based on Guam and the CNMI. Gill nets generally represent the most problematic fishery for sea turtles because the nets are often left untended, increasing the likelihood of drowning. Guam law prohibits drift gill nets and requires that staked gill nets be moved every six hours; these regulations would be expected to reduce the probability of mortality for any turtles incidentally captured. No such laws regarding gill nets exist in the CNMI that we are aware of. Sea turtles can also be hooked or entangled in hook-and-line fisheries, though the chance of survival is considered higher than if caught in a gill net. Leatherback sea turtles are known to have been occasionally captured offshore by Guam-based fishermen (Karen Frutchey, NMFS PIRO PRD, personal communication to Jordan Carduner, NMFS OPR, September 2014). In a study of stranded green turtles in Hawaii (those that are found on shore either injured, sick, or dead), the second and third most common known causes of stranding were fishing related. Hook-and-line fishing gear-induced trauma accounted for 7 percent, and gillnet fishing gear-induced trauma was responsible for 5 percent (Chaloupka et al. 2008b). However, most turtles that drown in fishing gear are likely never documented, making it very difficult to estimate the total number of turtles killed annually by nearshore fishing interactions, even in Hawaii where turtles are much better monitored and studied than in the Marianas.

We know very little about incidental fisheries interactions with cetaceans in the nearshore waters surrounding Guam and the CNMI. At the time this Opinion was written, the NMFS Pacific Islands Regional Office had not received any reports of hookings or entanglements of cetaceans,

nor had they observed any sign of fisheries interactions with cetaceans during their surveys (Erin Oleson, NMFS PIRO PRD, personal communication to Jordan Carduner, NMFS OPR, October 2014). As described above, fishing fleets based out of Guam and CNMI are small in scale and there are very few longline vessels or purse seine vessels that operate out of regional ports; thus fisheries interactions with cetaceans would be less likely among these vessels than among the larger scale fishing fleets that operate offshore within the Action Area. While we suspect that interactions with cetaceans likely occur among the offshore fisheries in the Action Area, data on these offshore fleets is scarce.

Bycatch of scalloped hammerhead sharks likely occurs in the Action Area though we are not aware of any data that is specific to the Action Area. Apra Harbor in Guam is considered an aggregation area for neonate and juvenile scalloped hammerheads, therefore incidental fisheries interactions with scalloped hammerheads near the harbor is a possibility; however we were not able to locate documentation of such bycatch. Guam law prohibits drift gill nets and requires that staked gill nets be moved every six hours; these regulations would be expected to reduce the probability of mortality for any sharks incidentally captured.

5.4.2 Directed Fisheries

The directed hunting of sea turtles in foraging areas and on nesting beaches as well as the harvesting of eggs from nesting beaches represent ongoing threats to sea turtles in the Action Area. Directed take through harvest of turtles and their nests continues on Guam and the other inhabited islands of the Mariana archipelago. Turtles were traditionally taken by residents of Guam for celebrations, and reports indicate that illegal harvesting still occurs. Poaching also occurs by immigrants, fishing crews, and tourists, especially those from areas where they are accustomed to eating turtles legally.

Between October 2013 and October 2014, the CNMI Department of Lands & Natural Resources reported two cases of attempted poaching of juvenile green sea turtles and one case of recovered juvenile green turtle remains that appeared consistent with poaching activity on Saipan, as well as the confiscation of five juvenile green turtle carapaces at Saipan International Airport. During the 2009 nesting season on Saipan, three out of what is thought to be a total of five nesting turtles were poached as were three nests. On Guam, DAWR has responded to 17 poachings of green sea turtles and 1 hawksbill since 1975. It is likely that the documented cases of poaching of adult sea turtles and sea turtle eggs represent just a fraction of the actual poaching cases that occur in the Action Area. Despite the evidence of continued poaching of adult sea turtles and sea turtle eggs, the available data on these activities is not adequate to allow for an accurate estimate of the impacts to listed sea turtle species in the Action Area.



Figure 17: Evidence of attempted poaching in the CNMI: A live juvenile green turtle found flipper-bound by a rubber strap, Saipan, 13 February 2014. Image courtesy of CNMI Department of Lands & Natural Resources.

Guam bans the possession, sale, or distribution of shark products, while the CNMI bans the landing of sharks at all ports within the archipelago. However, as described above, fisheries based in Guam and the CNMI are almost exclusively nearshore fisheries, and it is likely that offshore fisheries in the Action Area target sharks. Literature and technical reports describing fishing activity in the Action Area do not indicate that scalloped hammerhead sharks are directly targeted, though they are captured in shark fisheries that do not differentiate by species. Assessing harvest levels of scalloped hammerheads in the Action Area is difficult because many catch records do not differentiate among hammerhead species, or shark species in general (Miller 2014). For the nearshore fishery, the Western Pacific Fisheries Information Network (WPacFin) houses reported catch data from the fishery agencies of Guam (Division of Aquatic and Wildlife Resources; Bureau of Statistics and Plans) and CNMI (Division of Wildlife). However, reported shark catches for Guam and CNMI are aggregated into "Pelagic fishes" or "Sharks" categories for reporting purposes, making it difficult to differentiate scalloped hammerhead catch from these data. Similarly for the offshore environment, until 2011, the Western and Central Pacific Fisheries Commission (WCPFC) did not require the offshore fishery in the WCPFC Convention Area (inclusive of the Action Area) to report species specific information for many shark species, including hammerheads.

Observer data appears to be the most useful representation of species-specific catch rates in the offshore fishery of the Action Area (though it should be noted that these data are from observed fishing trips throughout the western and central Pacific Ocean and are not specific to the Action Area). Observer data from 1994 to 2009 indicates that hammerhead shark catch accounted for 0.2 percent of the total observed catch, by weight for longline fisheries (Programme 2010). Observer data from the purse seine fishery during the same time period indicated even lower shark catch rates: excluding catches of silky, whale, and oceanic whitetip sharks which were reported separately, catches of "Other sharks and rays" (inclusive of scalloped hammerhead sharks) represented only 0.01 percent of the total catch by weight of observed purse seine catches .

Scalloped hammerheads, like many shark species, are targeted for their fins because they fetch a high commercial value in the Asian shark fin trade. It is thought that scalloped hammerheads,

and sharks in general, are likely under-reported in catch records as many records do not account for discards, or finned individuals (Miller 2014). Observer data from the longline fisheries of the Western and Central Pacific Ocean indicates that of the 104 scalloped hammerheads observed discarded from 1994-2009 (on over 3,000 observed trips), 72 percent of those discarded were finned. Also of note, an additional 157 hammerheads were observed discarded over this time, but were not identified to species. Approximately 61 percent of those discarded individuals were finned. It should be noted that only a very small percentage of fishing vessels in the offshore portions of the Action Area have observer coverage, and many of the vessels that are most likely to be engaged in shark finning activities are also least likely to carry observers onboard. Many countries and fisheries management entities have aimed to restrict shark finning, though the practice continues in many areas. Since 2008, the Western and Central Pacific Fisheries Commission has attempted to discourage shark finning by requiring that fishing vessels retain all parts of the shark excepting head, guts, and skins, to the point of first landing. Further, onboard fins cannot weigh more than 5 percent of the weight of sharks onboard, up to the first point of landing. Despite these restrictions, illegal fishing activity is well documented, particularly on the high seas where enforcement is difficult. Guam banned the possession, sale, offer for sale, take, purchase, barter, transport, export, import, trade, or distribution of shark fins (with exemptions for research and subsistence fishing) in 2011. Similarly, CNMI banned the possession, sale, offer for sale, trade, or distribution of shark fins (with exemptions for research and subsistence fishing) in 2011.

5.5 Whaling

Large whale population numbers in the Action Areas have historically been impacted by commercial exploitation, mainly in the form of whaling. During the height of global whaling, Guam was an important stopover for whaling ships in the Pacific Ocean. However, we are not aware of any directed hunting of whales that presently occurs in the Action Area. Prior to current prohibitions on whaling, most large whale species had been significantly depleted. Table 26 lists the reported catches of all whale species considered in this Opinion and the year in which the International Whaling Commission (IWC) issued a moratorium on harvest of that species.

Table 26. Reported Catch of Endangered Whales Considered in This Opinion, in the North Pacific Ocean

Species	Estimated total catch	Data years	Source	IWC moratorium
Blue whale	9,500 whales	1910 - 1965	(Ohsumi and Wada 1972)	1966
Fin whale	46,000 whales	1919 - 1945	(C. Allison, IWC, pers. comm.; cited in : (Carretta et al. 2014)	1976
Humpback whale	15,000 whales	1919 - 1987	(Tonnessen and Johnsen 1982); C. Allison, IWC unpubl. Data; cited in: (Carretta et al. 2014)	1966
Sei whale	61,500 whales	1947 - 1987	(C Allison, IWC, pers. comm.(Allison 2007)	1976
Sperm whale	258,000 whales	1947 - 1987	(C. Allison, IWC, pers. comm.; cited in: (Carretta et al. 2014)	1988

These whaling numbers represent minimum catches, as illegal or underreported catches are not included. For example, recently uncovered Union of Soviet Socialist Republics catch records indicate extensive illegal whaling activity between 1948 and 1979, with a harvest totalling 157,680 sperm whales in the North Pacific Ocean (Ivashchenko et al. 2014). Of these, only 132,505 were reported by the USSR to the Bureau of International Whaling Statistics. Additionally, despite the moratorium on large-scale commercial whaling, catch of some of these species still occurs in the Pacific Ocean whether it be under objection of the IWC, for aboriginal subsistence purposes, or under IWC special permit (Table 27). Although these fisheries operate outside of the Action Area, some of the whales killed in these fisheries are likely part of the same populations of whales occurring within the Action Area for this consultation.

Table 27. Catches taken in the Pacific Ocean by commercial, aboriginal, and scientific permit whaling since 1985. Note that the large majority of these catches were taken in the Northwest Pacific Ocean by either Japan or Russia (USSR prior to 1992). Data compiled from the International Whaling Commission website (iwc.int/home; accessed on January 24, 2015).

Year	Sperm whale	Gray whale	Sei whale
1985	0	170	0
1986	200	171	0
1987	188	159	0
1988	0	151	0
1989	0	180	0
1990	0	162	0
1991	0	169	0
1992	0	0	0
1993	0	0	0
1994	0	44	0
1995	0	92	0
1996	0	43	0
1997	0	79	0
1998	0	125	0
1999	0	124	0
2000	5	115	0
2001	8	112	1
2002	5	131	40
2003	10	128	50
2004	3	111	100
2005	5	124	100
2006	6	134	101
2007	3	132	100
2008	2	130	100
2009	1	116	101
2010	3	118	100
2011	1	128	96
2012	3	143	100
2013	1	127	100
Totals	444	3418	1089

Historically, commercial whaling caused all of the large whale species to decline to the point where they faced extinction risks high enough to list them as endangered species. Since the end of large-scale commercial whaling, the primary threat to these species has been eliminated. However, as described in greater detail in the *Status of Listed Resources* section of this Opinion, all whale species have not recovered from those historic declines. Scientists cannot determine if

those initial declines continue to influence current populations of most large whale species in the North Pacific. For example, the North Pacific right and Western North Pacific gray whales have not recovered from the effects of commercial whaling and continue to face very high risks of extinction because of their small population sizes and low population growth rates. In contrast, species such as the humpack whale has increased substantially from post-whaling population levels and appear to be recovering despite the impacts of ship strikes, interactions with fishing gear, and increased levels of ambient sound in the Pacific Ocean.

5.6 Ongoing U.S. Military Training and Testing Activities in the Action Area

This section summarizes the United States Pacific Fleet marine species monitoring under the MMPA LOA for at-sea training in the MIRC. This data was provided by the Navy in in the Comprehensive Exercise and Marine Species Monitoring Report for The U.S. Navy's Mariana Islands Range Complex. Department of the Navy, Commander, U.S. Pacific Fleet, Pearl Harbor, Hawaii. 31 October 2014. The majority of the training and testing activities the Navy conducts in the MITT Action Area and proposes to continue to conduct are similar, if not identical, to activities that have been occurring in the same locations for decades.

There were two individual MTEs that took place in the MIRC from 12 August 2010 to 15 July 2014. These MTEs are summarized in Table 28.

Table 28. Summary of Major Training Exercises in MIRC

Exercise Type	12 Aug 2010 – 15 Feb 2011	16 Feb 2011 – 15 Feb 2012	16 Feb 2012 – 15 Feb 2013	16 Feb 2013 – 15 Feb 2014	16 Feb 2014 – 15 Jul 2014	Reporting Period Total
Joint Multi-Strike Group Exercise	1	0	1	0	0	2
Total	1	0	1	0	0	2

There were 11 reported sightings of an estimated 47 marine mammals during MTEs in the MIRC from 12 August 2010 to 15 July 2014. These sightings are summarized in Table 29.

Table 29. Summary of Sightings during Major Training Exercises

Marine Species	12 Aug 2010 – 15 Feb 2011	16 Feb 2011 – 15 Feb 2012	16 Feb 2012 – 15 Feb 2013	16 Feb 2013 – 15 Feb 2014	16 Feb 2014 – 15 Jul 2014	Reporting Period
Estimated Number of Animals Sighted While Sonar Active						
Dolphin	0	0	0	0	0	0
Whale	4	0	0	0	0	4
Pinniped	0	0	0	0	0	0
Turtle	0	0	0	0	0	0
Generic	1	0	0	0	0	1
Subtotal while Active	**5**	**0**	**0**	**0**	**0**	**5**
Estimated Number of Animals Sighted While Sonar Passive						
Dolphin	25	0	8	0	0	33
Whale	9	0	0	0	0	9
Pinniped	0	0	0	0	0	0
Turtle	0	0	0	0	0	0
Generic	0	0	0	0	0	0

Marine Species	12 Aug 2010 – 15 Feb 2011	16 Feb 2011 – 15 Feb 2012	16 Feb 2012 – 15 Feb 2013	16 Feb 2013 – 15 Feb 2014	16 Feb 2014 – 15 Jul 2014	Reporting Period
Subtotal while Passive	34	0	8	0	0	42
Total	**39**	**0**	**8**	**0**	**0**	**47**

There were 4 total mitigation events where active sonar was powered down or shut down due to the sighting of marine mammals or sea turtles during MTEs from 12 August 2010 to 15 July 2014. These mitigation events are summarized in Table 30. All of these sightings were observed within 4,000 yards of the Navy unit; one was observed by an aircraft, and one was an acoustic detection. The Navy's unclassified annual exercise reports from 2010 through 2014 contain tables listing all marine mammals sighted during that reporting year and the range of the sighting.

Table 30.Summary of Mitigation Events During Major Training Exercises

Marine Animal Species	Range of Detection (Yards, <200, 200-500, 500-1,000, 1,000-2,000, >2,000)	Mitigation Measure Implemented	Un-required Mitigation (Yes/No)
12 August 2010 – 15 February 2011			
Generic	Acoustic detection	Sonar shut down	Yes
Whale	<200	Sonar shut down	No
Whale	200-500	Sonar shut down	No
Whale	>2,000	Sonar shut down/maneuvered	Yes
16 February 2011 – 15 February 2012			
No mitigation events during this period			
16 February 2012 – 15 February 2013			
No mitigation events during this period			
16 February 2013 – 15 February 2014			
No mitigation events during this period			
16 February 2014 – 15 July 2014			
No mitigation events during this period			

5.7 Other U.S. Military Activities in the MITT Action Area

The following sections describe other past and ongoing military activities in the MITT Action Area.

5.7.1 Guam and CNMI Military Relocation

NMFS PIRO issued a biological opinion on 25 August 2010 on the Department of Navy (DoN) Joint Guam Program Office's Guam and CNMI Military Relocation. The action included three primary components: 1) Relocating U.S. Marines from Okinawa to Guam; 2) Increasing and upgrading vessel berthing and related facilities in Apra Harbor to accommodate increased visits by aircraft carriers and their accompanying ships, collectively referred to as a Carrier Strike Group (CSG), as well as supporting increased visits by Amphibious Taskforce (ATF) ships; and 3) Stationing an Army Air and Missile Defense Task Force on Guam. The action included substantial new upland construction and infrastructure improvements to support the incoming Marine and Army forces. That construction was not expected to directly affect ESA-listed species under NMFS jurisdiction. However, it was determined that the work necessary to

increase and upgrade vessel berthing and related facilities in Apra Harbor was likely to affect ESA-listed marine species. The action was expected have indirect impacts on ESA-listed marine species through increased wastewater discharge and increased commercial and recreational vessel traffic that were expected to result from the proposed population increase on Guam. Thus, those actions were subject of the consultation. NMFS determined that an undeterminable number of green and hawksbill sea turtles were expected to be adversely affected by the action, primarily through behavioral modification. As of the drafting of this Opinion, the majority of in-water work (Inner Apra Harbor Wharf Repairs) associated with the action in the CNMI Military Relocation consultation has been completed.

In February 2012, the DoN initiated a Supplemental EIS to evaluate the environmental consequences of establishing a live-fire training range complex on Guam in support of the relocation of Marine Corps forces to the island. Scoping meetings for the Supplemental EIS were held in March 2012. On 27 April 2012, the U.S.-Japan Security Consultative Committee issued a joint statement announcing its decision to adjust the plans outlined in the May 2006 Realignment Roadmap document. In accordance with the adjustments (the "2012 Roadmap Adjustments"), the DoD adopted a new force posture in the Pacific which provided a substantially smaller Marine Corps relocation to Guam. As a result of the 2012 Roadmap Adjustments, the DoN expanded the scope of the Supplemental EIS to also evaluate the potential environmental consequences from construction and operation of a main cantonment area, including family housing, and associated infrastructure to support the relocation of a substantially reduced number of Marines than previously analyzed. The Supplemental EIS supplements the 2010 Final EIS for the Guam and CNMI Military Relocation. As of the drafting of this Opinion, the Final SEIS for this action had not yet been released to the public. United States Marine forces are not expected to arrive in Guam until facilities are built and operational. Under the currently proposed timeline, this will not occur until 2020 (DoN 2012).

5.7.2 X-Ray Wharf Improvements

The Department of the Navy is planning improvements to its X-Ray wharf facility at Naval Base Guam in Apra Harbor to accommodate two berths for the Navy's new class of supply ships. ESA Section 7 consultation was completed on 9 January 2014 by NMFS PIRO. The temporary displacement of green and hawksbill sea turtles from Apra Harbor was expected as a result of the wharf construction, but no take was anticipated as a result of the action.

5.7.3 Surveillance Towed Array Sensor System Low Frequency Active Sonar

The Navy operates up to four Surveillance Towed Array Sensor System Low Frequency Active Sonar systems for routine training, testing, and military operations. Based on current Navy national security and operational requirements, routine training, testing, and military operations using these sonar systems could occur in the in the Pacific Ocean (including the Action Area), Atlantic Ocean, Indian Ocean, and Mediterranean Sea. A summary of SURTASS LFA sonar missions and mitigation measure detections from 2002 to 2014 is presented in Table 31.

During the first two quarters of the current LOA reporting period (2014 to 2015), one mission was completed over one day, during which LFA sonar was transmitted for 1.25 hours. There were no visual, passive acoustic, or active acoustic detections of marine animals, shutdowns of the LFA sonar, or reports of dead or injured marine animals. The results of the mitigation monitoring and its effectiveness support the Navy's and NMFS' conclusions that the Navy's

protocols for the use of SURTASS LFA sonar provide an effective means of minimizing risk of injury to protected marine species.

Table 31. Summary of SURTASS LFA sonar missions and mitigation measure detections from 2002 through 2014.

Year [1]	Vessel	Mission Summary			Visual Detections	Passive Acoustic Detections	Active Acoustic HF/M3 Detections	HF/M3 Unavailable[2]	Mitigation Protocol Suspensions/ Delays
		Number	Days	LFA Sonar Hours					
2002-2003	R/V *Cory Chouest*	7	34.2	82.2	0	0	3	0	3
2003-2004	R/V *Cory Chouest*	5	72.5	173.7	0	0	10	0	10
	USNS IMPECCABLE	5			0	0	6	2	8
2004-2005	R/V *Cory Chouest*	3	22.5	41.9	0	0	1	11	12
	USNS IMPECCABLE	2			0	0	1	0	1
2005-2006	R/V *Cory Chouest*	12	95.6	173.2	1	0	47	10	58
	USNS IMPECCABLE	6			2	0	3	0	5
2006-2007	R/V *Cory Chouest*	6	94.6	161.5	0	0	30	50	80
	USNS IMPECCABLE	12			1	0	0	0	1
2007-2008	R/V Cory Chouest	6	49.8	135.8	0	0	0	16	16
	USNS IMPECCABLE	8			1	0	19	7	27
2008-2009	USNS ABLE	3	23.7	32.5	1	0	1	3	5

Year [1]	Vessel	Mission Summary			Visual Detections	Passive Acoustic Detections	Active Acoustic HF/M3 Detections	HF/M3 Unavailable[2]	Mitigation Protocol Suspensions/ Delays
		Number	Days	LFA Sonar Hours					
	USNS IMPECCABLE	6			2	0	1	0	3
2009-2010	USNS ABLE	10	17.1	43.6	0	0	0	0	0
	USNS IMPECCABLE	21			1[3]	3[4]	3[4]	4	7
2010-2011	USNS ABLE	8	62.3	64.0	1[3]	1	1[3]	0	1
	USNS EFFECTIVE	1			2[5]	0	2[6]	1	4
	USNS IMPECCABLE	7			0	0	2	0	2
2011-2012	USNS ABLE	6	28.5	66.3	0[7]	1	1	0	3[8]
	USNS EFFECTIVE	5			0	0	0	0	0
	USNS IMPECCABLE	3			0	0	0	0	0
	USNS VICTORIOUS	1			0	0	0	0	0
2012-2013	USNS ABLE	3	24.4	47.3	0	0	0	0	0

Year [1]	Vessel	Mission Summary			Visual Detections	Passive Acoustic Detections	Active Acoustic HF/M3 Detections	HF/M3 Unavailable[2]	Mitigation Protocol Suspensions/ Delays
		Number	Days	LFA Sonar Hours					
	USNS EFFECTIVE	4			0	3	9	12	16
	USNS IMPECCABLE	2			0	0	0	0	12
	USNS VICTORIOUS	3			0	0	1	1	1
2013-2014	USNS ABLE	3	20.44	38.63	0	0	9	0	4[9]
	USNS EFFECTIVE	3			0	0	0	0	0
	USNS IMPECCABLE	0			0	0	0	0	0
	USNS VICTORIOUS	1			0	0	1	0	1
	Totals	**162**	**545.64**	**1060.63**	**66**	**39**	**218**	**117**	**315**

[1] August to August
[2] LFA sonar suspended during HF/M3 non-availability
[3] Contact made when LFA sonar not transmitting
[4] Marine mammal passive contacts verified by HF/M3 sonar system
[5] One contact confirmed with HF/M3 sonar, second was a sea turtle
[6] Only one contact confirmed visually
[7] 1 visual sighting of a marine mammal after the mission ended and LFA sonar was non-operational
[8] 1 shut down due to loss of passive acoustics system
[9] Although 9 HF/M3 sonar detections occurred during the USNS ABLE's missions, SURTASS LFA sonar operators determined that 5 of the HF/M3 detections were not biological sonar returns. Thus, LFA sonar transmissions were not suspended or delayed as a result of the HF/M3 detections.

The post-operational incidental harassment estimates for SURTASS LFA sonar transmissions from August 2013 to August 2014 indicate no marine mammals from any stocks in the northwestern Pacific Ocean were exposed to received levels at or above 180 dB (with mitigation applied). Some marine mammals were estimated to have been exposed to SURTASS LFA sonar transmissions during this period at received levels between 120 and 180 dB during this period (Table 32). No marine mammal stranding events associated with the times and locations of SURTASS LFA sonar missions were reported during this period and no apparent avoidance reactions or acute effects to threatened or endangered species were observed in response to exposure from SURTASS LFA sonar transmissions.

Table 32. Estimated number of ESA-Listed species that may be exposed to U.S. Navy Surveillance Towed Array Sensor System Low Frequency Active Sonar at received levels between 120 and 180 dB from August 2013 through August 2014. Information compiled from SURTASS LFA sonar Annual Report (2013-2014 LOA).

Species	Number of marine mammals in stock	Number of animals exposed (received levels of 120 to 180dB)
Blue Whale	9,250	3
Fin Whale	9,250	15
Western North Pacific Gray Whale	121	2
Humpback Whale	1,107	20
Sperm Whale	102,112	74
North Pacific Right Whale	922	4

The available evidence does not indicate that the use of SURTASS LFA has any adverse population-level impact on the the species evaluated in this Opinion or has otherwise adversely impacted the environmental baseline in the Action Area.

5.7.4 Divert Activities and Exercises

The U.S. Air Force proposes improvements to an existing airfield and associated infrastructure in the Mariana Islands in support of expanding mission requirements in the western Pacific. In addition, divert capabilities for current, emerging, and future training activities are proposed. A Draft EIS analyzing environmental impacts associated with the divert activities and exercises was published in June 2012. As of the issuance of this Opinion, the Final EIS for this action had not yet been made available to the public.

5.7.5 Dredging, Filling and Explosive Clearing

Apra Harbor is a natural deep-water harbor, which has been heavily modified, particularly since World War II (Figure 18). Much of the harbor's current topography and bathymetry is manmade; the result of work begun by the U.S. Government in 1943. Extensive dredging and fill projects resulted in the creation of Inner Apra Harbor and its channel as well as the creation of Dry Dock Peninsula, Polaris Point, and the manmade northeastern and southeastern shorelines and the Glass Breakwater, which extends from Cabras Island, out and across Luminau Reef to provide increased protection for the harbor. Other impacts include the knolls (hard bottom sites that protrude at least 25 ft (7.6 m) above the harbor bottom) that were explosively cleared during WWII, because they were considered navigational hazards. Some of the shallower knolls have been used as anchorage sites since WWII, and some are still used by military and commercial vessels. The Guam and CNMI military relocation involves additional dredging in Inner Apra Harbor (Office 2010).

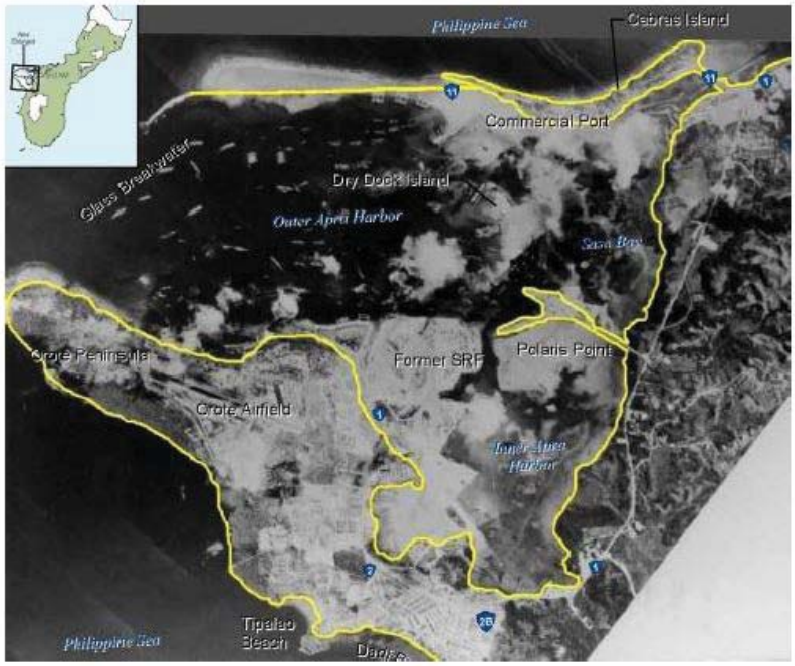

Figure 18. Apra Harbor July 1945. The yellow line indicates the approximate shoreline prior to the dredging and fill projects of the 1940s.

5.8 Commercial and Private Marine Mammal Watching

The 'whale watching' industry in the Action Area remains relatively small and is presently focused on dolphins rather than large whales. Although considered by many to be a non-consumptive use of marine mammals with economic, recreational, educational and scientific benefits, marine mammal watching is not without potential negative impacts. Whale watching has the potential to harass whales by altering feeding, breeding, and social behavior or even injure them if the vessel gets too close or strikes the whale. Another concern is that preferred habitats may be abandoned if disturbance levels are too high. Several studies have specifically examined the effects of whale watching on marine mammals, and investigators have observed a variety of short-term responses from animals, ranging from no apparent response to changes in vocalizations, duration of time spent at the surface, swimming speed, swimming angle or direction, respiration rate, dive time, feeding behavior, and social behavior (NMFS 2006b). Responses appear to be dependent on factors such as vessel proximity, speed, and direction, as well as the number of vessels in the vicinity (Au and Green 2000; Corkeron 1995; Erbe 2002b; Magalhaes et al. 2002; Richter et al. 2003; Scheidat et al. 2004; Watkins 1986; Williams et al. 2002a; Williams et al. 2002b). Foote et al. (2004) reported that southern resident killer whale call duration in the presence of whale watching boats increased by 10 to 15 percent between 1989 to 1992 and 2001 to 2003 and suggested this indicated compensation for a noisier environment. Disturbance by whale watch vessels has also been noted to cause newborn calves to separate briefly from their mothers' sides, which leads to greater energy expenditures by the calves (NMFS 2006b). Whale-watching vessels are also known to influence sperm whale behavior (Richter et al. 2006). Although numerous short-term behavioral responses to whale watching

vessels are documented, little information is available on whether long-term negative effects result from whale watching (NMFS 2006b). Christiansen et al. (2014) estimated the cumulative time minke whales spent with whale watching boats in Iceland to assess the biological significance of whale watching disturbances and found that, though some whales were repeatedly exposed to whale watching boats throughout the feeding season, the estimated cumulative time they spent with boats was very low. The authors suggested that the whale watching industry, in its current state, is likely not having any long-term negative effects on vital rates (Christiansen et al. (2014). To our knowledge, similar studies have not been conducted in Guam or CNMI.

5.9 Vessel Strike

Vessel strike is a significant concern for the recovery of listed whales and sea turtles. Evidence suggests that not all whales killed as a result of vessel strike are detected, particularly in offshore waters, and some detected carcasses are never recovered while those that are recovered may be in advanced stages of decomposition that preclude a definitive cause of death determination (Glass et al. 2010). Therefore, it is likely that the number of documented cetacean mortalities related to ship strikes is much lower than the actual number of mortalities associated with ship strikes. However, unlike other maritime entities, the Navy has a policy to report all ship strikes.

Ship strikes are a poorly-studied threat to sea turtles, but have the potential to be highly significant (Work et al. 2010b). All sea turtles must surface to breathe and several species are known to bask at the surface for long periods, including loggerhead sea turtles. Although sea turtles can move rapidly, they apparently are not adept at avoiding vessels that are moving at more than 4 km/hr; most vessels move far faster than this in open water (Hazel and Gyuris 2006; Hazel et al. 2007; Work et al. 2010b). Both live and dead sea turtles are often found with deep cuts and fractures indicative of collision with a boat hull or propeller (Hazel et al. 2007). Hazel et al. (2007) suggested that green sea turtles may use auditory cues to react to approaching vessels rather than visual cues, making them more susceptible to strike as vessel speed increases.

Portions of the Action Area are heavily traveled by commercial, recreational, and government marine vessels, with several commercial ports occurring in or near the Action Area. In the western Pacific Ocean, four waterways used by commercial vessels link Guam and the CNMI with major ports to both the east and west (Figure 19). Guam contains one commercial port located within Apra Harbor. The Port of Guam is the largest U.S. deepwater port in the Western Pacific and handles approximately 2 million tons (1,814,369,480 kilograms [kg]) of cargo a year (Port Authority of Guam 2011). The U.S. provides some 60 percent of Guam's imported goods, with the balance of Guam's trade coming from the Asian and Pacific markets of Japan, Taiwan, the Philippines, Hong Kong, and—to a lesser extent—Australia, New Zealand, and the islands of Micronesia (Port Authority of Guam 2011). Apra Harbor also provides economical transshipment services from the United States, Hawaii, and East Asia to the entire western Pacific. Most shipping lanes are located close to the coast but those that are trans-oceanic start and end to the northwest of Guam.

There are three ports within the CNMI. The Port of Rota, or Rota West Harbor, is located on the southwestern tip of the island and is classified as a very small port (World Port Source 2012a) that is mainly used for ferry boats. The Port of Tinian is described by the World Port Source as a

small port offering excellent shelter, which allows relatively large vessels to dock there. The Port of Saipan is the largest and most advanced of the three ports, but is nevertheless described as a small seaport with poor shelter by the World Port Source. A number of facilities and services are available at the Port of Saipan, which transferred over 338,000 tons of cargo in 2009 (Commonwealth Ports Authority 2005; Commonwealth Ports Authority 2010).

Major commercial shipping vessels use the shipping lanes for shipping goods between Hawaii, the continental U.S., and Asia. However, there are no direct routes between Guam and the U.S.; stops are made in Asia, and usually Japan or Korea, before continuing on to either Hawaii or the continental U.S. The total number of vessels transiting through the Port of Guam has steadily decreased from 2,924 in 1995 to 1,022 in 2008 (DoN 2010a). The Port Authority of Guam estimates 635 total vessel calls, not counting naval ships, in 2013. The decrease is most pronounced in the number of barges and fishing vessels that transit through the port; however, the number of container ships has increased from a low of 103 in 2003 to a high of 165 in 2008.

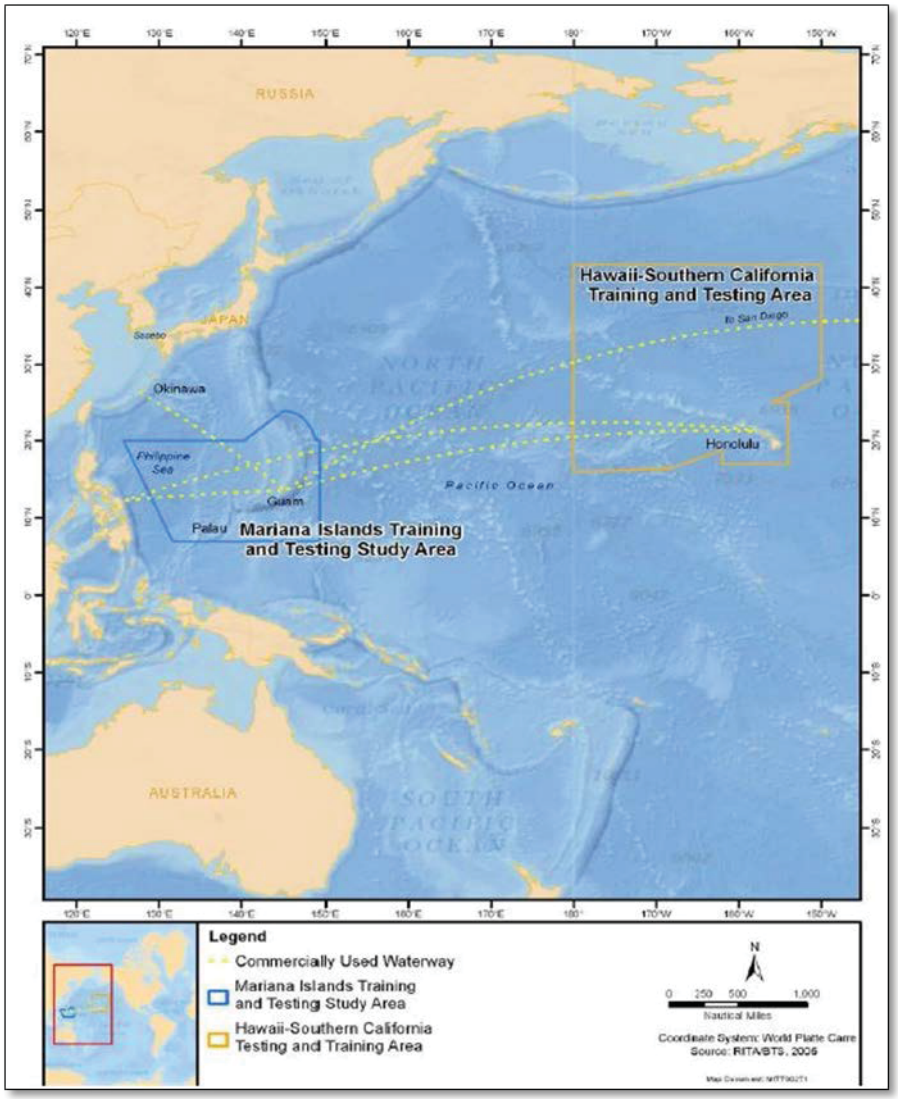

Figure 19: Shipping lanes in the Action Area

The magnitude of the risks commercial ship traffic pose to large whales in the proposed Action Area remains difficult to quantify or estimate. We struggle to estimate the number of whales that are killed or seriously injured in ship strikes on the U.S. Atlantic and Pacific coasts; information on ship strikes in Guam and the CNMI and in the offshore waters within the Action Area is virtually nonexistent. With the information available, we assume those interactions occur but we cannot estimate their significance to whale species.

As in the case of ship strikes to cetaceans, the information on ship strikes to sea turtles in the Action Area is lacking. Based on Hawaii data for the period of 1998 to 2007 (NMFS 2008), the estimated total number of green turtles killed annually by boat collisions in the Main Hawaiian Islands (MHI) was between 25 and 50. The number of hawksbills similarly killed was much lower; between 0.2 and 0.4 turtles annually. The nearshore densities of boats and turtles are

much lower around Guam and the CNMI than in Hawaiian nearshore waters, thus the number of green and hawksbill turtles killed annually by boat collisions around the Mariana Islands and surrounding waters is likely much lower. Although little information exists to quantify this impact, vessel collision has been implicated as the cause of three green turtle strandings in Apra Harbor between November 2002 and April 2008 (DAWR unpublished data).

5.10 Ocean Noise

A wide variety of anthropogenic and natural sources contribute to ocean noise throughout the world's oceans (Hatch and Wright 2007). Anthropogenic sources of noise that are most likely to contribute to increases in ocean noise are vessel noise from commercial shipping and general vessel traffic, oceanographic research, oil and gas exploration, underwater construction, and naval and other use of sound navigation and ranging.

Any potential for cumulative impact should be put into the context of recent changes to ambient sound levels in the world's oceans as a result of anthropogenic activities. However, there is a large and variable natural component to the ambient noise level as a result of events such as earthquakes, rainfall, waves breaking, and lightning hitting the ocean as well as biological noises such as those from snapping shrimp, other crustaceans, fishes, and the vocalizations of marine mammals (Crawford and Huang 1999; Patek 2002).

Andrew et al. (2002) compared ocean ambient sound from the 1960s to the 1990s from a receiver off the California coast. The data showed an increase in ambient noise of approximately 10 dB in the frequency ranges of 20–80 Hz and 200–300 Hz, and about 3 dB at 100 Hz over a 33-year period. Each 3 dB increase is noticeable to the human ear as a doubling in sound level. A possible explanation for the rise in ambient noise is the increase in shipping noise. There are approximately 11,000 supertankers worldwide, each operating approximately 300 days per year, each producing constant broadband noise at typical source levels of 198 dB (Hildebrand 2004). Generally the most energetic regularly operated sound sources are seismic airgun arrays from approximately 90 vessels with typically 12–48 individual guns per array, firing about every 10 seconds (Hildebrand 2004).

Seismic surveys are typically conducted by towing a sound source behind a research vessel, such as an airgun array that emits acoustic energy in timed intervals. The transmitted acoustic energy is reflected and received by an array of hydrophones. This acoustic information is processed to provide information about geological structure below the seafloor. The oil and gas industry conduct seismic surveys to search for new hydrocarbon deposits. In addition, research geologists conduct seismic surveys to study plate tectonics as well as other topics in marine geology. The underwater sound produced by seismic surveys could affect marine life, including ESA-listed marine species. All seismic surveys conducted by U.S. vessels are subject to the MMPA authorization process administered by the NMFS, as well as the NEPA process associated with issuing MMPA authorizations. Currently, there are several MMPA authorizations for seismic surveys near the Action Area, including one for the territorial waters of the CNMI.

Noise is of particular concern to marine mammals because many species use sound as a primary sense for navigating, finding prey, avoiding predators, and communicating with other individuals. As described in greater detail later in this Opinion, noise may cause marine

mammals to leave a habitat, impair their ability to communicate, or to cause stress. Noise can cause behavioral disturbances, mask other sounds including their own vocalizations, may result in injury and, in some cases, may result in behaviors that ultimately lead to death. The severity of these impacts can vary greatly between minor impacts that have no real cost to the animal, to more severe impacts that may have lasting consequences. A comprehensive discussion of the potential impacts of ocean noise on listed species is included in the *Effects of the Action* section of this Opinion.

Very little data is available on ocean noise and its impacts on listed species in the Action Area. The extent of commercial and recreational shipping in the Action Area, which directly influences the extent of ocean noise in a given area, is described above. The extent of noise-producing activities associated with U.S. Navy training and testing in the Action Area is described in detail in the *Effects of the Action* section of this Opinion.

5.10.1 Potential population-level impacts of anthropogenic noise

It is clear that impacts may result from increased levels of anthropogenic-induced background noise or high intensity, short-term anthropogenic sounds. The majority of impacts will likely be short-term behavioral responses, although more serious impacts are possible. Despite the potential for these impacts to affect individual animals, information is not currently available to determine the potential population level effect of anthropogenic sound levels in the marine environment (MMC 2007) on ESA-listed marine mammals and sea turtles. More information would be required including, but not limited to, empirical data on how sound impacts an individual's growth and vital rates, how these changes impact that individual's ability to reproduce successfully, and then the relative influence of that individual's reproductive success on the population being considered. As a result, the consequences of anthropogenic sound on threatened and endangered marine mammal and sea turtles at the population or species scale remain uncertain.

5.11 Invasive Species

Invasive species have been referred to as one of the top four threats to the world's oceans consistently ranked behind habitat degradation and alteration (Pughiuc 2010; Raaymakers 2003; Raaymakers and Hilliard 2002; Terdalkar et al. 2005; Wambiji et al. 2007). In most cases, habitat is directly affected by human alterations, as identified in the baseline section, such as hydromodification, mining, dredging, drilling, and construction. However, invasive species, facilitated by human commerce, have the ability to directly alter ecosystems upon which listed species rely.

Invasive species are a major threat to many ESA-listed species. For species listed by the USFWS, 26 percent were listed partially because of the impacts of invasive species and 7 percent were listed because invasive species were the major cause of listing (Anttila et al. 1998). Pimentel et al. (2004) found that roughly 40 percent of listed species are at risk of becoming endangered or extinct completely or in part due to invasive species, while Wilcove et al. (1998) found this to be 49 percent, with 27 percent of invertebrates, 37 percent of reptiles, 53 percent of fishes, and 57 percent of plants imperiled partly or wholly due to non-native invasions. In some regions of the world, up to 80 percent of species facing extinction are threatened by invasive species (Pimentel et al. 2004; Yan et al. 2002). Clavero and Garcia-Bertro (2005) found that

invasive species were a contributing cause to over half of the extinct species in the IUCN database; invasive species were the only cited cause in 20 percent of those cases. Richter et al. (1997) identified invasive species as one of three top threats to threatened and endangered freshwater species in the U.S. as a whole.

5.11.1 Diseases

The impacts of introduced pathogens in the aquatic environment has been poorly explored and we likely know very little about the true frequency and significance of pathogen invasions (Drake et al. 2001). Pathogens have adverse effects to invertebrate communities including reef-building corals. Various species of the genus *Vibrio*, known to cause cholera in humans, white pox and white plague type II diseases in corals have been identified in ports and ballast water of vessels (Aguirremacedo et al. 2008; Anguiano-Beltrán et al. 1998; Ben-Haim and Rosenberg 2002). Oyster species have sustained several outbreaks from invasive pathogens, including *Haplosporidium nelsoni* (the cause of MSX disease, which Chesapeake Bay eastern oysters have shown 75-92 percent mortality to) and *Perkinsus marinus* (the cause of Dermo disease) in California, eastern North America, and Europe (Andrews 1984; Burreson and Ford 2004; Burreson et al. 2000; Ford and Haskin 1982; Renault et al. 2000), *Bonamia ostreae* in Europe (Ciguarria and Elston 1997; Van Banning 1987), and in the northeastern US, respectively (Ford 1996).

5.11.2 Habitat Impacts

In general, species located higher within a food web (including most ESA-listed species under NMFS' jurisdiction) are more likely to become extinct as a result of an invasion; conversely, species that are more centrally or bottom-oriented within a food web are more likely to establish (Byrnes et al. 2007; Harvey and May 1997). Propagule pressure is generally the reason for this trend, as individuals lower in the food web tend to have higher fecundity and lower survival rates (r-selection). This unbalancing of food webs makes subsequent introductions more likely as resource utilization shifts, increasing resource availability, and exploitation success by non-native species (Barko and Smart 1981; Byrnes et al. 2007). Such shifts in the base of food webs fundamentally alters predator-prey dynamics up and across food chains (Moncheva and Kamburska 2002). The number of extinction events seems to be roughly correlated with the number of invasive establishments within an area (Harvey and May 1997).

Pathogens and species with toxic effects not only have direct effects to listed species, but also may affect habitat through ecosystem-mediated impacts. There are a number of non-native species that have the potential to either expel toxins at low levels, only becoming problematic for other members of the ecosystem if their population grows to very large sizes, resulting in very large amounts of toxins being released. In other cases, pathogens introduced to an environment may affect organisms that indirectly affect listed species.

Red tide dinoflagellates have been introduced via ballast water discharges and have the potential to undergo extreme seasonal population fluctuations. During bloom conditions, high levels of neurotoxins are released into local and regional surface water and air that can cause illness and death in fishes, sea turtles, marine mammals, and invertebrates (as well as their larvae) (Hallegraeff and Bolch 1992; Hallegraeff 1998; Hamer et al. 2001; Hamer et al. 2000; Lilly et al. 2002; McMinn et al. 1997). The brown alga, *Aureococcus anophagefferens*, causes brown tide

when it blooms, causing diebacks of eelgrass habitat due to blooms decreasing light availability and failure of scallops and mussels to recruit (Doblin et al. 2004).

The most commonly reported impact of non-native species in the coastal environment is competition for limited resources (Nyberg 2007). Molluscs, decapods, and aquatic plants tend to be especially capable invaders and have proven to be disruptive to food webs. The most common impacts are alteration of habitat and nutrient availability as well as altering species composition and diversity within an ecosystem (Strayer 2010). Crabs, polychaetes, and mussels can increase bioturbation and aerate the sediment (Nyberg 2007). Gastropods can alter the biogeochemical cycle through excretion of biogenic silicate in the faeces and pseudofaeces (Ragueneau et al. 2005). Molluscan invasions can also provide substrate for epibionts, shelter for benthic species, remove nutrients from the water, decrease turbidity and increase light penetration, remove sediments, and promote phytoplankton blooms by releasing nutrients from sediments (Bertness 1984; Gutierrez et al. 2003; Hecky et al. 2004). Invasives species may also prey upon ESA-listed species. For example, the crown-of-thorns sea star *Acanthaster planci* can significantly disrupt localized coral reef ecosystems by feeding on live coral (e.g., (Timmers et al. 2012)), including the ESA-listed coral considered in this Opinion. At the Tanguisson Reef, Guam, a population explosion of the sea star reduced coral cover to <1% of pre-disturbance levels in 1968-1969. However, the effect of the sea star can be relatively temporary. For example, at the Tanguisson Reef, coral species richness, cover, and composition reached or exceeded measurements of comparable reefs before the disturbance within 12 years (Colgan 1987).

Invasive plants can cause widespread habitat alteration, including native plant displacement, changes in benthic and pelagic animal communities, altered sediment deposition, altered sediment characteristics, and shifts in chemical processes such as nutrient cycling (Grout et al. 1997; Ruiz et al. 1999; Wigand et al. 1997). Introduced seaweeds alter habitat by colonizing previously unvegetated areas, while algae form extensive mats that exclude most native taxa, dramatically reducing habitat complexity and the ecosystem services provided by it (Wallentinus and Nyberg 2007). Invasive algae can alter native habitats through a variety of impacts, including trapping sediment, reducing the number of suspended particles that reach the benthos for benthic suspension and deposit feeders, reduce light availability, and adversely impact foraging for a variety of animals (Britton-Simmons 2004; Gribsholt and Kristensen 2002; Levi and Francour 2004; Sanchez et al. 2005). Invasive fishes can compose a large portion of fish taxa in at least some areas, including New Zealand where 53 percent of fish taxa are exotic, Puerto Rico where invasive fish are 91 percent of the total species, and Brazil where they are 13 percent of the total (Lövei 1997).

5.12 Scientific Research and Permits

Scientific research permits issued by the NMFS currently authorize studies of listed species in the Pacific Ocean which may occur in the Action Area. Table 33 identifies the cumulative number of takes for each listed marine mammal and sea turtle species in the Action Area authorized in scientific research permits. Cetacean takes include approach, biopsy, suction cup and implantable tagging, breath sampling, acoustic playbacks, and/or ultrasound. Sea turtle research involves approach, capture, handling, restraint, PIT, flipper, satellite, or sonic tagging, lavage, ultrasound, blood or tissue sampling, captive experiments, laproscopy, imaging, and/or antibiotic injections.

Table 33. Authorized takes of listed species in the Action Area under the ESA and/or MMPA.

Species	2005-2019 lethal take	2005-2014 sub-lethal take	2015-2019 sub-lethal take
Blue whale	0	9,935	10,035
Fin whale	0	11,619	15,521
Sei whale	0	8,102	6,408
Sperm whale	0	16,399	17,256
Green sea turtle	0	2,210	1,600
Hawksbill sea turtle	0	885	635
Leatherback sea turtle	0	0	0
Loggerhead sea turtle	0	0	0
Olive ridley sea turtle	0	0	0

Permit numbers: 1537, 1556, 14451, 15661, 15240[1], 15330, 16239[1], 17022[2], 17312[1], 731-1774[1], 18604

[1]This permit authorizes take throughout a large portion of the Pacific Ocean. Some of the take authorized is likely to occur within the Action Area.

[2]This permit authorizes take in waters surrounding various islands throughout the Pacific Ocean (e.g., Guam, Saipan, American Samoa, Johnson Atoll, Wake Island).

Several investigators have reported behavioral responses that suggest individual whales might experience stress responses to scientific research activities. Baker et al. (1983) described two responses of whales to vessels, including: (1) "horizontal avoidance" of vessels 2,000 to 4,000 meters away, characterized by faster swimming and fewer long dives; and (2) "vertical avoidance" of vessels from 0 to 2,000 meters away during which whales swam more slowly, but spent more time submerged. (Watkins 1981a) found that both fin and humpback whales appeared to react to vessel approach by increasing swim speed, exhibiting a startle reaction, and moving away from the vessel with strong fluke motions. Other researchers have noted changes in respiration, diving, swimming speed, social exchanges, and other behavior correlated with the number, speed, direction, and proximity of vessels. (Jahoda et al. 2003) studied the response of 25 fin whales in feeding areas in the Ligurian Sea to close approaches by inflatable vessels and to biopsy samples. They concluded close vessel approaches caused whales to stop feeding and swim away from the approaching vessel. The whales also tended to reduce the time they spent at surface and increase their blow rates, suggesting an increase in metabolic rates that might indicate a stress response to the approach. In their study, whales that had been disturbed while feeding remained disturbed for hours after the exposure ended. They recommended keeping vessels more than 200 meters from whales and having approaching vessels move at low speeds to reduce visible reactions.

5.13 Conclusion on the Impact of the Baseline on Listed Resources

Collectively, the stressors described above have had, and likely continue to have, lasting impacts on the ESA-listed species considered in this Opinion. Some of these stressors result in mortality or serious injury to individual animals (e.g., vessel strike, whaling), whereas others result in more indirect (e.g., a fishery that impacts prey availability) or non-lethal (e.g., whale watching, anthropogenic sound) impacts. Assessing the aggregate impacts of these stressors on the species considered in this Opinion is difficult and, to our knowledge, no such analysis exists. This becomes even more difficult considering that many of the species in this Opinion are wide ranging and subject to stressors in locations well beyond the Action Area.

We consider the best indicator of the aggregate impact of the *Environmental Baseline* on ESA-listed resources to be the status and trends of those species. As noted in Table 24, some of the species considered in this Opinion are seeing increases in population abundance, some are declining, and for some, the status remains unknown. Taken together, this indicates that the *Environmental Baseline* is impacting species in different ways. For the species that are increasing in population abundance, they are doing so despite the potential negative impacts of the *Environmental Baseline*. Therefore, while the *Environmental Baseline* described previously may slow their recovery, recovery is not being prevented. For the species that may be declining in abundance, it is possible that the suite of conditions described in the *Environmental Baseline* is preventing their recovery. However, it is also possible that their populations are at such low levels (e.g., due to historic commercial whaling) that even when the species' primary threats are removed, the species may not be able to achieve recovery. At small population sizes, they may experience phenomena such as demographic stochasticity, inbreeding depression, and Allee effects, among others, that cause their population size to become a threat in and of itself. A thorough review of the status and trends of each species is discussed thoroughly in the *Status of Listed Resources* section of this Opinion. Additionally, a brief discussion of the impacts of the Environmental Baseline on Guam's coral reefs in the MITT Action Area follows.

The overall health of Guam's reefs has declined over time, with impacts from global and local stressors contributing to a significant decline over recent decades. The average live coral cover was approximately 50 percent in the 1960s, but dwindled to less than 25 percent by the 1990s, with only a few areas having over 50 percent live cover. The health of Guam's coral reefs varies significantly. Reefs unaffected by sediment and nutrient loading, such as those in the northern part of the island and some coastal areas in the south, have healthy coral communities. Guam's reefs have been spared from large-scale bleaching events and coral diseases which are prevalent in many parts of the world. Big Blue Reef in Apra Harbor is considered one of the healthiest reefs in the harbor due to the reef's protection from water quality factors associated with Inner Apra Harbor and ship-induced sediment resuspension that impact other reef systems in the harbor. Reefs off Dry Dock Island, which was artificially created during WWII, are considered to also be among the healthiest reefs in the harbor, primarily due to protection from stressors. In contrast, the coral reef along Polaris Point, which was also constructed during WWII, is of marginal quality and has the greatest signs of stress, including high levels of total suspended solids likely derived from watershed discharge. Recent studies have identified evidence of anchor and/or anchor chain damage to coral in Apra Harbor, including the formation of a rubble field on the southern side of the floating dry dock. Movement of mooring chains on the southern side of the floating dry dock has produced a significant rubble field, although mooring chains on the northern (outer) side of the floating dry dock do not appear to have caused similar damage.

6 EFFECTS OF THE ACTION ON SPECIES AND CRITICAL HABITAT

In *Effects of the Action* sections of this Opinion, we present results of our assessment of the probable direct and indirect effects of federal actions that are the subject of a consultation as well as the direct and indirect effects of interrelated, and interdependent actions on threatened and endangered species and designated critical habitat. As we described in the *Approach to the Assessment* section of this Opinion, we organize our effects' analyses using a stressor identification - exposure – response – risk assessment framework; we conclude this section with

an *Integration and Synthesis of Effects* that integrates information we presented in the *Status of Listed Resources* and *Environmental Baseline* sections of this Opinion with the results of our exposure and response analyses to estimate the probable risks the action poses to endangered and threatened species.

The following sections present the U.S. Navy's predicted impacts on ESA-listed species for annual and non-annual, training and testing activities. We have assessed the Navy's methodology in NAEMO and determined that the modeling data is the best available to assess potential exposure and response to U.S. Navy stressors associated with training and testing. Potential take resulting from training and testing is totaled in our conclusions and in the incidental take statement of this opinion to provide the estimated, maximum annual assuming all activities assessed are conducted in the given year.

6.1 Stressors Associated with the Proposed Action

The potential stressors (risks) to ESA-listed species that we analyzed based on the training and testing activities the U.S. Navy proposes to conduct in the MITT Action Area are summarized in Table 34. A table of the determinations of effect for each species and each stressor is presented in Table 25.

What follows is a brief description of the stressors listed above. More information on each stressor is presented in the FEIS/OEIS, May 2015. Following the descriptions, we present the results of our exposure analyses, followed by the results of our response analyses.

Table 34. U.S. Navy Stressor Categories Analyzed in This Opinion

Stressor	Description of Stressor
Acoustic (sonar and other active acoustic sources, underwater explosives, weapons firing, launch and impact noise, aircraft noise, and vessel noise)	Effects on species from acoustic sources are dependent on a number of factors, including the type of sound received (non-impulse or impulse), the proximity of the animal to the sound source, and the duration, frequency, and intensity of the sound. Underwater sound propagation is highly dependent upon environmental characteristics such as bathymetry, bottom type, water depth, temperature, and salinity. The sound received at a particular location will be different than near the source due to the interaction of many factors, including propagation loss; how the sound is reflected, refracted, or scattered; the potential for reverberation; and interference due to multi-path propagation. Sonar and other active acoustic sources emit sound waves into the water to detect objects, safely navigate, and communicate. Most systems operate within specific frequencies (although some harmonic frequencies may be emitted at lower sound pressure levels). Most sonar use is associated with anti-submarine warfare (ASW) activities. Sonar use associated with mine warfare (MIW) would also contribute a notable portion of overall acoustic sound. Explosives used during training and testing activities include explosive ordnance, including bombs, missiles, and naval gun shells; torpedoes; demolition charges; and explosive sonobuoys. Depending on the activity, detonations would occur in the air, near the water's surface, or underwater (some torpedoes and sonobuoys). Demolition charges could occur near the surface, in the water column, or on the

Stressor	Description of Stressor
	seafloor. Most detonations would occur in waters greater than 200 ft. (61 m) in depth, and greater than 3 nm from shore, although MIW, demolition, and some testing detonations could occur in shallow water closer to shore. Detonations associated with ASW would typically occur in waters greater than 600 ft. (182.9 m) depth. Noise associated with weapons firing and the impact of non-explosive practice munitions (NEPM) could happen at any location within the Action Area but generally would occur at locations greater than 12 nm from shore for safety reasons. These training and testing events would occur in areas designated for anti-surface warfare and similar activities. The firing of a weapon may have several components of associated noise. Firing of guns could include sound generated by firing the gun (muzzle blast), vibration from the blast propagating through a ship's hull, and sonic booms generated by the projectile flying through the air. Missiles and targets would also produce noise during launch. In addition, the impact of NEPM at the water surface can introduce noise into the water. Fixed- and rotary-wing aircraft are used for a variety of training and testing activities throughout the Action Area, contributing both airborne and underwater sound to the ocean environment. Aircraft used in training and testing generally have reciprocating, turboprop, or jet engines. Motors, propellers, and rotors produce the most noise, with some noise contributed by aerodynamic turbulence. Aircraft sounds have more energy at lower frequencies. Takeoffs and landings occur at established airfields as well as on vessels at sea throughout the Action Area. Most aircraft noise would be produced around air fields in the range complex. Military activities involving aircraft generally are dispersed over large expanses of open ocean but can be highly concentrated in time and location. Vessels (including ships, small craft, and submarines) would produce low-frequency, broadband underwater sound. Overall, naval traffic is often a minor component of total vessel traffic (Mintz and Filadelfo 2011) (Mintz and Parker 2006). Commercial vessel traffic, which included cargo vessels, bulk carriers, passenger vessels, and oil tankers (all over 65 ft. [20 m] in length), was heaviest near and between the major shipping ports.
Energy **(electromagnetic devices)**	Electromagnetic devices are used in towed or unmanned MIW systems that mimic the electromagnetic signature of a vessel passing through the water. None of the devices include any type of electromagnetic "pulse." The devices work by emitting an electromagnetic field and mechanically generated underwater sound to simulate the presence of a ship. The sound and electromagnetic signature cause nearby mines to detonate. The static magnetic field generated by the electromagnetic devices is of relatively minute strength. Typically, the maximum magnetic field generated would be approximately 23 gauss (G). By comparison, magnetic field generated by a refrigerator magnet is between 150 and 200 G. The strength of an electromagnetic field decreases quickly with distance from the device. The magnetic field generated at a distance of 4 m from the source is comparable to the earth's magnetic field, which is approximately 0.5 G.

Stressor	Description of Stressor
Physical disturbance and strike **(vessels, in water devices, military expended materials)**	Physical disturbances, including direct strikes on marine animals, may occur in association with vessel movements, the use of in-water devices, and materials expended from vessels and aircraft. Vessels used as part of the Action include ships (e.g., aircraft carriers, surface combatants), support craft, small boats, and submarines, ranging in size from 5 to over 300 m. Large Navy ships generally operate at speeds in the range of 10–15 knots, and submarines generally operate at speeds in the range of 8–13 knots. Small craft (for purposes of this discussion, less than 40 ft. [12 m] in length), which are all support craft, have variable speeds. Locations of vessel use in the Action Area varies with the type of activity taking place, but greater activity would be expected near ports than in other areas of the Action Area. In-water devices as discussed in this analysis are unmanned vehicles, such as remotely operated vehicles, unmanned surface vehicles and unmanned undersea vehicles, and towed devices. These devices are self-propelled and unmanned or towed through the water from a variety of platforms, including helicopters and surface ships. In-water devices are generally smaller than most participating vessels ranging from several inches to about 15 m. These devices can operate anywhere from the water surface to the benthic zone. Certain devices do not have a realistic potential to strike marine animals because they either move slowly through the water column (e.g., most unmanned undersea vehicles) or are closely monitored by observers manning the towing platform (e.g., most towed devices). Military expended materials include: (1) all sizes of NEPM; (2) fragments from explosive munitions; and (3) expended materials other than munitions, such as sonobuoys, ship hulks, and expendable targets. Activities using NEPM (e.g., small-, medium-, and large-caliber gun ammunitions, missiles, rockets, bombs, torpedoes, and neutralizers), explosive munitions (generating munitions fragments), and materials other than munitions (e.g., flares, chaff, sonobuoys, decelerators/parachutes, aircraft stores and ballast, and targets) have the potential to contribute to the physical disturbance and strike stressor.

Stressor	Description of Stressor
Entanglement **(fiber optic cables and guidance wires, and decelerators/parachutes)**	The only type of cable expended during training and testing are fiber optic cables. Fiber optic cables are flexible, durable, and abrasion or chemical-resistant. The physical characteristics of the fiber optic material render the cable brittle and easily broken when kinked, twisted, or bent sharply (i.e., to a radius greater than 360 degrees). The fiber optic cable would be suspended within the water column during the activity, and then be expended to sink to the sea floor. The only types of wires expended during training and testing activities are guidance wires from heavy-weight torpedoes. Guidance wires are used to help the firing platform control and steer the torpedo. They trail behind the torpedo as it moves through the water or air. Finally, the guidance wire is released from both the firing platform and the torpedo then sinks to the ocean floor. The torpedo guidance wire is a single-strand, thin gauge, coated copper alloy. The tensile breaking strength of the wire is a maximum of 42 pounds (lb.) (19 kilograms [kg]) and can be broken by hand (Group 2005). The length of wire dispensed would generally be equal to the distance the torpedo travels to impact the target and any undispensed wire would be contained in the dispensers upon impact. Degradation rates for the wire may vary because of changing environmental conditions in seawater, but are likely to take between 12 and 45 months Aircraft-launched sonobuoys, lightweight torpedoes (such as the MK 46 and MK 54), illumination flares, and targets use nylon parachutes or decelerators ranging in size from 18 to 48 in. (46 to 122 cm) in diameter. Decelerators are made of cloth and nylon, and many have weights attached to the lines for rapid sinking. At water impact, the decelerator assembly is expended, and it sinks away from the unit. The decelerator assembly may remain at the surface for 5–15 seconds before the decelerator and its housing sink to the seafloor, where it becomes flattened (Group 2005). Some decelerators are weighted with metal clips that facilitate their descent to the seafloor. Once settled on the bottom the canopy may temporarily billow if bottom currents are present.
Ingestion **(munitions and military expended materials other than munitions)**	The only munitions small enough for a marine mammal or sea turtles to ingest are small- and medium-caliber projectiles. These projectiles include all sizes up to and including 2.25 in. (57 mm) in diameter. Projectiles are composed of solid metal materials and would quickly move through the water column and settle on the seafloor where they are most likely to be encountered by bottom foraging animals. Sinking projectiles are unlikely to be encountered in the water column by marine mammals or sea turtles. Many different types of explosive munitions can result in fragments that are expended at sea during training and testing activities. Types of explosive munitions that can result in fragments include demolition charges, grenades, projectiles, missiles, and bombs. Fragments would result from fractures in the munitions casing and would vary in size depending on the size of the net explosive weight and munition type; however, typical sizes of fragments are unknown. These solid metal materials would quickly sink through the water column and settle to the seafloor. Military expended materials other than munitions include target fragments, chaff, and flares. At-sea targets are usually remotely operated airborne, surface, or subsurface traveling units, most of which, but not all, are designed to be recovered for re-use. However, if they are used during activities that utilize explosives then they may result in fragments. Expendable targets that may result in fragments would include air-launched decoys, surface targets (such as marine

Stressor	Description of Stressor
	markers, paraflares, cardboard boxes, and 10 ft. [3.05 m] diameter red balloons), and mine shapes. Most target fragments would sink quickly to the seafloor. Floating material, such as Styrofoam, may be lost from target boats and remain at the surface for some time Chaff consists of reflective, aluminum-coated glass fibers used to obscure ships and aircraft from radar-guided systems. Chaff, which is stored in canisters, is either dispensed from aircraft or fired into the air from the decks of surface ships when an attack is imminent. The glass fibers create a radar cloud that mask the position of the ship or aircraft. Chaff is composed of an aluminum alloy coating on glass fibers of silicon dioxide (Force 1997). Chaff is released or dispensed in cartridges or projectiles that contain millions of fibers. When deployed, a diffuse cloud of fibers is formed that is undetectable to the human eye. Chaff is a very light material, similar to fine human hair. It can remain suspended in air anywhere from 10 minutes to 10 hours and can travel considerable distances from its release point, depending on prevailing atmospheric conditions (Arfsten et al. 2002; Force 1997). Chaff cartridge plastic end caps and pistons would also be released into the marine environment, where they would persist for long periods and could be ingested by marine animals. Chaff end caps and pistons sink in saltwater (Spargo 2007). Flares are pyrotechnic devices used to defend against heat-seeking missiles, where the missile seeks out the heat signature from the flare rather than the aircraft's engines. Similar to chaff, flares are also dispensed from aircraft and fired from ships. The flare device consists of a cylindrical cartridge approximately 1.4 in. (3.6 cm) in diameter and 5.8 in. (14.7 cm) in length. Flares are designed to burn completely. The only material that would enter the water would be a small, round, plastic end cap (approximately 1.4 in. [3.6 cm] in diameter).
Secondary **(explosion byproducts, metals, chemicals, sedimentation, and transmission of marine mammal diseases and parasites)**	Secondary stressors associated with some training and testing activities could pose indirect impacts to ESA-listed marine species through habitat degradation or alteration or an effect on prey availability. Secondary stressors include (1) explosives, (2) explosion byproducts and unexploded ordnance, (3) metals, (4) chemicals, and (5) transmission of marine mammal diseases and parasites. In addition to directly impacting marine species, underwater explosions could impact other species in the food web, including prey species that ESA-listed marine species feed upon. The impacts of explosions would differ depending upon the type of prey species in the area of the detonation. Indirect impacts of explosives and unexploded ordnance to marine species via degradation of sediment or water quality is possible in the immediate vicinity of the ordnance. Explosion byproducts are not toxic to marine organisms at realistic exposure levels (Rosen and Lotufo 2010). Relatively low solubility of most explosives and their degradation products means that concentrations of these contaminants in the marine environment are relatively low and readily diluted. Metals are introduced into seawater and sediments as a result of training and testing activities involving ship hulks, targets, ordnance, munitions, and other military expended materials. Several training and testing activities introduce potentially harmful chemicals into

Stressor	Description of Stressor
	the marine environment; principally, flares and propellants for rockets, missiles, and torpedoes. Properly functioning flares missiles, rockets, and torpedoes combust most of their propellants, leaving benign or readily diluted soluble combustion byproducts (e.g., hydrogen cyanide). Operational failures allow propellants and their degradation products to be released into the marine environment. The greatest risk to marine species would be from perchlorate released from flares, missile, and rockets that operationally fail. Perchlorate is highly soluble in water, persistent, and impacts metabolic processes in many plants and animals. The U.S. Navy deploys trained Atlantic bottlenose dolphins (Tursiops truncatus) and California sea lions (Zalophus californianus) for integrated training involving two primary mission areas; to find objects such as inert mine shapes, and to detect swimmers or other intruders around Navy facilities such as piers. When deployed, the animals are part of what the Navy refers to as Marine Mammal Systems. These Marine Mammal Systems include one or more motorized small boats, several crew members, and a trained marine mammal. Based on the standard operating procedures with which these systems are deployed, it is not reasonably foreseeable that use of these marine mammals systems would result in the transmission of disease or parasites to ESA-listed cetacea in the Action Area.

6.2 Risk Assessment Framework – Marine Mammals

The following is a summary of available information used to develop the Navy's risk assessment criteria for acoustic stressors. We subsequently reviewed and adopted the criteria for this risk analysis.

6.2.1 Direct Injury of Marine Mammals From Acoustic Stressors

The potential for direct injury of marine mammals has been inferred from terrestrial mammal experiments and from post-mortem examination of marine mammals believed to have been exposed to underwater explosions (Ketten et al. 1993; Richmond et al. 1973; Yelverton et al. 1973). Additionally, non-injurious effects on marine mammals (e.g., TTS) are extrapolated to injurious effects (e.g., PTS) based on data from terrestrial mammals to derive the criteria serving as the potential for injury (Southall et al. 2007b). Actual effects on marine mammals may differ from terrestrial animals due to anatomical and physiological adaptations to the marine environment, such as a reinforced trachea and flexible thoracic cavity (Ridgway and Dailey 1972) that may decrease the risk of lung injury.

Potential non-auditory direct injury from non-impulsive sound sources, such as sonar, is unlikely due to relatively lower peak pressures and slower rise times than potentially injurious impulsive sources such as explosives. Non-impulsive sources also lack the strong shock waves associated with explosions. Therefore, primary blast injury and barotrauma (i.e., injuries caused by large pressure changes; discussed below) would not occur from exposure to non-impulsive sources such as sonar. Further, though there have been marine mammal strandings associated with use of sonar, as Ketten (2012) has recently summarized, "to date, there has been no demonstrable evidence of acute, traumatic, disruptive, or profound auditory damage in any marine mammal as the result [of] anthropogenic noise exposures, including sonar." The theories of sonar induced acoustic resonance and sonar induced bubble formation are discussed below. These phenomena,

if they were to occur, would require the co-occurrence of a precise set of circumstances that are unlikely to occur.

6.2.2 Primary Blast Injury and Barotrauma

The greatest potential for direct, non-auditory tissue effects is primary blast injury and barotrauma after exposure to high amplitude impulsive sources, such as explosions. Primary blast injuries result from the initial compression of a body exposed to a blast wave. Primary blast injury is usually limited to gas-containing structures (e.g., lung and gut) and the auditory system (Craig Jr. 2001a; Craig Jr. and Hearn 1998). Barotrauma refers to injuries caused when large pressure changes occur across tissue interfaces, normally at the boundaries of air-filled tissues such as the lungs. Primary blast injury to the respiratory system may be fatal depending upon the severity of the trauma. Rupture of the lung may introduce air into the vascular system, producing air emboli that can restrict oxygen delivery to the brain or heart. Though often secondary in life-threatening severity to pulmonary blast trauma, the gastrointestinal tract can also suffer contusions and lacerations from blast exposure, particularly in air-containing regions of the tract. Although hemorrhage of solid organs (e.g., liver, spleen, and kidney) from blast exposure is possible, rupture of these organs is rarely encountered.

The only known occurrence of mortality or injury to a marine mammal due to U.S. Navy training or testing involving impulsive sources occurred in March 2011 at the Silver Strand Training Complex. Prior to this incident, this area had been used for underwater demolitions training for at least three decades without incident. On this occasion, however, a group of long-beaked common dolphins entered the mitigation zone surrounding an area where a time-delayed firing device had been initiated on an explosive with a net explosive weight of 8.76 lb (3.97 kg) placed at a depth of 48 ft. (14.6 m). Approximately 1 minute after detonation, three animals were observed dead at the surface; a fourth animal was discovered 3 days later stranded dead 42 nm to the north of the detonation. Upon necropsy, all four animals were found to have sustained typical mammalian primary blast injuries (Danil and St. Leger 2011). See the MITT Final EIS/OEIS for more information on the topic of stranding. Since this incident, the Navy, in consultation with NMFS, developed additional mitigation measures to minimize the potential for similar incidents in the future.

6.2.3 Auditory Trauma

Relatively little is known about auditory system trauma in marine mammals resulting from a known sound exposure. A single study spatially and temporally correlated the occurrence of auditory system trauma in humpback whales with the detonation of a 5,000 kg (11,023 lb.) explosive (Ketten et al. 1993). The exact magnitude of the exposure in this study cannot be determined, but it is likely the trauma was caused by the shock wave produced by the explosion. There are no known occurrences of direct auditory trauma in marine mammals exposed to tactical sonar or other non-impulsive sound sources (Ketten 2012). The potential for auditory trauma in marine mammals exposed to impulsive sources (e.g., explosions) is inferred from tests of submerged terrestrial mammals exposed to underwater explosions (Ketten et al. 1993; Richmond et al. 1973; Yelverton et al. 1973).

6.2.4 Acoustic Resonance

Acoustic resonance has been proposed as a hypothesis suggesting that acoustically induced vibrations (sound) from sonar or sources with similar operating characteristics could be damaging tissues of marine mammals. In 2002, NMFS convened a panel of government and private scientists to investigate the issue (NMFS 2002). They modeled and evaluated the likelihood that Navy mid-frequency sonar caused resonance effects in beaked whales that eventually led to their stranding in the Bahamas (DoN 2015). The conclusions of that group were that resonance in air-filled structures was not likely to have caused the stranding (NMFS 2002). The frequencies at which resonance was predicted to occur were below the frequencies utilized by the mid-frequency sonar systems associated with the Bahamas event. Furthermore, air cavity vibrations, even at resonant frequencies, were not considered to be of sufficient amplitude to cause tissue damage, even under the worst-case scenario in which air volumes would be undamped by surrounding tissues and the amplitude of the resonant response would be maximal. These same conclusions would apply to other training activities involving acoustic sources. Therefore, we conclude that acoustic resonance is not likely under realistic conditions during training and testing activities and this type of impact is not considered further in this analysis.

6.2.5 Bubble Formation (Acoustically Induced)

A suggested cause of injury to marine mammals is rectified diffusion (Crum and Mao 1996), the process of increasing the size of a bubble by exposing it to a sound field. The process is dependent upon a number of factors including the sound pressure level and duration. Under this hypothesis, one of three things could happen: (1) bubbles grow to the extent that tissue hemorrhage (injury) occurs, (2) bubbles develop to the extent an immune response is triggered or nervous tissue is subjected to enough localized pressure that pain or dysfunction occurs (a stress response without injury), or (3) the bubbles are cleared by the lung without negative consequence to the animal. The probability of rectified diffusion, or any other indirect tissue effect, will necessarily be based upon what is known about the specific process involved. Rectified diffusion is more likely if the environment in which the ensonified bubbles exist is supersaturated with gas. Repetitive diving by marine mammals can cause the blood and some tissues to accumulate gas to a greater degree than is supported by the surrounding environmental pressure (Ridgway and Howard 1979). The dive patterns of some marine mammals (e.g., beaked whales) are theoretically predicted to induce greater supersaturation (Houser 2010; Houser et al. 2001b). If rectified diffusion were possible in marine mammals exposed to high-level sound, conditions of tissue supersaturation could theoretically speed the rate of bubble growth and increase the size of the bubbles. Subsequent effects due to tissue trauma and emboli would presumably mirror those observed in humans suffering from decompression sickness. It is unlikely the short duration of sonar or explosion sounds would be long enough to drive bubble growth to any substantial size, if such a phenomenon occurs.

An alternative but related hypothesis has also been suggested: stable microbubbles could be destabilized by high-level sound exposures such that bubble growth then occurs through static diffusion of gas out of the tissues. In such a scenario, the marine mammal would need to be in a gas-supersaturated state for enough time for bubbles to become a problematic size. Recent research with *ex vivo* supersaturated bovine tissues suggested that for a 37 kHz signal, a sound exposure of approximately 215 dB re 1 µPa would be required before microbubbles became

destabilized and grew (Crum et al. 2005). Assuming spherical spreading loss and a nominal sonar source level of 235 dB re 1 µPa at 1 m, a whale would need to be within 10 m (33 ft.) of the sonar dome to be exposed to such sound levels. Furthermore, tissues in the study were supersaturated by exposing them to pressures of 400 to 700 kilopascals for hours and then releasing them to ambient pressures. Assuming the equilibration of gases with the tissues occurred when the tissues were exposed to the high pressures, levels of supersaturation in the tissues could have been as high as 400 to 700 percent. These levels of tissue supersaturation are substantially higher than model predictions for marine mammals (Houser et al. 2001a; Saunders et al. 2008). It is improbable this mechanism is responsible for stranding events or traumas associated with beaked whale strandings. Both the degree of supersaturation and exposure levels observed to cause microbubble destabilization are unlikely to occur.

There is considerable disagreement among scientists as to the likelihood of this phenomenon (Evans and Miller 2004; Piantadosi and Thalmann 2004). Although it has been argued that traumas from recent beaked whale strandings are consistent with gas emboli and bubble-induced tissue separations (Fernandez et al. 2005a; Jepson et al. 2003), bubble formation as the cause of the traumas has not been verified. The presence of bubbles postmortem, particularly after decompression, is not necessarily indicative of bubble pathology (Bernaldo de Quiros et al. 2012; Dennison et al. 2011; Moore et al. 2009). Prior experimental work has also demonstrated the post-mortem presence of bubbles following decompression in laboratory animals can occur as a result of invasive investigative procedures (Stock et al. 1980).

6.2.6 Nitrogen Decompression

Although not a direct injury, variations in marine mammal diving behavior or avoidance responses could possibly result in nitrogen tissue supersaturation and nitrogen off-gassing. Nitrogen supersaturation and off-gassing levels could result in deleterious vascular and tissue bubble formation (Jepson et al. 2003) (Hooker et al. 2012; Saunders et al. 2008). Nitrogen off-gassing occurring in human divers is called decompression sickness. The mechanism for bubble formation from saturated tissues would be indirect and also different from rectified diffusion, but the effects would be similar. The potential process for this to occur is hypothetical and under debate in the scientific community (Hooker et al. 2012; Saunders et al. 2008). It is speculated if exposure to a startling sound elicits a rapid ascent to the surface, tissue gas saturation sufficient for the evolution of nitrogen bubbles might result (Fernandez et al. 2005a; Hooker et al. 2012; Jepson et al. 2003). In this scenario, the rate of ascent would need to be sufficiently rapid to compromise behavioral or physiological protections against nitrogen bubble formation.

Previous modeling suggests even unrealistically rapid rates of ascent from normal dive behaviors are unlikely to result in supersaturation to the extent bubble formation would be expected in beaked whales (Zimmer and Tyack 2007). Tyack et al. (2006) suggested emboli observed in animals exposed to mid-frequency active (MFA) sonar (Fernandez et al. 2005a; Jepson et al. 2003) could stem from a behavioral response that involves repeated dives, shallower than the depth at which lung collapse would occur. A bottlenose dolphin was trained to repetitively dive to to elevate nitrogen saturation to the point that asymptomatic nitrogen bubble formation was predicted to occur. However, inspection of the vascular system of the dolphin via ultrasound did not demonstrate the formation of any nitrogen gas bubbles (Houser 2010).

More recently, modeling has suggested that the long, deep dives performed regularly by beaked whales over a lifetime could result in the saturation of tissues (e.g., fat, bone lipid) to the point that they are supersaturated when the animals are at the surface (Hooker et al. 2009; Saunders et al. 2008). Proposed adaptations for prevention of bubble formation under conditions of persistent tissue saturation have been suggested (Fahlman et al. 2006; Hooker et al. 2009). Since bubble formation is facilitated by compromised blood flow, it has been suggested that rapid stranding may lead to bubble formation in animals with supersaturated tissues because of the stress of stranding and the cardiovascular collapse that can accompany it (Houser 2010).

A fat embolic syndrome was identified by Fernandez et al. (2005b) coincident with the identification of bubble emboli in stranded beaked whales. The fat embolic syndrome was the first pathology of this type identified in marine mammals, and was thought to possibly arise from the formation of bubbles in fat bodies, which subsequently resulted in the release of fat emboli into the blood stream. Recently, Dennison et al. (2011) reported on investigations of dolphins stranded in 2009 and 2010.Using ultrasound the authors identified gas bubbles in kidneys from 21 of 22 live-stranded dolphins and in the liver from two of 22. The authors postulated stranded animals are unable to recompress by diving, and thus may retain bubbles that are otherwise re-absorbed in animals that can continue to dive. The researchers concluded minor bubble formation can be tolerated since the majority of stranded dolphins released did not re-strand (Dennison et al. 2011). Recent modeling by Kvadsheim (2012) determined behavioral and physiological responses to sonar have the potential to result in bubble formation. However, the observed behavioral responses of cetaceans to sonar do not imply any significantly increased risk over what may otherwise occur normally in individual marine mammals. As a result, no marine mammals addressed in this analysis are given differential treatment due to the possibility for acoustically mediated bubble growth.

6.2.7 Hearing Loss

The most familiar effect of exposure to high intensity sound is hearing loss, meaning an increase in the hearing threshold. Both auditory injury and auditory fatigue may result in hearing loss. The meaning of the term “hearing loss” does not equate to “deafness.” Hearing loss is a noise-induced threshold shift, or simply a threshold shift. If high-intensity sound over stimulates tissues in the ear, causing a threshold shift, the impacted area of the ear (associated with and limited by the sound’s frequency band) no longer provides the same auditory impulses to the brain as before the exposure (Ketten 2012). The distinction between PTS and TTS is based on whether there is a complete recovery of a threshold shift following a sound exposure. If the threshold shift eventually returns to zero (the threshold returns to the pre-exposure value), the threshold shift is a TTS.

For TTS, full recovery of the hearing loss (to the pre-exposure threshold) has been determined from studies of marine mammals, and this recovery occurs within minutes to hours for the small amounts of TTS that have been experimentally induced (Finneran et al. 2005b; Finneran and Schlundt 2010; Nachtigall et al. 2004). The recovery time is related to the exposure duration, sound exposure level, and the magnitude of the threshold shift, with larger threshold shifts and longer exposure durations requiring longer recovery times (Finneran et al. 2005b; Finneran and Schlundt 2010; Mooney et al. 2009a; Mooney et al. 2009b). In some cases, threshold shifts as large as 50 dB (loss in sensitivity) have been temporary, although recovery sometimes required

as much as 30 days (Ketten 2012). If the threshold shift does not return to zero but leaves some finite amount of threshold shift, then that remaining threshold shift is a PTS. Again for clarity, PTS, as discussed in this document, is not the complete loss of hearing, but instead is the loss of hearing sensitivity over a particular range of frequency. Figure 20 shows one hypothetical threshold shift that completely recovers, a TTS, and one that does not completely recover, leaving some PTS. The actual amount of threshold shift depends on the amplitude, duration, frequency, temporal pattern of the sound exposure, and on the susceptibility of the individual animal.

Many are familiar with hearing protection devices (i.e., ear plugs) required in many occupational settings where pervasive noise could otherwise cause auditory fatigue and possibly result in hearing loss. The mechanisms responsible for auditory fatigue differ from auditory trauma and would primarily consist of metabolic fatigue and exhaustion of the hair cells and cochlear tissues. Note that the term "auditory fatigue" is often used to mean TTS; however, the Navy uses a more general meaning to differentiate fatigue mechanisms (e.g., metabolic exhaustion and distortion of tissues) from trauma mechanisms (e.g., physical destruction of cochlear tissues occurring at the time of exposure).

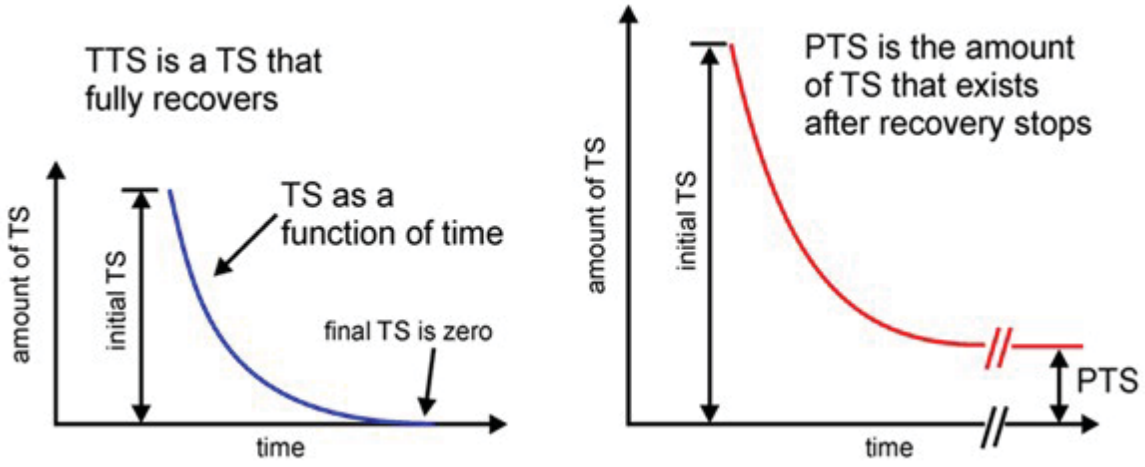

Figure 20. Two Hypothetical Threshold Shifts, Temporary and Permanent

Hearing loss, or auditory fatigue, in marine mammals has been studied by a number of investigators (Finneran et al. 2005b; Finneran and Schlundt 2010; Finneran et al. 2007; Finneran et al. 2000; Finneran et al. 2002; Lucke et al. 2009; Mooney et al. 2009a; Mooney et al. 2009b; Nachtigall et al. 2003; Schlundt et al. 2000). The studies of marine mammal auditory fatigue were all designed to determine relationships between TTS and exposure parameters such as level, duration, and frequency.

In these studies, hearing thresholds were measured in trained marine mammals before and after exposure to intense sounds. The difference between the pre-exposure and post-exposure thresholds indicated the amount of TTS. Species studied include the bottlenose dolphin, beluga, harbor porpoise, finless porpoise, California sea lion, harbor seal, and Northern elephant seal.

Some of the more important data obtained from these studies are onset-TTS levels—exposure levels sufficient to cause a measurable amount of TTS, often defined as 6 dB of TTS (Schlundt et al. 2000). These criteria for onset-TTS are very conservative, and it is not clear that this level of threshold shift would have a functional effect on the hearing of a marine mammal in the ocean.

The primary findings of the marine mammal TTS studies are:

- The growth and recovery of TTS shift are analogous to those in terrestrial mammals. This means that, as in terrestrial mammals, threshold shifts primarily depend on the amplitude, duration, frequency content, and temporal pattern of the sound exposure.

- The amount of TTS increases with exposure sound pressure level and the exposure duration.

- For continuous sounds, exposures of equal energy lead to approximately equal effects (Ward 1997). For intermittent sounds, less hearing loss occurs than from a continuous exposure with the same energy (some recovery will occur during the quiet period between exposures (Kryter et al. 1965; Ward 1997; (Kastelein et al. 2014a).

- Sound exposure level is correlated with the amount of TTS and is a good predictor for onset-TTS from single, continuous exposures with similar durations. This agrees with human TTS data presented by (Ward et al. 1958; Ward et al. 1959a; Ward et al. 1959b). However, for longer duration sounds beyond 16 to 32 seconds, the relationship between TTS and sound exposure level breaks down and duration becomes a more important contributor to TTS (Finneran and Schlundt 2010). Still, for a wide range of exposure durations, wound exposure level correlates reasonably well to TTS growth (Popov et al. 2014).

- The maximum TTS after tonal exposures occurs one-half to one octave above the exposure frequency (Finneran et al. 2007; Schlundt et al. 2000). TTS from tonal exposures can thus extend over a large (greater than one octave) frequency range.

- For bottlenose dolphins, sounds with frequencies above 10 kHz are more hazardous than those at lower frequencies (i.e., lower sound exposure levels required to affect hearing) (Finneran and Schlundt 2010) (Finneran and Schlundt 2013).

- The amount of observed TTS tends to decrease with increasing time following the exposure. The time required for complete recovery of hearing depends on the magnitude of the initial shift; for relatively small shifts recovery may be complete in a few minutes, while large shifts (e.g., 40 dB) may require several days for recovery.

- TTS can accumulate across multiple intermittent exposures, but the resulting TTS will be less than the TTS from a single, continuous exposure with the same sound exposure level. This means that predictions based on total, cumulative sound exposure level will overestimate the amount of TTS from intermittent exposures.

Although there have been no marine mammal studies designed to measure PTS, the potential for PTS in marine mammals can be estimated based on known similarities between the inner ears of marine and terrestrial mammals. Experiments with marine mammals have revealed their similarities with terrestrial mammals with respect to features such as TTS, age-related hearing loss (called Presbycusis), ototoxic drug-induced hearing loss, masking, and frequency selectivity. Therefore, in the absence of marine mammal PTS data, onset-PTS shift exposure levels may be estimated by assuming some upper limit of TTS that equates the onset of PTS, then using TTS relationships from marine and terrestrial mammals to determine the exposure levels capable of producing this amount of TTS.

Hearing loss resulting from auditory fatigue could effectively reduce the distance over which animals can communicate, detect biologically relevant sounds such as predators, and echolocate (for odontocetes). The costs to marine mammals with TTS, or even some degree of PTS have not been studied; however, a relationship between the duration, magnitude, and frequency range of hearing loss could have consequences to biologically important activities (e.g., intraspecific communication, foraging, and predator detection) that affect survivability and reproduction. However, the classification of modeled effects from acoustic stressors, such as TTS and PTS, are performed in a manner as to conservatively overestimate the impacts of those effects. Acoustic stressors are binned and all stressors within each bin are modeled as the loudest source, necessarily overestimating impacts within each bin. Therefore, the temporary duration of TTS may be on the shorter end of the range and last briefly. Even longer duration TTS is only expected to last hours or at most a few days. The brief amount of time marine mammals are expected to experience TTS is unlikely to significantly impair their ability to communicate, forage, or breed and will not have fitness level consequences at the individual or population level. Although PTS is a permanent shift in hearing, it is not the same as deafness and to our knowledge there are no published studies on the longterm effects of PTS on marine mammal fitness. Concievably, PTS could result in changes to individual's ability to communicate, breed, and forage but it is unclear if these impacts would significantly impact their fitness. Results from 2 years (2009 and 2010) of intensive monitoring by independent scientists and Navy observers in the SOCAL and Hawaii Range Complexes have recorded an estimated 161,894 marine mammals with no evidence of distress or unusual behavior observed during Navy activities. This supports that TTS and PTS are unlikely to significantly impair their ability to communicate, forage, or breed and will not have fitness level consequences at the individual or population level. For additional discussion on the effects of hearing loss on marine mammals see section 6.8.3.2.

6.2.8 Auditory Masking

Auditory masking occurs when a sound, or noise in general, limits the perception of another sound. As with hearing loss, auditory masking can effectively limit the distance over which a marine mammal can communicate, detect biologically relevant sounds, and echolocate (odontocetes). Unlike hearing loss, which likely results in a behavioral stress response,

behavioral changes resulting from auditory masking may not be coupled with a stress response. Another important distinction between masking and hearing loss is that masking only occurs in the presence of the sound stimulus, whereas hearing loss can persist after the stimulus is gone.

Critical ratios, a measure of the relative ability of an animal to extract signals from noise, have been determined for pinnipeds (Southall et al. 2000; Southall et al. 2003) and bottlenose dolphins (Johnson 1967) and detections of signals under varying masking conditions have been determined for active echolocation and passive listening tasks in odontocetes (Au and Pawloski 1989a; Au and Pawloski 1989b; Branstetter 2013; Erbe 2000; Johnson 1971). These studies provide baseline information from which the probability of masking can be estimated.

Clark et al. (2009) developed a methodology for estimating masking effects on communication signals for low frequency cetaceans, including calculating the cumulative impact of multiple noise sources. For example, their technique calculates that in Stellwagen Bank National Marine Sanctuary, when two commercial vessels pass through a North Atlantic right whale's (a baleen whale like blue, fin, sei, and humpback whales) optimal communication space (estimated as a sphere of water with a diameter of 20 km), that space is decreased by 84 percent. This methodology relies on empirical data on source levels of calls (which is unknown for many species), and requires many assumptions about ancient ambient noise conditions and simplifications of animal behavior. However, it is an important step in determining the impact of anthropogenic noise on animal communication. Subsequent research for the same species and location estimated that an average of 63 to 67 percent of North Atlantic right whale's communication space has been reduced by an increase in ambient noise levels, and that noise associated with transiting vessels is a major contributor to the increase in ambient noise (Hatch et al. 2012).

Vocal changes in response to anthropogenic noise can occur across sounds produced by marine mammals, such as whistling, echolocation click production, calling, and singing. Changes to vocal behavior and call structure may result from a need to compensate for an increase in background noise. In cetaceans, vocalization changes have been reported from exposure to anthropogenic noise sources such as sonar, vessel noise, and seismic surveying. Vocalizations may also change in response to variation in the natural acoustic environment (e.g., from variation in sea surface motion)(Dunlop et al. 2014).

In the presence of low frequency active sonar, humpback whales have been observed to increase the length of their songs (Fristrup et al. 2003; Miller et al. 2000), possibly due to the overlap in frequencies between the whale song and the low frequency active sonar. North Atlantic right whales have been observed to increase the frequency and amplitude (intensity) (Parks 2009) of their calls while reducing the rate of calling in areas of increased anthropogenic noise (Parks et al. 2007). In contrast, both sperm and pilot whales potentially ceased sound production during experimental sound exposure (Bowles et al. 1994), although it cannot be absolutely determined whether the inability to acoustically detect the animals was due to the cessation of sound production or the displacement of animals from the area.

Different vocal responses in marine mammals have been documented in the presence of seismic survey noise. An overall decrease in vocalization during active surveying has been noted in large

marine mammal groups (Potter et al. 2007). In contrast, blue whale feeding and social calls increased when seismic exploration was underway (Di Lorio and Clark 2010), indicative of a potentially compensatory response to the increased noise level. (Melcon et al. 2012) recently documented that blue whales decreased the proportion of time spent producing certain types of calls when simulated mid-frequency sonar was present. At present it is not known if these changes in vocal behavior corresponded to changes in foraging or any other behaviors. Controlled exposure experiments in 2007 and 2008 in the Bahamas recorded responses of false killer whales, short-finned pilot whales, and melon-headed whales to simulated MFA sonar (Deruiter et al. 2013a). The responses to exposures between species were variable. After hearing each MFA signal, false killer whales were found to "increase their whistle production rate and made more-MFA-like whistles" (Deruiter et al. 2013a). In contrast, melon-headed whales had "minor transient silencing" after each MFA signal, while pilot whales had no apparent response. Consistent with the findings of other previous research (see, for example, (Southall et al. 2007b)), Deruiter et al. (2013a) found the responses were variable by species and with the context of the sound exposure.

Evidence suggests that at least some marine mammals have the ability to acoustically identify predators. For example, harbor seals that reside in the coastal waters off British Columbia are frequently targeted by certain groups of killer whales, but not others. The seals discriminate between the calls of threatening and non-threatening killer whales (Deecke et al. 2002), a capability that should increase survivorship while reducing the energy required for attending to and responding to all killer whale calls. Auditory masking may prevent marine mammals from responding to the acoustic cues produced by their predators. The effects of auditory masking on the predator-prey relationship depends on the duration of the masking and the likelihood of encountering a predator during the time that predator cues are impeded.

6.2.9 Physiological Stress

Marine mammals naturally experience stressors within their environment and as part of their life histories. Changing weather and ocean conditions, exposure to diseases and naturally occurring toxins, lack of prey availability, social interactions with members of the same species, and interactions with predators all contribute to the stress a marine mammal experiences. In some cases, naturally occurring stressors can have profound impacts on marine mammals; for example, chronic stress, as observed in stranded animals with long-term debilitating conditions (e.g., disease), has been demonstrated to result in an increased size of the adrenal glands and an increase in the number of epinephrine-producing cells (Clark et al. 2006).

Anthropogenic activities have the potential to provide additional stressors above and beyond those that occur naturally. For example, various efforts have investigated the impact of vessels on marine mammals (both whale-watching and general vessel traffic noise) and demonstrated that impacts do occur (Bain 2002; Erbe 2002b; Noren et al. 2009; Pirotta et al. 2015; Williams and Ashe 2006; Williams and Noren 2009). In an analysis of energy costs to killer whales, Williams et al. (2009) suggested that whale-watching in the Johnstone Strait resulted in lost feeding opportunities due to vessel disturbance. Ayres et al. (2012) measured fecal hormones of southern resident killer whales in the Salish Sea to assess the lack of prey (salmon) and vessel traffic on species recovery. Ayres et al. (2012) suggested that the lack of prey overshadowed any population-level physiological impacts on southern resident killer whales from vessel traffic.

Marine mammals may exhibit a behavioral response or combinations of behavioral responses upon exposure to anthropogenic sounds. If a sound is detected by a marine mammal, a stress response (e.g., startle or annoyance) or a cueing response (based on a past stressful experience) can occur. Although preliminary because of the small numbers of samples collected, different types of sounds have been shown to produce variable stress responses in marine mammals. Belugas demonstrated no catecholamine (hormones released in situations of stress) response to the playback of oil drilling sounds (Thomas et al. 1990) but showed an increase in catecholamines following exposure to impulsive sounds produced from a seismic water gun (Romano et al. 2004). A bottlenose dolphin exposed to the same seismic water gun signals did not demonstrate a catecholamine response, but did demonstrate an elevation in aldosterone, a hormone that may be a significant indicator of stress in odontocetes (St. Aubin et al. 2001; St. Aubin and Geraci 1989). Increases in heart rate were observed in bottlenose dolphins to which conspecific calls were played, although no increase in heart rate was observed when tank noise was played back (Miksis et al. 2001). Collectively, these results suggest a variable response that depends on the characteristics of the received signal and prior experience with the received signal.

Other types of stressors include the presence of vessels, fishery interactions, acts of pursuit and capture, the act of stranding, and pollution. In contrast to the limited amount of work performed on stress responses resulting from sound exposure, a considerably larger body of work exists on stress responses associated with pursuit, capture, handling and stranding. A study compared pathological changes in organs/tissues of odontocetes stranded on beaches or captured in nets over a 40-year period (Cowan and Curry 2008). The type of changes observed indicate multisystemic harm caused in part by an overload of catecholamines into the system, as well as a restriction in blood supply capable of causing tissue damage or tissue death. This response to a stressor or stressors is thought be mediated by the over-activation of the animal's normal physiological adaptations to diving or escape. Pursuit, capture and short-term holding of belugas have been observed to result in decreased thyroid hormones (St. Aubin and Geraci 1988) and increases in epinephrine (St. Aubin and Dierauf 2001). In dolphins, the trend is more complicated with the duration of the handling time potentially contributing to the magnitude of the stress response (Ortiz and Worthy 2000; St. Aubin 2002; St. Aubin et al. 1996). Male grey seals subjected to capture and short-term restraint showed an increase in cortisol levels accompanied by an increase in testosterone (Lidgard et al. 2008). This result may be indicative of a compensatory response that enables the seal to maintain reproduction capability in spite of stress. Elephant seals demonstrate an acute cortisol response to handling, but do not demonstrate a chronic response; on the contrary, adult females demonstrate a reduction in the adrenocortical response following repetitive chemical immobilization (Engelhard et al. 2002). Similarly, no correlation between cortisol levels and heart/respiration rate changes were seen in harbor porpoises during handling for satellite tagging (Eskesen et al. 2009). Taken together, these studies illustrate the wide variations in the level of response that can occur when faced with these stressors.

Factors to consider when trying to predict a stress or cueing response include the mammal's life history stage and whether they are experienced with the stressor. Prior experience with a stressor

may be of particular importance as repeated experience with a stressor may dull the stress response via acclimation (St. Aubin and Dierauf 2001).

The sound characteristics that correlate with specific stress responses in marine mammals are poorly understood. Therefore, in practice and for the purposes of this Opinion, a stress response is assumed if a physical injury such as hearing loss or trauma is predicted; or if a significant behavioral response is predicted.

6.2.10 Behavioral Reactions

The response of a marine mammal to an anthropogenic sound will depend on the frequency, duration, temporal pattern and amplitude of the sound as well as the animal's prior experience with the sound and the context in which the sound is encountered (i.e., what the animal is doing at the time of the exposure). The distance from the sound source and whether it is perceived as approaching or moving away can affect the way an animal responds to a sound (Wartzok et al. 2003). For marine mammals, a review of responses to anthropogenic sound was first conducted by Richardson and others (Richardson et al. 1995c). More recent reviews (Ellison et al. 2012; Nowacek et al. 2007; Southall et al. 2009) (Southall et al. 2007b) address studies conducted since 1995 and focus on observations where the received sound level of the exposed marine mammal(s) was known or could be estimated.

Except for some vocalization changes that may be compensating for auditory masking, all behavioral reactions are assumed to occur due to a preceding stress or cueing response, however stress responses cannot be predicted directly due to a lack of scientific data (see preceding section). Responses can overlap; for example, an increased respiration rate is likely to be coupled with a flight response. Differential responses are expected among and within species since hearing ranges vary across species, the behavioral ecology of individual species is unlikely to completely overlap, and individuals of the same species may react differently to the same, or similar, stressor.

Southall et al. (2007a) synthesized data from many past behavioral studies and observations to determine the likelihood of behavioral reactions to specific sound levels exposures. While in general, the louder the sound source the more intense the behavioral response, it was clear that the proximity of a sound source and the animal's experience, motivation, and conditioning were also critical factors influencing the response (Southall et al. 2007b). After examining all of the available data, the authors felt that the derivation of thresholds for behavioral response based solely on exposure level was not supported because context of the animal at the time of sound exposure was an important factor in estimating response. Nonetheless, in some conditions consistent avoidance reactions were noted at higher sound levels dependent on the marine mammal species or group allowing conclusions to be drawn. Most low-frequency cetaceans (mysticetes) observed in studies usually avoided sound sources at levels of greater than or equal to 160 dB re 1 µPa. Published studies of mid-frequency cetaceans analyzed include sperm whales, belugas, bottlenose dolphins, and river dolphins. These groups showed no clear tendency, but for non-impulsive sounds, captive animals tolerated levels in excess of 170 dB re 1 µPa before showing behavioral reactions, such as avoidance, erratic swimming, and attacking the test apparatus. High-frequency cetaceans (observed from studies with harbor porpoises) exhibited changes in respiration and avoidance behavior at levels between 90 and 140 dB re 1 µPa, with

profound avoidance behavior noted for levels exceeding this. Phocid seals showed avoidance reactions at or below 190 dB re 1 µPa, thus seals may actually receive levels adequate to produce TTS before avoiding the source. Recent studies with beaked whales have shown them to be particularly sensitive to noise, with animals during 3 playbacks of sound breaking off foraging dives at levels below 142 dB re 1 µPa, although acoustic monitoring during actual sonar exercises revealed some beaked whales continuing to forage at levels up to 157 dB re 1 µPa (Tyack et al. 2011b). Passive acoustic monitoring of beaked whales, classified as Blainville's beaked whales and Cross-seamount type beaked whales, at Pacific Missile Range Facility, Kauai, Hawaii showed statistically significant differences in dive rates, diel occurrence patterns, and spatial distribution of dives after the initiation of a training event. However, for the beaked whale dives that continued to occur during MFAS activity, differences from normal dive profiles and click rates were not detected with estimated receive levels up to 137 dB re 1 uPa while the animals were at depth during their dives (Manzano-Roth et al. 2013b).

6.2.10.1 *Behavioral Reactions of Marine Mammals to Impulsive Sound Sources*

The following sections describe the behavioral reactions of marine mammals to impulsive sound sources such as underwater explosions.

6.2.10.1.1 Mysticetes

Baleen whales have shown a variety of responses to impulsive sound sources, including avoidance, reduced surface intervals, altered swimming behavior, and changes in vocalization rates (Richardson et al. 1995b; Southall et al. 2007d). While most bowhead whales did not show active avoidance until within 8 km of seismic vessels (Richardson et al. 1995a), some whales avoided vessels by more than 20 km at received levels as low as 120 dB re 1 µPa root mean square. Additionally, Malme et al. (1988) observed clear changes in diving and respiration patterns in bowheads at ranges up to 73 km from seismic vessels, with received levels as low as 125 dB re 1 µPa.

Gray whales migrating along the U.S. west coast showed avoidance responses to seismic vessels at 164 dB re 1 µPa (10 percent of animals showed avoidance response), and at 190 dB re 1 µPa (90 percent of animals showed avoidance response), with similar results for whales in the Bering Sea (Malme et al. 1986; Malme et al. 1988). In contrast, noise from seismic surveys was not found to impact Western North Pacific gray whale feeding behavior or exhalation rates off the coast of Russia (Gailey et al. 2007; Yazvenko et al. 2007).

Humpback whales showed avoidance behavior at ranges of 5 to 8 km from a seismic array during observational studies in western Australia (McCauley et al. 1998; Todd et al. 1996a) found no clear short-term behavioral responses by foraging humpbacks to explosions associated with construction operations in Newfoundland, but did see a trend of increased rates of net entanglement and a shift to a higher incidence of net entanglement closer to the noise source.

Seismic pulses at average received levels of 131 dB re 1 μPa^2-s caused blue whales to increase call production (Di Lorio and Clark 2010). McDonald et al. (1995) tracked a blue whale with seafloor seismometers and reported that it stopped vocalizing and changed its travel direction at a range of 10 km from the seismic vessel (estimated received level 143 dB re 1 µPa peak-to-peak).

Castellote et al. (2012a) found that vocalizing fin whales in the Mediterranean left the area where a seismic survey was being conducted and that their displacement persisted beyond the completion of the survey. These studies demonstrate that even low levels of noise received far from the noise source can induce behavioral responses.

6.2.10.1.2 Odontocetes

Madsen et al. (2006) and Miller et al. (2009) tagged and monitored eight sperm whales in the Gulf of Mexico exposed to seismic airgun surveys. Sound sources were approximately 2 to 7 nm away from the whales and, based on multipath propagation received levels, were as high as 162 dB SPL re 1 µPa with energy content greatest between 0.3 kHz to 3.0 kHz (Madsen et al. 2006). The whales showed no horizontal avoidance, although the whale that was approached most closely had an extended resting period and did not resume foraging until the airguns had ceased firing (Miller et al. 2009). The remaining whales continued to execute foraging dives throughout exposure, however swimming movements during foraging dives were 6 percent lower during exposure than control periods, suggesting subtle effects of noise on foraging behavior (Miller et al. 2009). Captive bottlenose dolphins sometimes vocalized after an exposure to impulsive sound from a seismic watergun (Finneran and Schlundt 2010; Thompson et al. 2013).

6.2.10.2 *Behavioral Reactions of Marine Mammals to Non-Impulsive Sources*

The following sections describe the behavioral reactions of marine mammals to non-impulsive sound sources such as sonar.

6.2.10.2.1 Mysticetes

Specific to U.S. Navy systems using low frequency sound, studies were undertaken pursuant to the Navy's Low Frequency Sound Scientific Research Program. These studies found only short-term responses to low frequency sound by mysticetes (fin, blue, and humpback whales) including changes in vocal activity and avoidance of the source vessel (Clark and Fristrup 2001; Croll et al. 2001b; Fristrup et al. 2003; Miller et al. 2000; Nowacek et al. 2007). Work by (Risch et al. 2012) found that humpback whale vocalizations were reduced concurrently with pulses from the low frequency Ocean Acoustic Waveguide Remote Sensing (OAWRS) source located approximately 200 km away. However, (Gong et al. 2014), disputes these findings, suggesting that (Risch et al. 2012) mistakes natural variations in humpback whale song occurrence for changes caused by OAWRS activity approximately 200 km away. (Risch et al. 2014) responded to (Gong et al. 2014) and highlighted the context-dependent nature of behavioral responses to acoustic stressors.

Baleen whales exposed to moderate low-frequency signals demonstrated no variation in foraging activity (Croll et al. 2001b). However, five out of six North Atlantic right whales exposed to an acoustic alarm interrupted their foraging dives, although the alarm signal was long in duration, lasting several minutes, and purposely designed to elicit a reaction from the animals as a prospective means to protect them from ship strikes (Nowacek et al. 2004). Although the animal's received sound pressure level was similar in the latter two studies (133 to 150 dB re 1 µPa), the frequency, duration, and temporal pattern of signal presentation were different. Additionally, the right whales did not respond to playbacks of either right whale social sounds or vessel noise, highlighting the importance of the sound characteristics, species differences, and individual sensitivity in producing a behavioral reaction.

Low-frequency signals of the Acoustic Thermometry of Ocean Climate sound source were not found to affect dive times of humpback whales in Hawaiian waters (Frankel and Clark 2000) or to overtly affect elephant seal dives off California (Costa et al. 2003). However, they did produce subtle effects that varied in direction and degree among the individual seals, again illustrating the uncertain nature of behavioral effects and consequent difficulty in defining and predicting them.

Despite previous assumptions based on vocalizations and anatomy that blue whales predominantly hear low-frequency sounds below 400 Hz (Croll et al. 2001b; Oleson et al. 2007b; Stafford and Moore 2005a), preliminary results from the 2010 and 2011 field seasons of an ongoing behavioral response study in Southern California waters indicated that in some cases and at low received levels, tagged blue whales responded to mid-frequency sonar. However, those responses were mild and there was a quick return to their baseline activity (Southall et al. 2011a). Blue whales appeared to ignore sonar transmissions at received levels lower than approximately 150 dB and generally ignored received levels greater than these when they were engaged in feeding behavior (Southall et al. 2011a).

Goldbogen et al. (2013) used DTAGs to test the response of blue whales in the Southern California Bight to playbacks of simulated MFA sonar. Source levels of simulated sonar and control sounds (pseudo-random noise or PRN) in the 3.5 to 4.0 kHz range were ramped up in 3 dB increments from 160 to 210 dB re 1 µPa. Responses varied depending on the whales' prior behavioral state: surface feeding whales showed no response, while deep feeding whales and whales that were not feeding were affected. Responses among affected animals ranged from termination of deep foraging dives to prolonged mid-water dives. The reactions were context dependent, leading the authors to conclude a combination of received sound level and the behavioral state of the animal are likely to influence behavioral response. The authors note that whales responded even at low SPLs, suggesting that received level alone may not be a reliable predictor of behavior. Goldbogen et al. (2013) noted that behavioral responses observed were temporary and whales typically resumed normal behavior quickly after the cessation of sound exposure. Perhaps the most significant reponse documented in the study resulted from an experiment involving PRN rather than simulated sonar, which corresponded with a blue whale terminating a foraging bout. The more significant reaction to PRN may be indicative of habituation to mid-frequency sonar signals; the authors noted that the responses they documented were in a geographical region with a high level of naval activity and where mid-frequency sonar use is common.

Melcon et al. (2012) tested whether MFA sonar and other anthropogenic noises in the mid-frequency band affected the "D-calls" produced by blue whales in the Southern California Bight. The authors used passive acoustic monitoring data recorded with stationary High-frequency Acoustic Recording Packages in the Southern California Bight. The likelihood of an animal calling decreased with the increased received level of mid-frequency sonar, beginning at a sound pressure level of approximately 110 to 120 dB re 1 µPa. Observations indicated that after sonar cessation, blue whales start producing D calls again. The authors concluded that blue whales heard and devoted attention to the sonar, despite its high frequency (relative to their putative hearing sensitivity) and its low received level. However, the authors noted that while D calls are typically associated with blue whale foraging behavior, they were unable to determine if

suppression of D calls reflected a change in their feeding performance or abandonment of foraging behavior.

Martin et al. (2015) used bottom mounted hydrophone arrays to estimate minke whale densities in the Pacific Missile Range Facility (PMRF) located off Kauai, Hawaii before, during, and after Navy training events involving active sonar. The study indicated minke whales decreased calling during the transmission of MFA sonar, but could not determine whether or not the whales left the area. The authors also suggested the presence of Naval surface ships during MFA transmission should be considered as a factor in the cessation of calling, rather than assuming the MFA sonar itself is the sole cause for the cessation of calling.

6.2.10.2.2 Odontocetes

From 2007 to present, behavioral response studies have been conducted through the collaboration of various research organizations in the Bahamas, Southern California, Mediterranean, Cape Hatteras, and Norwegian waters. These studies attempted to define and measure responses of beaked whales and other cetaceans to controlled exposures of sonar and other sounds to better understand their potential impacts. Results from the 2007 to 2008 study conducted near the Bahamas showed a change in diving behavior of an adult Blainville's beaked whale to playback of mid-frequency source and predator sounds (Boyd et al. 2008; Southall et al. 2009; Tyack et al. 2011c). Reaction to mid-frequency sounds included premature cessation of clicking, termination of a foraging dive, and a slower ascent rate to the surface. Preliminary results have been presented for the behavioral response study in Southern California waters (e.g., (Boyd et al. 2008; Southall et al. 2013; Southall et al. 2012; Southall et al. 2011a).

For example, Stimpert et al. (2014) tagged a Baird’s beaked whale and exposed it to simulated mid-frequency sonar. Some changes in the animal’s dive behavior and locomotion were observed when received level reached 127 dB re 1µPa. Deruiter et al. (2013b) presented results from two Cuvier’s beaked whales that were tagged and exposed to simulated MFA sonar during the 2010 and 2011 field seasons of the southern California behavioral response study. The 2011 whale was also incidentally exposed to MFA sonar from a distant naval exercise. Received levels from the MFA sonar signals from the controlled and incidental exposures were calculated as 84 to 144 and 78 to 106 dB re 1 µPa root mean square, respectively. Both whales showed responses to the controlled exposures, ranging from initial orientation changes to avoidance responses characterized by energetic fluking and swimming away from the source. However, the authors did not detect similar responses to incidental exposure to distant naval sonar exercises at comparable received levels, indicating that context of the exposures (e.g., source proximity, controlled source ramp-up) may have been a significant factor. Cuvier's beaked whale responses suggested particular sensitivity to sound exposure as consistent with results for Blainville’s beaked whale. Similarly, beaked whales exposed to sonar during British training exercises stopped foraging (DSTL 2007).

Miller et al. (2011) reported on behavioral responses of pilot whales, killer whales, and sperm whales off Norway to Norwegian Navy mid-frequency sonar sources (a 3-year effort called the 3S experiments) (see also (Antunes et al. 2014); (Kuningas et al. 2013); (Kvadsheim et al. 2011); (Miller et al. 2012); (Miller et al. 2014); (Sivle et al. 2012). Reactions at different distances and received levels were variable, and types of responses observed included cessation of feeding,

avoidance, changes in vocalizations, and changes in dive behavior. Some exposures elicited no observable reactions, and others resulted in brief or minor reactions, such as minor changes in vocalizations or locomotion. The experimental exposures occurred across different behavioral and environmental contexts, which may have played a role in the type of response observed, at least for killer whales (Miller et al. 2014). Some aspects of the experiment differ from typical Navy actions and may have exacerbated observed reactions; for example, animals were directly approached by the source vessel, researchers conducted multiple approaches toward the same animal groups over the course of each session, some exposures were conducted in bathymetrically restricted areas, and, in some cases, researchers "leapfrogged" the boat to repeatedly move ahead of the animals in order to repeatedly approach animals on their travel path. For example, separation of a killer whale calf from its mother occurred during the fifth vessel approach towards a killer whale group in a fjord. In contrast, U.S. Navy vessels avoid approaching marine mammals head-on, and vessels will maneuver to maintain a distance of at least 500 yd. (457 m) from observed animals. Furthermore, Navy mitigation measures would dictate powerdown of hull-mounted ASW sonars within 1,000 yd. (914m) of marine mammals and ultimately shutdown if an animal is within 200 yd. (183 m).

In the 2007 to 2008 Bahamas study, playback sounds of a potential predator— a killer whale— resulted in a similar but more pronounced reaction, which included longer inter-dive intervals and a sustained straight-line departure of more than 20 km from the area. The authors noted, however, that the magnified reaction to the predator sounds could represent a cumulative effect of exposure to the two sound types since killer whale playback began approximately 2 hours after mid-frequency source playback (Boyd et al. 2008; Tyack et al. 2011c). In contrast, preliminary analyses suggest that none of the pilot whales or false killer whales in the Bahamas showed an avoidance response to controlled exposure playbacks (Southall et al. 2009).

Through analysis of the behavioral response studies, a preliminary overarching effect of greater sensitivity to all anthropogenic exposures was seen in beaked whales compared to the other odontocetes studied (Southall et al. 2009). Therefore, recent studies have focused specifically on beaked whale responses to MFA sonar transmissions or controlled exposure playback of simulated sonar on various military ranges (Claridge and Durban 2009; DSTL 2007; McCarthy et al. 2011; Moretti 2009; Tyack et al. 2011c). In the Bahamas, Blainville's beaked whales located on the range will move off-range during MFA sonar use and return only after the sonar transmissions have stopped, sometimes taking several days to do so (Claridge and Durban 2009; McCarthy et al. 2011; Moretti 2009; Tyack et al. 2011c). Moretti et al. (2014) used recordings from seafloor mounted hydrophones at the Atlantic Undersea Test and Evaluation Center (AUTEC) to analyze the probability of Blainsville's beaked whale dives before, during, and after Navy sonar exercises. They developed an empirical risk function and predicted a 0.5 probability of disturbance at received levels of 150 dB.

Claridge (2013) used photo-recapture methods to estimate population abundance and demographics of Blainville's beaked whale (Mesoplodon densirostris) in the Bahamas at two sample locations; one within the bounds of the AUTEC where sonar training occurs and the second along the edge of Abaco Island approximately 170 km to the north. To investigate the potential effect of beaked whale exposure to MFA sonar, Claridge assumed that the two sample sites should have equal potential abundances and hypothesized that a lower abundance found at

the AUTEC was due to either reduced prey availability at AUTEC or due to population level effects from the exposure to MFA sonar at AUTEC.

There are two major issues with this study. First, all of the re-sighted whales during the 5-year study at both sites were female. Claridge acknowledges that this can lead to a negative bias in the estimation of abundances. It has been shown in other cetacean species that females with calves may prefer "nursery" habitats or form nursery groups with other mother-calf pairs (e.g., (Claridge 2006; Scott et al. 1990; Weir et al. 2008)). It may be that the site at Abaco is a preferred site for females with calves, while the site at AUTEC is not, and therefore over the 5-year study period fewer females with calves were observed at AUTEC as these females went elsewhere in the area during the 3-year weaning period. In addition, Marques et al. (2009) estimated the Blainville's beaked whale population at AUTEC to be between 22.5 and 25.3 animals per 1,000 km^2 . This density was estimated over 6 days using passive acoustic methods, which is a method Claridge identified as one that may be better for estimating beaked whale densities than visual methods. The results at AUTEC are also biased by reduced effort and a shorter overall study period that did not capture some of the emigration/immigration trends Claridge identified at Abaco. For these reasons among others, it is unclear whether there are significant differences in the abundances between the two sites.

Second, Claridge assumed that the two sites are identical and therefore should have equal potential abundances; Abaco is a "control" site with the difference being the use of sonar at AUTEC. Although the sample boundaries at each location were drawn to create samples "of comparable size," there are differences between the two sample area locations as follows: the Abaco site is along a leeward shore, AUTEC is windward; the Abaco sample area is a long narrow margin along a canyon wall, the rectangular AUTEC sample site is a portion of a deep and landlocked U-shaped trough. In addition to the physical differences, Claridge notes that it remains unclear whether or not variation in productivity between sites influenced what she refers to as the substantial differences in abundance. Claridge reports that a study investigating prey distributions at her sample locations was unable to sample prey at the beaked whale foraging depth. Claridge dismisses the possibility of differences in prey availability between the sites noting that there is no supporting evidence that prey availability differs between the two sites. As this study illustrates, the multiple and complex factors required by investigations of potential long-term cause and effect from actions at sea require a comprehensive assessment of all factors influencing potential trends in species abundances that are not likely attributable to a single cause and effect.

In the Caribbean, research on sperm whales in 1983 coincided with the U.S. intervention in Grenada. Sperm whales interrupted their activities by stopping echolocation and leaving the area. This response was assumed to be the result of underwater sounds originating from submarine mid to high-frequency sonar signals (Watkins et al. 1985b; Watkins and Schevill 1975a). The authors did not provide any sound levels associated with these observations, although they did note getting a similar reaction from banging on their boat hull. It was unclear if the sperm whales were reacting to the sonar signal itself or to a potentially new unknown sound as had been demonstrated on another occasion during which sperm whales in the Caribbean stopped vocalizing when presented with sounds from nearby acoustic pingers (Watkins and Schevill 1975a).

Researchers at the Navy's Marine Mammal Program facility in San Diego, California have conducted a series of controlled experiments on bottlenose dolphins and beluga whales to study TTS (Finneran 2010; Finneran 2011; Finneran et al. 2001; Finneran et al. 2003; Finneran et al. 2010; Finneran and Schlundt 2004; Schlundt et al. 2000). Ancillary to the TTS studies, scientists evaluated whether the marine mammals performed their trained tasks when prompted, during and after exposure to mid-frequency tones. Altered behavior during experimental trials usually involved refusal of animals to return to the site of the sound stimulus. This refusal included what appeared to be deliberate attempts to avoid a sound exposure or to avoid the location of the exposure site during subsequent tests (Finneran et al. 2002; Schlundt et al. 2000). Bottlenose dolphins exposed to 1-second tones exhibited short-term changes in behavior above received sound levels of 178 to 193 dB re 1 µPa root mean square, and beluga whales did so at received levels of 180 to 196 dB re 1 µPa and above. In some instances, animals exhibited aggressive behavior toward the test apparatus (Ridgway et al. 1997; Schlundt et al. 2000). While these studies were not designed to test avoidance behavior and animals were commonly reinforced with food, the controlled environment and ability to measure received levels provide insight on received levels at which animals will behaviorally responds to noise sources. More recently, a controlled-exposure study was conducted with U.S. Navy bottlenose dolphins at the Navy Marine Mammal Program facility specifically to study behavioral reactions to simulated mid-frequency sonar (Houser et al. 2013). Animals were trained to swim across a pen, touch a panel, and return to the starting location. During transit, a simulated mid-frequency sonar signal was played. Behavioral reactions were more likely with increasing received level and included increased respiration rates, fluke or pectoral fin slapping, and refusal to participate, among others. From these data, it was determined that bottlenose dolphins were more likely to respond to the initial trials, but habituated to the sound over the course of 10 trials except at the highest received levels. All dolphins responded at the highest received level (185 dB re 1 µPa).

Studies with captive harbor porpoises showed increased respiration rates upon introduction of acoustic alarms, such as those used on fishing nets to help deter marine mammals from becoming caught or entangled (Kastelein et al. 2001; Kastelein et al. 2006a) and emissions for underwater data transmission (Kastelein et al. 2005). However, exposure of the same acoustic alarm to a striped dolphin under the same conditions did not elicit a response (Kastelein et al. 2006b), again highlighting the importance in understanding species differences in the tolerance of underwater noise (Southall et al. 2007b). Henderson et al. (2014) observed behavioral responses of delphinids to MFA sonar in the Southern California Bight from 2004 to 2008. The authors observed responses ranging from changes in behavioral state or direction of travel, to changes in vocalization activity. Behavioral responses were generally observed at received sound pressure levels ranging from 107 to 117 dB_{rms} re: 1 µPa. We are not reasonably certain that exposure to such sound pressure levels will elicit a substantive behavioral reaction and rise to the level of take per the ESA.

6.2.10.3 *Behavioral Reactions of Marine Mammals to Vessels*

Sound emitted from large vessels, such as shipping and cruise ships, is the principal source of low-frequency noise in the ocean today, and marine mammals are known to react to or be affected by that noise (Foote et al. 2004; Hatch and Wright 2007; Hildebrand 2005; Holt et al. 2008b; Kerosky et al. 2013; Melcon et al. 2012; Richardson et al. 1995c). As noted previously, in

the Inland Waters of Puget Sound, Erbe et al. (2012) estimated the maximum annual underwater sound exposure level from vessel traffic near Seattle was 215 dB re 1 µPa^2-s. Bassett et al. (2010) measured mean sound pressure levels at Admiralty Inlet from commercial shipping at 117 dB re 1 µPa with a maximum exceeding 135 dB re 1 µPa on some occasions.

In short-term studies, researchers have noted changes in resting and surface behavior states of cetaceans to whale watching vessels (Acevedo 1991b; Aguilar Soto et al. 2006; Arcangeli and Crosti 2009; Au and Green 2000; Christiansen et al. 2010; Erbe 2002b; Noren et al. 2009; Stensland and Berggren 2007; Stockin et al. 2008; Williams and Noren 2009). Noren et al. (2009) conducted research in the San Juan Islands in 2005 and 2006 and their findings suggested that close approaches by vessels impacted the whales' behavior and that the whale-watching guideline minimum approach distance of 100 m may be insufficient in preventing behavioral responses. Most studies of this type are opportunistic and have only examined the short-term response to vessel sound and vessel traffic (Magalhaes et al. 2002; Noren et al. 2009; Richardson and Wursig 1995; Watkins 1981d).

Long-term and cumulative implications of vessel sound on marine mammals remains largely unknown. Clark et al. (2009) provided a discussion on calculating the cumulative impacts of anthropogenic noise on baleen whales and estimated the noise from the passage of two vessels could reduce the optimal communication space for North Atlantic right whales by 84 percent (see also (Hatch et al. 2012)).

Bassett et al. (2012) recorded vessel traffic over a period of just under a year as large vessels passed within 20 km of a hydrophone site located at Admiralty Inlet in Puget Sound. During this period there were 1,363 unique Automatic Identification System transmitting vessels recorded. Navy vessels, given they are much fewer in number, are a small component of overall vessel traffic and vessel noise in most areas where they operate and this is especially the case in the Action Area (see Mintz and Filadelfo (2011) concerning a general summary for the U.S. Exclusive Economic Zone). In addition, Navy combatant vessels have been designed to generate minimal noise and use ship quieting technology to elude detection by enemy passive acoustic devices (Mintz and Filadelfo 2011; Southall et al. 2005).

6.2.10.3.1 Mysticetes

Fin whales may alter their swimming patterns by increasing speed and heading away from a vessel, as well as changing their breathing patterns in response to a vessel approach (Jahoda et al. 2003). Vessels that remain 328 ft. (100 m) or farther from fin and humpback whales were largely ignored in one study where whale watching activities are common (Watkins 1981b). Only when vessels approached more closely did the fin whales in this study alter their behavior by increasing time at the surface and exhibiting avoidance behaviors. Other studies have shown when vessels are near, some but not all fin whales change their vocalizations, surface time, swimming speed, swimming angle or direction, respiration rates, dive times, feeding behavior, and social interactions (Au and Green 2000; Castellote et al. 2012c; Richter et al. 2003; Williams et al. 2002b).

Based on passive acoustic recordings and in the presence of sounds from passing vessels, Melcon et al. (2012) reported that blue whales had an increased likelihood of producing certain types of calls. Castellote et al. (2012c) demonstrated that fin whales' songs had shortened duration and decreased bandwidth, center frequency, and peak frequency in the presence of high shipping noise levels. It is not known if these changes in vocal behavior corresponded to other behaviors.

In the Watkins (1981b) study, humpback whales did not exhibit any avoidance behavior but did react to vessel presence. In a study of regional vessel traffic, Baker et al. (1983) found that when vessels were in the area, the respiration patterns of the humpback whales changed. The whales also exhibited two forms of behavioral avoidance: horizontal avoidance (changing direction or speed) when vessels were between 1.24 and 2.48 mi. (2,000 and 4,000 m) away, and vertical avoidance (increased dive times and change in diving pattern) when vessels were within approximately 1.2 mi. (2,000 m; (Baker and Herman 1983)). Similar findings were documented for humpback whales when approached by whale watch vessels in Hawaii (Au and Green 2000).

Gende et al. (2011) reported on observations of humpback whales in inland waters of Southeast Alaska subjected to frequent cruise ship transits (i.e., in excess of 400 transits in a 4-month season in 2009). The study was focused on determining if close encounter distance was a function of vessel speed. The reported observations, however, seem in conflict with other reports of avoidance at much greater distance so it may be that humpback whales in those waters are more tolerant of vessels (given their frequency) or are engaged in behaviors, such as feeding, that they are less willing to abandon. This example again highlights that context is critical for predicting and understanding behavioral reactions as concluded by Southall et al. (2007b) and Ellison et al. (2012).

Sei whales have been observed ignoring the presence of vessels and passing close to them (National Marine Fisheries Service 1993). In the presence of approaching vessels, blue whales perform shallower dives accompanied by more frequent surfacing, but otherwise do not exhibit strong reactions (Calambokidis et al. 2009). Minke whales in the Antarctic did not show any apparent response to a survey vessel moving at normal cruising speeds (about 12 knots) at a distance of 5.5 nm; however, when the vessel drifted or moved at very slow speeds (about 1 knot), many whales approached it (Leatherwood et al. 1982a).

Although not expected to be in the MITT Action Area, North Atlantic right whales tend not to respond to the sounds of oncoming vessels (Nowacek et al. 2004) and therefore might provide insight to behavioral responses of other baleen whales. North Atlantic right whales continue to use habitats in high vessel traffic areas (Nowacek et al. 2004). Studies show that North Atlantic right whales demonstrate little if any reaction to sounds of vessels approaching or the presence of the vessels themselves (Nowacek et al. 2004; Terhune and Verboom 1999). Although this may minimize potential disturbance from passing ships, it does increase the whales' vulnerability to potential ship strike. The regulated approach distance for North Atlantic right whales is 500 yards (yd.) (457 m) (NMFS 1997).

Using historical records, Watkins (1986) showed that the reactions of four species of mysticetes to vessel traffic and whale watching activities in Cape Cod had changed over the 25-year period examined (1957 through 1982). Reactions of minke whales changed from initially more positive

reactions, such as coming towards the boat or research equipment to investigate, to more 'uninterested' reactions towards the end of the study. Finback [fin] whales, the most numerous species in the area, showed a trend from initially more negative reactions, such as swimming away from the boat with limited surfacing, to more uninterested (ignoring) reactions allowing boats to approach within 98.4 ft. (30 m). Right whales showed little change over the study period, with a roughly equal number of reactions judged to be negative and uninterested; no right whales were noted as having positive reactions to vessels. Humpback whales showed a trend from negative to positive reactions with vessels during the study period. The author concluded that the whales had habituated to the human activities over (Watkins 1986).

Mysticetes have been shown to both increase and decrease calling behavior in the presence of vessel noise. An increase in feeding call rates and repetition by humpback whales in Alaskan waters was associated with vessel noise (Doyle et al. 2008). Melcon et al. (2012) also recently documented that blue whales increased the proportion of time spent producing certain types of calls when vessels were present. Conversely, decreases in singing activity by humpback whales have been noted near Brazil due to boat traffic (Sousa-Lima and Clark 2008). The Central North Pacific stock of humpback whales is the focus of whale-watching activities in both its feeding grounds (Alaska) and breeding grounds (Hawaii). Regulations addressing minimum approach distances and vessel operating procedures are in place in Hawaii, however, there is still concern that whales may abandon preferred habitats if the disturbance is too high (Allen and Angliss 2010b).

6.2.10.3.2 Odontocetes

Sperm whales generally react only to vessels approaching within several hundred meters; however, some individuals may display avoidance behavior, such as quick diving (Magalhaes et al. 2002; Wursig et al. 1998). One study showed that after diving, sperm whales showed a reduced timeframe from when they emitted the first click than before vessel interaction (Richter et al. 2006). Small whale-watching and research vessels generate more noise in higher frequency bands and are more likely to approach odontocetes directly, and to spend more time near the individual whale. Reactions to Navy vessels are not well documented, but smaller whale-watching and research boats have been shown to cause these species to alter their breathing intervals and echolocation patterns.

Wursig et al. (1998) reported most *Kogia* species and beaked whales react negatively to vessels by quick diving and other avoidance maneuvers. Cox et al. (2006) noted very little information is available on the behavioral impacts of vessels or vessel noise on beaked whales. A single observation of vocal disruption of a foraging dive by a tagged Cuvier's beaked whale documented when a large noisy vessel was opportunistically present, suggests that vessel noise may disturb foraging beaked whales (Aguilar Soto et al. 2006). Tyack et al. (2011b) noted the result of a controlled exposure to pseudorandom noise suggests beaked whales would respond to vessel noise at similar received levels to those noted previously for mid-frequency sonar.

Most delphinids react neutrally to vessels, although both avoidance and attraction behavior is known (Hewitt 1985a; Wursig et al. 1998). Avoidance reactions include a decrease in resting behavior or change in travel direction (Bejder et al. 2006a). Incidence of attraction includes harbor porpoises approaching a vessel and common, rough-toothed, and bottlenose dolphins bow

riding and jumping in the wake of a vessel (Norris and Prescott 1961; Shane et al. 1986) (Ritter 2002; Wursig et al. 1998). A study of vessel reactions by dolphin communities in the eastern tropical Pacific found that populations that were often the target of tuna purse-seine fisheries (spotted, spinner and common dolphins) show evasive behavior when approached; however populations that live closer to shore (within 100 nm; coastal spotted and bottlenose dolphins) that are not set on by purse-seine fisheries tend to be attracted to vessels (Archer et al. 2010a; Archer et al. 2010b). Pirotta et al. (2015) quantified the effect of boat disturbance on bottlenose dolphin foraging and determined that foraging activity was more affected by boat presence than noise level.

Killer whales, the largest of the delphinids, are targeted by numerous small whale-watching vessels in the Pacific Northwest. For the 2012 season, it was reported that 1,590 vessel incidents were possible violations of the federal vessel approach regulations or MMPA and ESA laws as well (Eisenhardt 2013). Research suggests that whale-watching distances may be insufficient to prevent behavioral disturbances due to vessel noise (Noren et al. 2009). In 2012, there were 79 U.S. and Canadian commercial whale watch vessels in the Haro Strait region (Eisenhardt 2013). These vessels have measured source levels that ranged from 145 to 169 dB re 1 µPa at 1 m. The sound they produce underwater has the potential to result in behavioral disturbance, interfere with communication, and affect the killer whales' hearing (Erbe 2002b). Killer whales foraged significantly less and traveled significantly more when boats were within 328 ft. (100 m) (Kruse 1991b; Lusseau et al. 2009; Trites and Bain 2000; Williams and Noren 2009; Williams et al. 2002b). These short-term feeding activity disruptions may have important long-term population-level effects (Lusseau et al. 2009; Noren et al. 2009). The reaction of the killer whales to whale-watching vessels may be in response to the vessel pursuing them, rather than to the noise of the vessel itself, or to the number of vessels in their proximity.

Odontocetes have been shown to make short-term changes to vocal parameters such as intensity (Holt et al. 2008a) as an immediate response to vessel noise, as well as increase the pitch, frequency modulation, and length of whistling (May-Collado and Wartzok 2008). Likewise, modification of multiple vocalization parameters has been shown in belugas residing in an area known for high levels of commercial traffic. These animals decreased their call rate, increased certain types of calls, and shifted upward in frequency content in the presence of small vessel noise (Lesage et al. 1999). Another study detected a measurable increase in the amplitude of their vocalizations when ships were present (Scheifele et al. 2005). Killer whales off the northwestern coast of the United States have been observed to increase the duration of primary calls once a threshold in observed vessel density (e.g., whale watching) was reached, which has been suggested as a response to increased masking noise produced by the vessels (Foote et al. 2004). On the other hand, long-term modifications to vocalizations may be indicative of a learned response to chronic noise, or of a genetic or physiological shift in the populations. For example, the source level of killer whale vocalizations has been shown to increase with higher background noise levels associated with vessel traffic (Hotchkin and Parks 2013). In addition, calls with a high-frequency component have higher source levels than other calls, which may be related to behavioral state, or may reflect a sustained increase in background noise levels (Holt et al. 2008a).

6.2.10.4 *Behavioral Reactions of Marine Mammals to Aircraft and Missile Overflight*

Thorough reviews on the behavioral reactions of marine mammals to aircraft and missile overflight are presented in Richardson et al. (1995c), Efroymson et al. (2000), Luksenburg and Parsons (2009), and Holst et al. (2011). The most common responses of cetaceans to aircraft overflights were short surfacing durations, abrupt dives, and percussive behavior (breaching and tail slapping) (Nowacek et al. 2007). Other behavioral responses such as flushing and fleeing the area of the source of the noise have also been observed (Holst et al. 2011; Manci et al. 1988). Richardson et al. (1995c) noted that marine mammal reactions to aircraft overflight largely consisted of opportunistic and anecdotal observations. These observations lack a clear distinction between reactions potentially caused by the noise of the aircraft and the visual cue an aircraft presents. In addition, it was suggested that variations in the responses noted were due to other undocumented factors associated with overflight (Richardson et al. 1995c). These factors could include aircraft type (single engine, multi-engine, jet turbine), flight path (centered on the animal, off to one side, circling, level and slow), environmental factors such as wind speed, sea state, cloud cover, and locations where native subsistence hunting continues.

6.2.10.4.1 Mysticetes

Mysticetes either ignore or occasionally dive in response to aircraft overflights (Efroymson et al. 2000; Koski et al. 1998). Richardson et al. (1995c) reported that while data on the reactions of mysticetes is meager and largely anecdotal, there is no evidence that single or occasional aircraft flying above mysticetes causes long-term displacement of these mammals. In general, overflights above 1,000 ft. (305 m) do not cause a reaction.

Bowhead whales in the Beaufort Sea exhibited a transient behavioral response to fixed-wing aircraft and vessels. Reactions were frequently observed at less than 1,000 ft. (305 m) above sea level, infrequently observed at 1,500 ft. (457 m), and not observed at 2,000 ft. (610 m) above sea level (Richardson et al. 1995c). Bowhead whales reacted to helicopter overflights by diving, breaching, changing direction or behavior, and altering breathing patterns. Behavioral reactions decreased in frequency as the altitude of the helicopter increased to 492 ft. (150 m) or higher. It should be noted that bowhead whales may have more acute responses to anthropogenic activity than many other marine mammals since these animals are often presented with limited egress due to limited open water between ice floes. Additionally, many of these animals may be hunted by Alaska Natives, which could lead to animals developing additional sensitivity to human noise and presence.

6.2.10.4.2 Odontocetes

Variable responses to aircraft have been observed in toothed whales, though overall little change in behavior has been observed during flyovers. Toothed whale responses to aircrafts include diving, slapping the water with their flukes or flippers, swimming away from the direction of the aircraft, or not visibly reacting (Richardson et al. 1995c).

During standard marine mammal surveys at an altitude of 750 ft. (229 m), some sperm whales remained on or near the surface the entire time the aircraft was in the vicinity, while others dove immediately or a few minutes after being sighted. Other authors have corroborated the variability in sperm whales' reactions to fixed-wing aircraft or helicopters (Green et al. 1992; Richter et al. 2006; Richter et al. 2003; Smultea et al. 2008; Wursig et al. 1998). In one study, sperm whales

showed no reaction to a helicopter until they encountered the downdrafts from the rotors (Richardson et al. 1995c). A group of sperm whales responded to a circling aircraft (altitude of 800 to 1,100 ft. [244 to 335 m]) by moving closer together and forming a defensive fan-shaped semicircle, with their heads facing outward. Several individuals in the group turned on their sides, apparently to look up toward the aircraft (Smultea et al. 2008). Whale-watching aircraft apparently caused sperm whales to turn more sharply but did not affect blow interval, surface time, time to first click, or the frequency of aerial behavior (Richter et al. 2003). Navy aircraft do not fly at low altitude, hover over, or follow whales and so are not expected to evoke this type of response.

Smaller delphinids generally react to overflights either neutrally or with a startle response (Wursig et al. 1998). The same species that show strong avoidance behavior to vessel traffic (*Kogia* species and beaked whales) also react to aircraft (Wursig et al. 1998). Beluga whales reacted to helicopter overflights by diving, breaching, changing direction or behavior, and altering breathing patterns to a greater extent than mysticetes in the same area (Patenaude et al. 2002). These reactions increased in frequency as the altitude of the helicopter dropped below 492 ft. (150 m).

6.2.11 Repeated Exposures of Marine Mammals

Navy sonar systems are generally deployed from highly mobile vessels or in-water devices which do not directly target marine mammals. Further, the typical duty cycle with most tactical anit-submarine warefare is lower than used in the controlled exposure experiments described above, transmitting about once per minute (Navy 2013). For example, a typical Navy vessel with hull mounted MFA sonar would travel over 0.3 kilometers between pings (based on a speed of 10 knots/hr and transmission rate of 1 ping/min). Based on this distance traveled and potential avoidance behavior of acoustically exposed animals, we expect repeat acoustic exposures capable of eliciting a behavioral response to an individual over a brief period of time to be rare. For sonar devices that are stationary (e.g. dipped sonar), due to the duty cycle, duration of active transmission in a specific location, and mitigation measures (e.g. avoidance of visible marine mammals), we would not expect repeated exposures.

Some individuals may be exposed to multiple sound-producing activities over a season, year, or life stage. Repeated exposure to acoustic and other anthropogenic stimuli has been studied in several cases, especially as related to vessel traffic and whale watching. Common dolphins in New Zealand responded to dolphin-watching vessels by interrupting foraging and resting bouts, and took longer to resume behaviors in the presence of the vessel (Stockin 2008). Bejder et al. (2006a) studied responses of bottlenose dolphins to vessel approaches and found shorter lasting reactions in populations exposed to higher levels of vessel traffic. The authors indicated that lesser reactions in populations of dolphins regularly subjected to high levels of vessel traffic could be a sign of habituation, or it could be that the more sensitive animals in this population previously abandoned the area of higher human activity.

Marine mammals exposed to high levels of human activities may leave the area, habituate to the activity, or tolerate the disturbance and remain in the area. Individual marine mammals that are more tolerant may stay in a disturbed area, whereas individuals that are more sensitive may leave for areas with less human disturbance. Animals that remain throughout the disturbance may be

unable to leave the area for a variety of physiological or environmental reasons. However, given the highly migratory, wide ranging life histories, and open ocean environments of the species considered in this Opinion, we do not believe this will result from Navy training and testing activities in the MITT Action Area. Longer-term displacement can lead to changes in abundance or distribution patterns of the species in the affected region if they do not become acclimated to the presence of the sound (Bejder et al. 2006b; Blackwell et al. 2004; Teilmann et al. 2006). Gray whales in Baja California abandoned a historical breeding lagoon in the mid-1960s due to an increase in dredging and commercial shipping operations. Whales did repopulate the lagoon after shipping activities had ceased for several years (Bryant et al. 1984). Over a shorter time scale, studies on the Atlantic Undersea Test and Evaluation Center instrumented range in the Bahamas have shown that some Blaineville's beaked whales may be resident during all or part of the year in the area, and that individuals may move off of the range for several days during and following a sonar event. However animals are thought to continue feeding at short distances (a few kilometers) from the range out of the louder sound fields (less than 157 dB re 1 µPa) (McCarthy et al. 2011; Tyack et al. 2011c). Mysticetes in the northeast tended to adjust to vessel traffic over a number of years, trending towards more neutral responses to passing vessels (Watkins 1986) indicating that some animals may habituate or otherwise learn to cope with high levels of human activity. Nevertheless, the long-term consequences of these habitat utilization changes are unknown, and likely vary depending on the species, geographic areas, and the degree of acoustic or other human disturbance.

Moore and Barlow (2013) have noted a decline in beaked whales in a broad area of the Pacific Ocean area out to 300 nm from the coast and extending from the Canadian-U.S. border to the tip of Baja Mexico. There are scientific caveats and limitations to the data used for that analysis, as well as oceanographic and species assemblage changes not thoroughly addressed in Moore and Barlow (2013), although the authors suggest Navy sonar as one possible explanation for the apparent decline in beaked whale numbers over that broad area. In the small portion of the Pacific coast overlapping the Navy's SOCAL Range Complex, long-term residency by individual Cuvier's beaked whales and documented higher densities of beaked whales provide indications that the proposed decline in numbers elsewhere along the Pacific coast is not apparent where the Navy has been intensively training with sonar and other systems for decades. While it is possible that a downward trend in beaked whales may have gone unnoticed at the range complex (due to a lack of survey precision) or that beaked whale densities may have been higher before the Navy began using sonar more than 60 years ago, there is no data available to suggest that beaked whale numbers have declined on the range where Navy sonar use has routinely occurred. As Moore and Barlow (2013) point out, it remains clear that the Navy range in SOCAL continues to support high densities of beaked whales. Furthermore, a large part of the U.S. West Coast Action Area used by Moore and Barlow (2013) in their assessment of possible reasons for the decline include vast areas where the Navy does not conduct in-water training with sonar or explosives.

Establishing a causal link between anthropogenic noise, animal communication, and individual impacts as well as population viability is difficult to quantify and assess (McGregor 2013) (Read et al. 2014). Assessing the effects of sounds, both individually and cumulatively, on marine species is difficult because responses depend on a variety of factors incuding age class, prior experience, behavioral state at the time of exposure, and indirect effects. Responses may be also

be influenced by other non-sound related factors (Ellison et al. 2011; Goldbogen et al. 2013; Kight and Swaddle 2011; McGregor 2013; Williams et al. 2014) (Read et al. 2014). McGregor (2013) summarized sound impacts and described two types of possible effects based on the studies they reviewed: 1) an apparent effect of noise on communication, but with a link between demonstrated proximate cost and ultimate cost in survival or reproductive success being inferred rather than demonstrated, and 2) studies showing a decrease in population density or diversity in relation to noise, but with a relationship that is usually a correlation, so factors other than noise or its effect on communication might account for the relationship. Within the ocean environment, aggregate anthropogenic impacts have to be considered in context of natural variation and climate change (Boyd and Hutchins 2012). These contexts can include additive effects from two or more factors, multiplicity where response from two or more factors is greater than the sum of individual effects, synergism between factors and response, antagonism as a negative feedback between factors, acclimation as a short-term individual response, and adaptation as a long-term population change (Boyd and Hutchins 2012). To address aggregate impacts and responses from any changes due to processes such as habituation, tolerance, and sensitization, future experiments over an extended period of time still need further research (Bejder et al. 2009; Blickley et al. 2012) (Read et al. 2014).

Some, including (Goldbogen et al. 2013) and (Stockin et al. 2008) have speculated that repeated interruptions of a marine mammal's normal activity could lead to fitness consequences and eventually, long-term implications for the population. However, to our knowledge, empirical data has not confirmed this to be the case. For example, Goldbogen et al. (2013) suggested that if a blue whale responded to MFA sonar by temporarily interrupting feeding behavior, this could have impacts on individual fitness and eventually, population health. However, for this to be true, we would have to assume that an individual whale could not compensate for this lost feeding opportunity by either immediately feeding at another location, by feeding shortly after cessation of acoustic exposure, or by feeding at a later time. There is no indication this is the case, particularly since unconsumed prey would still be available in the environment following the cessation of acoustic exposure.

If sound exposure were to be concentrated in a relatively small geographic area over a long period of time (e.g., days or weeks during major training exercises), it would be possible for individuals confined to a specific area to be exposed to acoustic stressors (e.g., MFA sonar) multiple times during a relatively short time period. However, we do not expect this to occur as we would expect individuals to move and avoid areas where exposures to acoustic stressors are at higher levels (e.g., greater than 120dB). For example, Goldbogen et al. (2013) indicated some horizontal displacement of deep foraging blue whales in response to simulated MFA sonar. Given these animal's mobility and large ranges, we would expect these individuals to temporaily select alternative foraging sites nearby until the exposure levels in their initially selected foraging area have decreased. Therefore, even temporary displacement from initially selected foraging habitat is not expected to impact the fitness of any individual animals because we would expect equivalent foraging to be available in close proximity. Because we do not expect any fitness consequences from any individual animals, we do not expect any population level effects from these behavioral responses.

6.2.12 Stranding

When a marine mammal swims or floats (live or dead) onto shore and becomes "beached" or incapable of returning to sea, the event is termed a "stranding" (Geraci et al. 1999; Geraci and Lounsbury 2005). Animals outside of their "normal" habitat are also sometimes considered "stranded" even though they may not have beached themselves. The legal definition for a stranding within the United States is that: (A) a marine mammal is dead and is (i) on a beach or shore of the United States; or (ii) in waters under the jurisdiction of the United States (including any navigable waters); or (B) a marine mammal is alive and is (i) on a beach or shore of the United States and is unable to return to the water; (ii) on a beach or shore of the United States and, although able to return to the water, is apparently in need of medical attention; or (iii) in the waters under the jurisdiction of the United States (including any navigable waters), but is unable to return to its natural habitat under its own power or without assistance" (16 United States Code Section 1421h).

Marine mammals are subjected to a variety of natural and anthropogenic factors, acting alone or in combination, which may cause a marine mammal to strand on land or die at-sea (Geraci et al. 1999; Geraci and Lounsbury 2005). Even for the fractions of more thoroughly investigated strandings involving post-stranding data collection and necropsies, the cause (or causes) for the majority of strandings remain undetermined. Natural factors related to strandings include the availability of food, predation, disease, parasitism, climatic influences, and aging (Bradshaw et al. 2006; Culik 2004; Geraci et al. 1999; Geraci and Lounsbury 2005; Hoelzel 2003; NRC 2003; Perrin and Geraci 2002; Walker et al. 2005). Anthropogenic factors include pollution (Anonmyous 2010; Elfes et al. 2010; Hall et al. 2006a; Hall et al. 2006b; Jepson et al. 2005; Tabuchi et al. 2006), vessel strike (Berman-Kowalewski et al. 2010; De Stephanis and Urquiola 2006; Geraci and Lounsbury 2005; Jensen and Silber 2003b; Laist et al. 2001), fisheries interactions (Look 2011; Read et al. 2006), entanglement (Baird and Gorgone 2005; Johnson et al. 2005; Saez et al. 2013), and noise (Cox et al. 2006; NRC 2003; Richardson et al. 1995c).

Along the coasts of the continental United States and Alaska between 2001 and 2009, there were approximately 1,400 cetacean strandings and 4,300 pinniped strandings (5,700 total) per year (NMFS 2011b; NMFS 2011c; NMFS 2011d). Several "mass stranding" events—strandings that involve two or more individuals of the same species (excluding a single cow-calf pair)—that have occurred over the past two decades have been associated with naval operations, seismic surveys, and other anthropogenic activities that introduced sound into the marine environment. An in-depth discussion of strandings is presented in DoN (2013b).

Sonar use during exercises involving U.S. Navy (most often in association with other nations' defense forces) has been identified as a contributing cause or factor in five specific mass stranding events: Greece in 1996; the Bahamas in March 2000; Madeira Island, Portugal in 2000; the Canary Islands in 2002, and Spain in 2006 (MMC 2006). These five mass stranding events have resulted in approximately 40 known stranding deaths among cetaceans, consisting mostly of beaked whales, with a potential link to sonar (ICES 2005a; ICES 2005b; ICES 2005c). The U.S.-Navy-funded research involving Behavioral Response Studies in SOCALand the Bahamas discussed previously were motivated by the desire to understand any links between the use of mid-frequency sonar and cetacean behavioral responses, including the potential for strandings. Although these events have served to focus attention on the issue of impacts resulting from the

use of sonar, as Ketten (2012) recently pointed out, "ironically, to date, there has been no demonstrable evidence of acute, traumatic, disruptive, or profound auditory damage in any marine mammal as the result [of] anthropogenic noise exposures, including sonar."

In these previous circumstances, exposure to non-impulsive acoustic energy has been considered a potential indirect cause of the death of marine mammals (Cox et al. 2006). One hypothesis regarding a potential cause of the strandings is tissue damage resulting from "gas and fat embolic syndrome" (Fernandez et al. 2005a; Jepson et al. 2003; Jepson et al. 2005). Models of nitrogen saturation in diving marine mammals have been used to suggest that altered dive behavior might result in the accumulation of nitrogen gas such that the potential for nitrogen bubble formation is increased (Houser 2010; Houser et al. 2001b; Zimmer and Tyack 2007). If so, this mechanism might explain the findings of gas and bubble emboli in stranded beaked whales. It is also possible that stranding is a behavioral response to a sound under certain contextual conditions and that the subsequently observed physiological effects (e.g., overheating, decomposition, or internal hemorrhaging from being on shore) were the result of the stranding rather than direct physical impact from exposure to sonar (Cox et al. 2006).

In May 2003 there was an incident involving the use of mid-frequency sonar by the USS SHOUP, which was portrayed in some media reports at the time as having potentially causing harbor porpoise strandings in the region. On May 5, 2003, in the area of Admiralty Inlet, the USS SHOUP began the use of mid-frequency sonar as part of a training event, which continued until later that afternoon and ended as the USS SHOUP transited Haro Strait heading north. Between May 2 and June 2, 2003, approximately 16 strandings involving 15 harbor porpoises (*Phocoena phocoena*) and 1 Dall's porpoise (*Phocoenoides dalli*) had been reported to the Northwest Marine Mammal Stranding Network, and allegations were made that these strandings had been caused by the USS SHOUP's use of sonar. A comprehensive review of all strandings and the events involving USS SHOUP on May 5, 2003, were subsequently presented in a report by U.S. Department of Navy (DON 2004).

Additionally NMFS undertook a series of necropsy analyses on the stranded animals to determine the cause of the strandings (NMFS 2005a; Norman et al. 2004a). Necropsies were performed on 10 of the porpoises and two heads were selected for computed tomographic imaging (Norman et al. 2004a).

None of the 11 harbor porpoises demonstrated signs of acoustic trauma. A putative cause of death was determined for five of the porpoises based only on the necropsy results; two animals had blunt trauma injuries and three animals had indication of disease processes. A cause of death could not be determined in the remaining animals, which is consistent with the expected percentage of marine mammal necropsies conducted within the northwest region. It is important to note, that these determinations were based only on the evidence from the necropsy to avoid bias with regard to determinations of the potential presence or absence of acoustic trauma. For example, the necropsy investigators had no knowledge of other potential external causal factors, such as Specimen 33NWR05005 having been found tangled in a fishing net, which may have otherwise assisted in their determination regarding the likely cause of death for that animal. Additionally, seven of the porpoises collected and analyzed died prior to SHOUP departing to sea on May 5, 2003. Of these seven, one, discovered on May 5, 2003, was in a state of moderate

decomposition, indicating it died before May 5; the cause of death was determined, most likely, to be Salmonella septicemia. Another porpoise, discovered at Port Angeles on May 6, 2003, was in a state of moderate decomposition, indicating that this porpoise also died prior to May 5. One stranded harbor porpoise discovered fresh on May 6 is the only animal that could potentially be linked to the USS SHOUP's May 5 active sonar use. Necropsy results for this porpoise found no evidence of acoustic trauma. The remaining eight strandings were discovered 1 to 3 weeks after the USS SHOUP's May 5 use of sonar. Two of the eight porpoises died from blunt trauma injury and a third suffered from parasitic infestation, which possibly contributed to its death (Norman et al. 2004a). For the remaining five porpoises, NMFS was unable to identify the causes of death.

NMFS concluded from a retrospective analysis of stranding events that the number of harbor porpoise stranding events in the approximate month surrounding the USS SHOUP's use of sonar was higher than expected based on annual strandings of harbor porpoises (Norman et al. 2004a). This conclusion in the NMFS report also conflicts with data from The Whale Museum, which has documented and responded to harbor porpoise strandings since 1980 (Osborne 2003). According to The Whale Museum, the number of strandings as of May 15, 2003, was consistent with what was expected based on historical stranding records and was less than that occurring in certain years. For example, since 1992, the San Juan Stranding Network has documented an average of 5.8 porpoise strandings per year. In 1997, there were 12 strandings in the San Juan Islands, with more than 30 strandings throughout the general Puget Sound area. In reporting their findings, NMFS acknowledged that the intense level of media attention to the 2003 strandings likely resulted in increased reporting effort by the public over that which is normally observed (Norman et al. 2004a). NMFS also noted in its report that the "sample size is too small and biased to infer a specific relationship with respect to sonar usage and subsequent strandings." It was also clear that in 2003, the number of strandings from May to June was also higher for the outer coast, indicating a much wider phenomena than use of sonar by USS SHOUP in Puget Sound for one day in May. It was later determined by NMFS that the number of harbor porpoise strandings in the northwest had been increased beginning in 2003 and through 2006. On November 3, 2006, an Unusual Mortality Event in the Pacific Northwest was declared by NMFS (see (DoN 2013b), Cetacean Stranding Report for more detail on this Unusual Mortality Event).

The speculative association of the harbor porpoise strandings to the use of sonar by the USS SHOUP was inconsistent with prior stranding events linked to the use of mid-frequency sonar. Specifically, in prior events strandings occurred shortly after the use of sonar (less than 36 hours) and stranded individuals were spatially co-located. Although MFA sonar was used by the USS SHOUP, the distribution of harbor porpoise strandings by location and with respect to time surrounding the event do not support the suggestion that MFA sonar was a cause of harbor porpoise strandings. Rather, a lack of evidence of any acoustic trauma within the harbor porpoises, and the identification of probable causes of stranding or death in several animals, supports the conclusion that harbor porpoise strandings in 2003 in the Pacific Northwest were unrelated to the sonar activities by the USS SHOUP.

As the ICES (2005c) noted, taken in context of marine mammal populations in general, sonar is not a major threat, or significant portion of the overall ocean noise budget. This has also been demonstrated by monitoring in areas where the Navy operates (Bassett et al. 2010; Baumann-Pickering et al. 2010; Hildebrand et al. 2011; McDonald et al. 2006a; Tyack et al. 2011a).

Regardless of the direct cause, the Navy considers potential sonar related strandings important and continues to fund research and work with scientists to better understand circumstances that may result in strandings. During a Navy training event on March 4, 2011, at the Silver Strand Training Complex in San Diego, California, four long-beaked common dolphins were killed by the detonation of an underwater explosive (Danil and St. Leger 2011). This area has been used for underwater demolitions training for at least 3 decades without incident. During this underwater detonation training event, a pod of 100 to 150 long-beaked common dolphins were moving towards the explosive's 700-yd. (640 m) exclusion zone monitored by a personnel in a safety boat and participants in a dive boat. Within the exclusion zone, approximately 5 minutes remained on a time-delayed firing device connected to a single 8.76 lb (3.8 kg) explosive charge set at a depth of 48 ft. (14.6 m), approximately 0.5 to 0.75 nm from shore. Although the dive boat was placed between the pod and the explosive in an effort to guide the dolphins away from the area, that effort was unsuccessful and three long-beaked common dolphins died as a result of being in proximity to the explosion. In addition, to the three dolphins found dead on March 4th at the event site, the remains of a fourth dolphin were discovered on March 7th (3 days later and approximately 42 mi. (68 km) from the location where the training event occurred), which was assessed as being related to this event (Danil and St. Leger 2011). Details such as the dolphins' depth and distance from the explosive at the time of the detonation could not be estimated from the 250-yd (229 m) standoff point of the observers in the dive boat or the safety boat.

These dolphin mortalities are the only known occurrence of a U.S. Navy training event involving impulsive energy (underwater detonation) that has resulted in injury to a marine mammal. Despite this being a rare occurrence, the Navy has reviewed training requirements, safety procedures, and potential mitigation measures and, along with NMFS, is determining appropriate changes to reduce the potential for this to occur in the future.

In comparison to potential strandings or injury resulting from events associated with Navy activities, marine mammal strandings and injury from commercial vessel ship strike (Berman-Kowalewski et al. 2010; Silber et al. 2010), impacts from urban pollution (Hooker et al. 2007; O'Shea and Brownell Jr. 1994), and annual fishery-related entanglement, bycatch, injury, and mortality (Baird and Gorgone 2005; Forney and Kobayashi 2007; Saez et al. 2013), have been estimated worldwide to be orders of magnitude greater (hundreds of thousands of animals versus tens of animals; (Culik 2004; ICES 2005c; Read et al. 2006)) than the few potential injurious impacts that could be possible as a result of Navy activities. This does not negate the potential influence of mortality or additional stress to small, regionalized sub-populations which may be at greater risk from human related mortalities (fishing, vessel strike, sound) than populations with larger oceanic level distributions, but overall the Navy's impact in the oceans and inland water areas where training occurs is small by comparison to other human activities. Nonetheless, the focus of our analysis is to determine, considering the status of the resources, the environmental baseline and effects from future non-federal activities, whether the Navy's activities are likely to jeopardize listed species or are likely to destroy or adversely modify critical habitat.

6.2.13 Long-term Consequences to the Individual and the Population

Long-term consequences to a population are determined by examining changes in the population growth rate. Individual effects that could lead to a reduction in the population growth rate include mortality or injury (that removes animals from the reproductive pool), hearing loss (which

depending on severity could impact navigation, foraging, predator avoidance, or communication), chronic stress (which could make individuals more susceptible to disease), displacement of individuals (especially from preferred foraging or mating grounds), and disruption of social bonds (due to masking of conspecific signals or displacement). However, the long-term consequences of any of these effects are difficult to predict because individual experience and time can create complex contingencies, especially for intelligent, long-lived animals like marine mammals. While a lost reproductive opportunity could be a measureable cost to the individual, the outcome for the animal, and ultimately the population, can range from insignificant to significant. Any number of factors, such as maternal inexperience, years of poor food supply, or predator pressure, could produce a cost of a lost reproductive opportunity, but these events may be "made up" during the life of a normal healthy individual. The same holds true for exposure to human-generated noise sources. These biological realities must be taken into consideration when assessing risk, uncertainties about that risk, and the feasibility of preventing or recouping such risks. The long-term consequence of relatively trivial events like short-term masking of a conspecific's social sounds, or a single lost feeding opportunity, can be exaggerated beyond its actual importance by focusing on the single event and not the important variable, which is the individual and its lifetime parameters of growth, reproduction and survival.

Population models are well known from many fields in biology including fisheries and wildlife management. These models accept inputs for the population size and changes in vital rates of the population such as the mean values for survival age, lifetime reproductive success, and recruitment of new individuals into the population. The time-scale of the inputs in a population model for long-lived animals such as marine mammals is on the order of seasons, years, or life stages (e.g., neonate, juvenile, reproductive adult), and are often concerned only with the success of individuals from one time period or stage to the next. Unfortunately, information is not available to accurately assess the impact of acoustic and explosive exposure on individual marine mammal vitals rates. Further for assessing the impact of acoustic and explosive impacts to marine mammal populations, many of the inputs required by population models are not known.

Recently, efforts have been made to understand the linkage between a stressor, such as anthropogenic sound, and its immediate behavioral or physiological consequences for the individual, and then the subsequent effects on that individual's vital rates (growth, survival and reproduction), and the consequences, in turn, for the population. In 2005, a panel convened by the National Research Council of the United States National Academy of Sciences published a report on 'Marine Mammal Populations and Ocean Noise: Determining When Noise Causes Biologically Significant Effects'. The panel developed what it called "a conceptual model" that outlined how marine mammals might be affected by anthropogenic noise and how population level effects could be inferred on the basis of observed behavioral changes. They called this model 'Population Consequences of Acoustic Disturbance' (PCAD). In 2009 the US Office of Naval Research (ONR) set up a working group to transform this framework into a formal mathematical structure and determine how that structure could be parameterized using data from a number of case studies. The ONR working group extended the PCAD framework so that it could be used to consider other forms of disturbance and to address the impact of disturbance on physiology as well as behavior. Their current version of that framework is now known as PCoD (Population Consequences of Disturbance) (New et al. 2014). It is important to note that PCoD is

ongoing and is an exploratory project to determine how an interim PCoD approach might inform analysis. It is not intended to provide an actual assessment of the population-level consequences of disturbance for beaked whale populations on Navy ranges.

New et al. (2013) developed a mathematical model simulating a functional link between feeding energetics and a species' requirements for survival and reproductions for 21 species of beaked whale. The authors report "reasonable confidence" in their model, although approximately 29 percent (6 of 21 beaked whale species modeled) failed to survive or reproduce, which the authors attribute to possible inaccuracies in the underlying parameters. Based on the model simulation, New et al. (2013) determined that if habitat quality and "accessible energy" (derived from the availability of either plentiful prey or prey with high energy content) are both high, then survival rates are high as well. If these variables are low, then adults may survive but calves will not. For the 29 percent of beaked whale species for which the model failed (within the assumed range of current inputs), the assumption was a 2-year calving period (or inter-calf interval), however, for species with longer gestation periods (such as the 17-month gestation period of Baird's beaked whale (Berardius bairdii), this inter-calf interval may be too short. For Blainville's beaked whale, (Claridge 2013) has shown that calf age at separation is at least 3 years, and that the inter-calf interval at Abaco in the Bahamas may be 4 years. New et al. (2013) acknowledge that an assumed 2-year calving period in the modeling may not be long enough to build up the energetic resources necessary for mother and calf survival.

As another critical model assumption, prey preferences were modeled based on stomach content analyses of stranded animals, which the authors acknowledge are traditionally poor estimates of the diets of healthy animals, as stranded animals are often sick prior to stranding. Stomach content remnants of prey species do not digest equally, as only the hard parts of some prey types remain (e.g., fish otoliths, beaks of cephalopods) and thus often provide an incomplete picture of diet. Given these unknowns and the failure of the simulation to work for 29 percent of beaked whale species, the modeled survival rates of all beaked whales, particularly those modeled with prey having low energy content, may be better than simulated if higher-energy prey makes up a larger part of the diet than assumed by the model simulations.

In short, for the model output New et al. (2013) created to correctly represent links between the species and their environment, that model must identify all the critical and relevant ecological parameters as input variables, provide the correct values for those parameters, and then the model must appropriately integrate modeling functions to duplicate the complex relationships the model intends to represent. If an assumption (model input) such as calving period or prey preferences is incorrect (and there is presently no way to know), then the model would not be representing what may actually be occurring. New et al. (2013) report that their simulations suggest that adults will survive but not reproduce if anthropogenic disturbances result in being displaced to areas of "impaired foraging." Underlying this suggestion is the additional unstated assumption that habitat capable of sustaining a beaked whale is limited in proximity to where any disturbance has occurred and there are no data to indicate that is a valid assumption.

While the New et al. (2013) model provides a test case for future research, this pilot study has very little of the critical data necessary to form any conclusions applicable to current management decisions. The authors note the need for more data on prey species and reproductive

parameters including gestation and lactation duration, as the model results are particularly affected by these assumptions. Therefore, any suggestion of biological sensitivity to the simulation's input parameters is uncertain.

New et al. (2014) used a simulation model to assess how behavioral disruptions (e.g., significant disruption of foraging behavior) may affect southern elephant seal health, offspring survival, individual fitness, and population growth rate. They suggested their model can determine the population consequences of disturbance from short-term changes in individual animals. Their model assumed that disturbance affected behavior by reducing the number of drift dives in which the animals were feeding and increasing the time they spent in transit. For example, they suggested a disturbance lasting 50 percent of an average annual foraging trip would reduce pup survival by 0.4 percent. If this level of disturbance continued over 30 years and the population did not adapt, the authors found that the population size would decrease by approximately 10 percent.

The findings of New et al. (2014) are not applicable to the temporary behavioral disruptions that may be caused by Navy training and testing activities for a number of reasons. First, the model assumed that individuals would be unable to compensate for lost foraging opportunities. As described previously, available empirical data does not confirm this would be the case. For example, elephant seals are unlikely to be affected by short-term variations in prey availability because they take long foraging trips, allowing for some margin of error in prey availability (Costa 1993), as cited in New et al. (2014). We expect the species considered in this Opinion to be similarly unaffected. We have no information to suggest animals eliciting a behavioral response (e.g., temporary disruption of feeding) to Navy training and testing activities would be unable to compensate for this temporary disruption in feeding activity by either immediately feeding at another location, by feeding shortly after cessation of acoustic exposure, or by feeding at a later time. Additionally, the behavioral disruption of ESA-listed species reasonably expected to occur due to Navy training and testing activities will not have as long of a duration as those considered in the New et al. (2014) study. As discussed in Section 6.2.11, no individual animals will be exposed to Navy training and testing activities for a long enough duration to disrupt 50 percent of its annual feeding opportunities over multiple years. New et al. (2014) suggest it would be unlikely even for episodic environmental change, such as El Niño events, to affect the probability of population persistence. As suggested by the authors, the New et al. (2014) model may be more applicable to the consideration of potential long-term behavioral disruptions (e.g., those that may result from climate change).

Until an appropriate quantitative model is developed and until all relevent empirical data is collected to support such a model for the species considered in this Opinion, the best assessment of long-term consequences from training and testing activities will be to monitor the populations over time within a given Navy range complex. A U.S. Navy workshop on Marine Mammals and Sound (Fitch et al. 2011) indicated a critical need for baseline biological data on marine mammal abundance, distribution, habitat, and behavior over sufficient time and space to evaluate impacts from human-generated activities on long-term population survival. The Navy has developed monitoring plans for protected marine mammals and sea turtles occurring on Navy ranges with the goal of assessing the impacts of training activities on marine species and the effectiveness of the Navy's current mitigation practices. Monitoring has resulted in data on occurrence, exposure,

and behavioral response in the MITT Action Area. All monitoring reported are available to the public and posted at www.navymarinespeciesmonitoring.us/.

6.2.14 Criteria for Predicting Acoustic and Explosive Impacts – Marine Mammals

When Navy activities introduce sound or explosive energy into the marine environment, an analysis of potential impacts to marine mammals is conducted. To do this, information about the numerical sound and energy levels that are likely to elicit certain types of physiological and behavioral reactions is needed. The following contains information on the Navy's criteria, thresholds, and methodology for quantifying impacts from acoustic and explosive sources, which were jointly developed with NMFS. For this information in its entirety, please see Navy 2013.

6.2.14.1 *Frequency Weighting*

Frequency-weighting functions are used to adjust the received sound level based on the sensitivity of the animal to the frequency of the sound. The weighting functions de-emphasize sound exposures at frequencies to which marine mammals are not particularly sensitive. This effectively makes the acoustic thresholds frequency-dependent, which means they are applicable over a wide range of frequencies and therefore applicable for a wide range of sound sources. Frequency-weighting functions, called "M-weighting" functions, were proposed by Southall et al. (2007b) to account for the frequency bandwidth of hearing in marine mammals. These M-weighting functions were derived for each marine mammal hearing group based on an algorithm using the range of frequencies that are within 80 kHz of an animal or group's best hearing. The Southall et al. (2007b) M-weighting functions are nearly flat between the lower and upper cutoff frequencies, and thus were believed to represent a conservative approach to assessing the effects of noise (Figure 21). For the purposes of this analysis, we refer to these as Type I auditory weighting functions. Otariid seal thresholds and weighting functions were applied to sea otter as described in Finneran and Jenkins (2012).

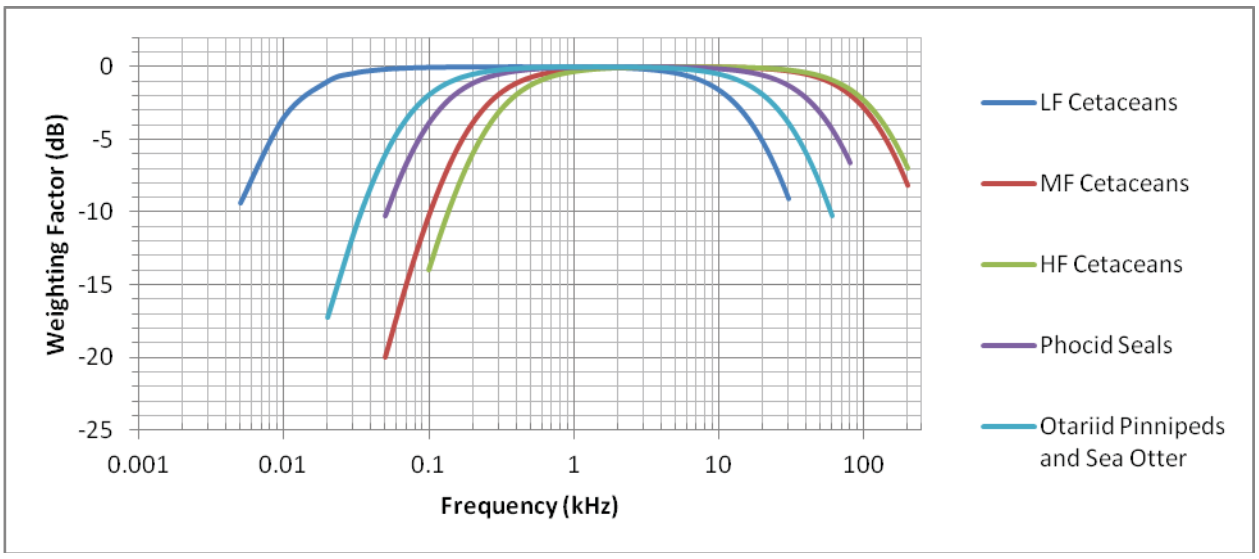

Figure 21. Type I Auditory Weighting Functions Modified from the Southall et al. (2007) M-Weighting Functions

Finneran and Jenkins (2012) considered data since Southall et al. (2007b) and determined two published studies suggested adjustments to the weighting functions were appropriate. The first experiment measured TTS in a bottlenose dolphin after exposure to pure tones with frequencies from 3 to 28 kHz (Finneran and Schlundt 2010). These data were used to derive onset-TTS values as a function of exposure frequency, and demonstrate that the use of a single numeric threshold for onset-TTS, regardless of frequency, is not correct. The second experiment examined how subjects perceived the loudness of sounds at different frequencies to derive equal loudness contours (Finneran and Schlundt 2011a). These data are important because human auditory weighting functions are based on equal loudness contours. The dolphin equal loudness contours provide a means to generate auditory weighting functions in a manner directly analogous to the approach used to develop safe exposure guidelines for people working in noisy environments (NIOSH 1998).

Taken together, the recent higher-frequency TTS data and equal loudness contours provide the underlying data necessary to develop new weighting functions, referred to as Type II auditory weighting functions. Type II auditory weighting functions improve accuracy and avoid underestimating the impacts to animals at higher frequencies as shown in Figure 22. To generate the new Type II weighting functions, Finneran and Schlundt (2011b) substituted lower and upper frequency values which differ from the values used by Southall et al. (2007b).

The new weighting curve predicts appreciably higher (almost 20 dB) susceptibility for frequencies above 3 kHz for bottlenose dolphins, a mid-frequency cetacean. Since data below 3 kHz are not available, the original weighting functions from Southall et al. (2007b) were substituted below this frequency. Low- and high-frequency cetacean weighting functions were extrapolated from the dolphin data as well, because of the suspected similarities of greatest susceptibility at best frequencies of hearing. Similar Type II weighting curves were not developed for pinnipeds since their hearing is markedly different from cetaceans, and because they do not hear as well at higher frequencies. Their weighting curves do not require the same adjustment (see Finneran and Jenkins (2012) for additional details).

The Type II auditory cetacean weighting functions (Figure 22) are applied to the received sound level before comparing it to the appropriate sound exposure level thresholds for TTS or PTS, or the impulse behavioral response threshold. Note that for pinnipeds and sea otters, the Southall et al. (2007) weighting functions (Figure 22) are used in lieu of any new weighting functions. For some criteria, received levels are not weighted before being compared to the thresholds to predict effects. These include the peak pressure criteria for predicting TTS and PTS from underwater explosions, the acoustic impulse metrics used to predict onset-mortality and slight lung injury, and the thresholds used to predict behavioral responses from harbor porpoises and beaked whales from sonar and other active acoustic sources.

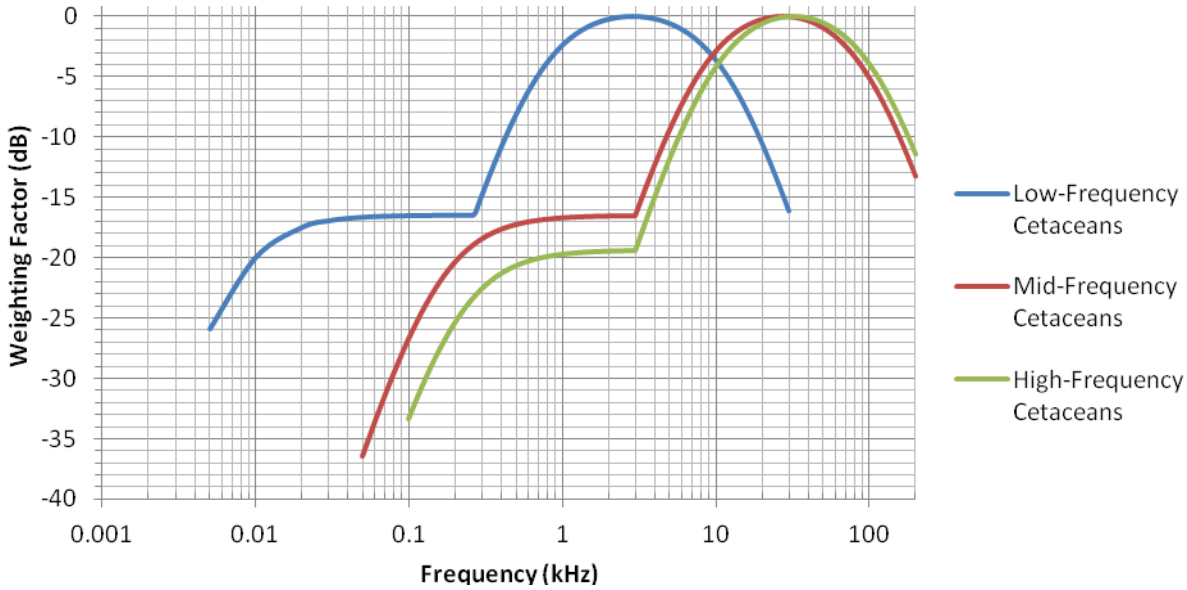

Figure 22. Type II Weighting Functions for Low-, Mid-, and High-Frequency Cetaceans

6.2.14.2 ***Summation of Energy from Multiple Sources***

In most cases, an animal's received level will be the result of exposure to a single sound source. In some scenarios, however, multiple sources will be operating simultaneously, or nearly so, creating the potential for accumulation of energy from multiple sources. Energy is summed for multiple exposures of similar source types. For sonar, including use of multiple systems within any scenario, energy will be summed for all exposures within a cumulative exposure band, with the cumulative exposure bands defined in four bands: 0 to 1.0 kHz (low-frequency sources), 1.1 to 10.0 kHz (mid-frequency sources), 10.1 kHz to 100.0 kHz (high-frequency sources), and above 100.0 kHz (very high-frequency sources). Sources operated at frequencies above 200 kHz are considered to be inaudible to all groups of marine mammals and are not analyzed in the quantitative modeling of exposure levels. After the energy has been summed within each frequency band, the band with the greatest amount of energy is used to evaluate the onset of PTS or TTS. For explosives, including use of multiple explosives in a single scenario, energy is summed across the entire frequency band.

6.2.14.3 ***Hearing Loss – Temporary and Permanent Threshold Shift***

Criteria for physiological effects (Table 35) from sonar and other active acoustic sources are based on TTS and PTS with thresholds based on cumulative sound exposure levels. The onset of TTS or PTS from exposure to impulsive sources is predicted using a sound exposure level-based threshold in conjunction with a peak pressure threshold. The horizontal ranges are then compared, with the threshold producing the longest range being the one used to predict effects. For multiple exposures within any 24-hour period, the received sound exposure level for individual events is accumulated for each animal. Since no studies have been designed to intentionally induce PTS in marine mammals, onset-PTS levels have been estimated using empirical TTS data obtained from marine mammals and relationships between TTS and PTS established in terrestrial mammals.

Temporary and permanent threshold shift thresholds are based on TTS onset values for impulsive and non-impulsive sounds obtained from representative species of mid- and high-frequency cetaceans and pinnipeds. These data are then extended to the other marine mammals for which data are not available. The *Criteria and Thresholds for U.S. Navy Acoustic and Explosive Effects Analysis Technical Report* provides a detailed explanation of the selection of criteria and derivation of thresholds for temporary and permanent hearing loss for marine mammals (Finneran and Jenkins 2012).

Table 35. Acoustic Criteria and Thresholds for Predicting Physiological Effects to Marine Mammals Underwater from Sonar and Other Active Acoustic Sources

Hearing Group	Species	Onset temporary	Onset permanent
Low-Frequency Cetaceans	All mysticetes	178 dB re 1 µPa^2-s SEL (Type II weighting)	198 dB re 1 µPa^2-s SEL (Type II weighting)
Mid-Frequency Cetaceans	Dolphins, beaked whales, and medium and large toothed whales	178 dB re 1 µPa^2-s SEL (Type II weighting)	198 dB re 1 µPa^2-s SEL (Type II weighting)
High-Frequency Cetaceans	Porpoises and *Kogia* spp.	152 dB re 1 µPa^2-s SEL (Type II weighting)	172 dB re 1 µPa^2-s SEL (Type II weighting)
Phocid Seals (underwater)	Northern Elephant & Harbor Seals	183 dB re 1 µPa^2-s SEL (Type I weighting)	197 dB re 1 µPa^2-s SEL (Type I weighting)
Otariidae (underwater)	Sea Lion & Fur Seals	206 dB re 1 µPa^2-s SEL (Type I weighting)	220 dB re 1 µPa^2-s SEL (Type I weighting)
Mustelidae (underwater)	Sea Otters		

Notes: dB = decibels, SEL = Sound Exposure Level, dB re 1 µPa^2-s = decibels referenced to 1 micropascal squared second

6.2.14.3.1 Temporary Threshold Shift – Non-Impulsive Sources

Temporary threshold shift involves no tissue damage, is by definition temporary, and therefore is not considered injury. The onset of TTS in mid-frequency cetaceans exposed to non-impulsive sound are derived from multiple studies (Finneran et al. 2010; Finneran et al. 2005b; Finneran and Schlundt 2010; Mooney 2009; Schlundt et al. 2000) from two species, bottlenose dolphins and beluga whales. Especially notable are data for frequencies above 3 kHz, where bottlenose dolphins have exhibited lower TTS onset thresholds than at 3 kHz (Finneran 2011; Finneran and Schlundt 2010). This difference in TTS onset at higher frequencies is incorporated into the weighting functions.

Lucke et al. (2009) measured TTS in a harbor porpoise exposed to a small seismic air gun and those results are reflected in the current impulsive sound TTS thresholds described below. The beluga whale, which had been the only species for which both impulsive and non-impulsive TTS data exist, has a non-impulsive TTS onset value about 6 dB above the (weighted) impulsive threshold (Finneran et al. 2002; Schlundt et al. 2000). Therefore, 6 dB was added to the harbor porpoise's impulsive TTS threshold demonstrated by Lucke et al. (2009) to derive the non-impulsive TTS threshold used in the current Navy modeling for high frequency cetaceans. The first direct measurements of TTS from non-impulsive sound was presented by Kastelein et al. (2012d) for harbor porpoise. These data are fully consistent with the current harbor porpoise thresholds used in the modeling of effects from non-impulsive sources.

There are no direct measurements of TTS or hearing abilities for low-frequency cetaceans. The Navy uses mid-frequency cetacean thresholds to assess PTS and TTS for low-frequency cetaceans, since mid-frequency cetaceans are the most similar to the low frequency group (see Finneran and Jenkins (2012) on the development of the thresholds and criteria).

Pinniped TTS criteria are based on data provided by Kastak et al. (2005) for representative species of both of the pinniped hearing groups: harbor seals (Phocidae) and California sea lions (Otariidae). Kastak et al. (2005) used octave band noise centered at 2.5 kHz to extrapolate an onset TTS threshold. More recently Kastelein et al. (2012a) used octave band noise centered at 4 kHz to obtain TTS thresholds in the same two species resulting in similar levels causing onset-TTS as those found in Kastak et al. (2005). For sea otters, the otariid TTS threshold and weighting function are applied due to similarities in taxonomy and auditory performance. The appropriate frequency weighting function for each species group is applied when using the sound exposure level-based thresholds to predict TTS.

Table 36 illustrates the ranges to the onset of TTS (i.e., the maximum distances to which TTS would be expected) for one, five, and ten pings from four representative source bins and sonar systems. Due to the lower acoustic thresholds for TTS versus PTS, ranges to TTS are longer; this can also be thought of as a larger volume acoustic footprint for TTS effects. Because the effects threshold is total summed sound energy and because of the longer distances, successive pings can add together, further increasing the range to onset-TTS.

Table 36. Approximate Maximum Ranges to the Onset of Temporary Threshold Shift for Four Representative Sonar Over a Representative Range of Ocean Environments

Functional Hearing Group	Approximate Ranges to the Onset of TTS (meters)											
	Sonar Bin MF1 (e.g., SQS-53; ASW Hull-Mounted Sonar)			Sonar Bin MF4 (e.g., AQS-22; ASW Dipping Sonar)			Sonar Bin MF5 (e.g., SSQ-62; ASW Sonobuoy)			Sonar Bin HF4 (e.g., SQQ-32; MIW Sonar)		
	One Ping	Five Pings	Ten Pings	One Ping	Five Pings	Ten Pings	One Ping	Five Pings	Ten Pings	One Ping	Five Pings	Ten Pings
Low-frequency cetaceans	560-2,280	1,230-6,250	1,620-8,860	220-240	490-1,910	750-2,700	110-120	240-310	340-1,560	100-160	150-730	150-820

Functional Hearing Group	Approximate Ranges to the Onset of TTS (meters)											
	Sonar Bin MF1 (e.g., SQS-53; ASW Hull-Mounted Sonar)			Sonar Bin MF4 (e.g., AQS-22; ASW Dipping Sonar)			Sonar Bin MF5 (e.g., SSQ-62; ASW Sonobuoy)			Sonar Bin HF4 (e.g., SQQ-32; MIW Sonar)		
	One Ping	Five Pings	Ten Pings	One Ping	Five Pings	Ten Pings	One Ping	Five Pings	Ten Pings	One Ping	Five Pings	Ten Pings
Mid-frequency cetaceans	150-180	340-440	510-1,750	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50
High-frequency cetaceans	2,170-7,570	4,050-15,350	5,430-19,500	90	180-190	260-950	< 50	< 50	< 50	< 50	< 50	< 50
Otariid seals, sea lion, & Mustelid (sea otter)	230-570	1,240-1,300	1,760-1,780	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50
Phocid seals & Manatees	70-	200-	350-	< 50	100	150	< 50	< 50	< 50	< 50	< 50	< 50

6.2.14.3.2 Temporary Threshold Shift – Impulsive Sources

The TTS sound exposure level thresholds for cetaceans are consistent with the USS MESA VERDE ship shock trial that was approved by NMFS (73 FR 143) and are more representative of TTS induced from impulses (Finneran et al. 2002) rather than pure tones (Schlundt et al. 2000). In most cases, a total weighted sound exposure level is more conservative than greatest sound exposure level in one-third octave bands, which was used prior to the USS MESA VERDE ship shock trials. There are no data on TTS obtained directly from low-frequency cetaceans, so mid-frequency cetacean impulse threshold criteria from Finneran et al. (2002) have been used. High frequency cetacean TTS thresholds are based on research by Lucke et al. (2009), who exposed harbor porpoises to pulses from a single air gun.

Pinniped criteria were not included for prior ship shock trials, as pinnipeds were not expected to occur at the shock trial sites, and TTS criteria for previous Navy EIS/OEISs did not differentiate between cetaceans and pinnipeds (NMFS 2008b; NMFS 2008d). TTS values for impulse sound criteria have not been obtained for pinnipeds, but there are TTS data for octave band sound from representative species of both major pinniped hearing groups (Kastak et al. 2005). Impulsive sound TTS criteria for pinnipeds were estimated by applying the difference between mid-frequency cetacean TTS onset for impulsive and non-impulsive sounds to the pinniped non-impulsive TTS data (Kastak et al. 2005), a methodology originally developed by Southall et al. (Southall et al. 2007b). Therefore, the TTS criteria for impulsive sounds from explosions for pinnipeds is 6 dB less than the non-impulsive onset-TTS criteria derived from Kastak et al. (2005).

6.2.14.3.3 Permanent Threshold Shift – Non-Impulsive Sources

There are no direct measurements of PTS onset in marine mammals. Well understood relationships between terrestrial mammalian TTS and PTS have been applied to marine mammals. Threshold shifts up to 40 to 50 dB have been induced in terrestrial mammals without

resultant PTS (Miller et al. 1963; Ward et al. 1958; Ward et al. 1959a; Ward et al. 1959b). These data would suggest that a PTS criteria of 40 dB would be reasonable for conservatively predicting (overestimating) PTS in marine mammals. Data from terrestrial mammal testing (Ward et al. 1958; Ward et al. 1959a; Ward et al. 1959b) show growth of TTS by 1.5 to 1.6 dB for every 1 dB increase in exposure level. The difference between measureable TTS onset (6 dB) and the selected 40 dB upper safe limit of TTS yields a difference in TTS of 34 dB which, when divided by a TTS growth function of 1.6 indicates that an increase in exposure of 21 dB would result in 40 dB of TTS. For simplicity and additional conservatism we have rounded that number down to 20 dB (Southall et al. 2007b).

Therefore, exposures to sonar and other active acoustic sources with levels 20 dB above those producing TTS are assumed to produce a PTS. For example, an onset-TTS criteria of 195 dB re 1 μPa^2-s would have a corresponding onset-PTS criteria of 215 dB re 1 μPa^2-s. This extrapolation process is identical to that recently proposed by Southall et al. (Southall et al. 2007b). The method overestimates or predicts greater effects than have actually been observed in tests on a bottlenose dolphin (Finneran and Schlundt 2010; Schlundt et al. 2006) and is therefore protective.

Kastak et al. (2007) obtained different TTS growth rates for pinnipeds than Finneran and colleagues obtained for mid-frequency cetaceans. NMFS recommended reducing the estimated PTS criteria for both groups of pinnipeds, based on the difference in TTS growth rate reported by Kastak et al. (2007) (14 dB instead of 20 dB).

The appropriate frequency weighting function for each species group is applied when using the sound exposure level-based thresholds to predict PTS.

Table 37 lists the ranges to the PTS threshold (i.e., range to the onset of PTS: the maximum distance to which PTS would be expected), relative to the marine mammal's functional hearing group, from three of the most powerful sonar systems. For a SQS-53 sonar transmitting for 1 second at 3 kHz and a representative source level of 235 dB re 1 μPa^2-s at 1 m, the range to PTS for the most sensitive species (the high-frequency cetaceans) extends from the source to a range of 100 m (110 yd.). Since any hull mounted sonar, such as the SQS-53, engaged in anti-submarine warfare training would be moving at 10 to 15 knots (5.1 to 7.7 m/second) and nominally pinging every 50 seconds, the vessel will have traveled a minimum distance of approximately 260 m (280 yd) during the time between those pings (10 knots is the speed used in the Navy Acoustic Effects Model). As a result, there is little overlap of PTS footprints from successive pings, indicating that in most cases, an animal predicted to receive PTS would do so from a single exposure (i.e., one ping). For all other functional hearing groups (low-frequency cetaceans, mid-frequency cetaceans, and phocid seals and manatees) single-ping PTS zones are within 100 m of the sound source. A scenario could occur where an animal does not leave the vicinity of a ship or travels a course parallel to the ship within the PTS zone; however, the distances required make PTS exposure less likely. For a Navy vessel moving at a nominal 10 knots, it is unlikely a marine mammal could maintain the speed to parallel the ship and receive adequate energy over successive pings to suffer PTS. For all sources except hull-mounted sonar

(e.g., SQS-53 and BQQ-10) ranges to PTS are well within 50 m (55 yd), even for multiple pings (up to five pings) and the most sensitive functional hearing group (high-frequency cetaceans).

Table 37. Approximate Ranges to Permanent Threshold Shift Criteria for Each Functional Hearing Group for a Single Ping from Three of the Most Powerful Sonar Systems within Representative Ocean Acoustic Environments

Functional Hearing Group	Ranges to the Onset of PTS for One Ping (meters)		
	Sonar Bin MF1 (e.g., SQS-53; Anti-Submarine Warfare Hull Mounted Sonar)	Sonar Bin MF4 (e.g., AQS-22; Anti-Submarine Warfare Dipping Sonar)	Sonar Bin MF5 (e.g., SSQ-62; Anti-Submarine Warfare Sonobuoy)
Low-Frequency Cetaceans	70	10	<2
Mid-Frequency Cetaceans	10	<2	<2
High-Frequency Cetaceans	100	20	10
Phocid Seals	80	10	<2
Otariid Seals & Sea Lion, & Mustelid (Sea Otter)	10	<2	<2

6.2.14.3.4 Permanent Threshold Shift – Impulsive Sources

Since marine mammal PTS data from impulsive exposures do not exist, onset PTS levels for these animals are estimated by adding 15 dB to the sound exposure level-based TTS threshold and by adding 6 dB to the peak pressure based thresholds. These relationships were derived by Southall et al. (Southall et al. 2007b) from impulsive noise TTS growth rates in chinchillas. The appropriate frequency weighting function for each species group is applied when using the resulting sound exposure level-based thresholds, as shown in Figure 22, to predict PTS.Mortality and Injury from Explosives

There is a considerable body of laboratory data on actual injury for impulse sound, usually from explosive pulses, obtained from tests with a variety of lab animals (mice, rats, dogs, pigs, sheep, and other species). Onset Slight Gastrointestinal (GI) Tract Injury, Onset Slight Lung Injury, and Onset Mortality (a 50 percent lung injury with mortality occurring in 1 percent of those having this injury) represent a series of effects with increasing likelihood of serious injury or lethality. Primary impulse injuries from explosive blasts are the result of differential compression and rapid re-expansion of adjacent tissues of different acoustic properties (e.g., between gas-filled and fluid-filled tissues or between bone and soft tissues). These injuries usually manifest themselves in the gas-containing organs (lung and gut) and auditory structures (e.g., rupture of the eardrum across the gas-filled spaces of the outer and inner ear) (Craig and Hearn 1998) (Craig Jr. 2001a).

Criteria and thresholds for predicting injury and mortality to marine mammals from explosive sources are listed in Table 38. Upper and lower frequency limits of hearing are not applied for

lethal and injurious exposures. These criteria and their origins are explained in greater detail in Finneran and Jenkins (2012), who covered the development of the thresholds and criteria for assessment of impacts.

Table 38. Criteria and Thresholds for Predicting Physiological Effects to Marine Mammals Underwater for Explosives

Group	Species	Onset TTS	Onset PTS	Onset Slight GI Tract Injury	Onset Slight Lung Injury	Onset Mortality
Low-Frequency Cetaceans	Mysticetes	172 dB re 1 μPa^2-s (low-freq weighting) or 224 dB Peak SPL	187 dB re 1 μPa^2-s (low-freq weighting) or 230 dB Peak SPL	237 dB re 1 µPa	Equation 1	Equation 2
Mid-Frequency Cetaceans	Odontocetes (Toothed Whales)	172 dB re 1 μPa^2-s (mid-freq weighting) or 224 dB Peak SPL	187 dB re 1 μPa^2-s (mid-freq weighting) or 230 dB Peak SPL			
High-Frequency Cetaceans	Porpoises and *Kogia* spp.	146 dB re 1 μPa^2-s (mid-freq weighting) or 195 dB Peak SPL	161 dB re 1 μPa^2-s (mid-freq weighting) or 201 dB Peak SPL			
Phocid Seals (In-Water)	Harbor, beared, hooded common, spotted, ringed, harp, ribbon and gray seals	177 dB re 1 μPa^2-s (phocid weighting) or 212 dB Peak SPL	192 dB re 1 μPa^2-s (phocid weighting) or 218 dB Peak SPL			

Equations:

(1) $$= 39.1M^{1/3}\left(1+\frac{D_{Rm}}{10.081}\right)^{1/2} Pa-sec$$

(2) $$= 91.4M^{1/3}\left(1+\frac{D_{Rm}}{10.081}\right)^{1/2} Pa-sec$$

D_m = depth of the receiver (animal) in meters; M = mass of the animals in kg; SPL = sound pressure level

[1] Impulse calculated over a delivery time that is the lesser of the initial positive pressure duration or 20 percent of the natural period of the assumed-spherical lung adjusted for animal size and depth.
Notes: TTS = temporary threshold shift, PTS = permanent threshold shift, GI = gastrointestinal, M = mass of animals in kilograms, DRm = depth of receiver (animal) in meters, SEL = Sound Exposure Level, SPL = Sound Pressure Level (re 1 µPa), dB = decibels, dB re 1 µPa = decibels referenced to 1 micropascal, dB re 1 µPa^2-s = decibels referenced to 1 micropascal squared second

6.2.14.3.5 Onset of gastrointestinal tract injury

Evidence indicates that gas-containing internal organs, such as lungs and intestines, are the principal damage sites from shock waves in submerged terrestrial mammals (Clark and Ward 1943; Greaves et al. 1943; Richmond et al. 1973; Yelverton et al. 1973). Furthermore, slight injury to the gastrointestinal tract may be related to the magnitude of the peak shock wave pressure over the hydrostatic pressure and would be independent of the animal's size and mass (Goertner 1982).

There are instances where injury to the gastrointestinal tract could occur at a greater distance from the source than slight lung injury, especially for animals near the surface. Gastrointestinal tract injury from small test charges (described as "slight contusions") was observed at peak pressure levels as low as 104 pounds per square inch (psi), equivalent to a sound pressure level of 237 dB re 1 µPa (Richmond et al. 1973). This criterion was previously used by the Navy and NMFS for ship shock trials (Finneran and Jenkins (2012); 63 FR 230, 66 FR 87, 73 FR 143).

6.2.14.3.6 Slight lung injury and mortality

The most commonly reported internal bodily injury from impulse energy is hemorrhaging in the fine structure of the lungs. Biological damage is governed by the impulse of the underwater blast (pressure integrated over time), not peak pressure or energy (Richmond et al. 1973; Yelverton and Richmond 1981; Yelverton et al. 1973; Yelverton et al. 1975). Therefore, impulse was used as a metric upon which internal organ injury could be predicted. Species-specific minimal animal masses are used for determining impulse-based thresholds of slight lung injury and mortality. The Criteria and Thresholds for U.S. Navy Acoustic and Explosive Effects Analysis technical report (Finneran and Jenkins 2012) provides a nominal conservative body mass for each species based on newborn weights. In some cases body masses were extrapolated from similar species rather than the listed species. The scaling of lung volume to depth is conducted for all species since data is from experiments with terrestrial animals held near the water's surface.

Because the thresholds for onset of mortality and onset of slight lung injury are proportional to the cube root of body mass, the use of all newborn, or calf, weights rather than representative adult weights results in an over-estimate of effects to animals near an explosion. The range to onset mortality for a newborn compared to an adult animal of the same species can range from

less than twice to over four times as far from an explosion, depending on the differences in calf versus adult sizes for a given species and the size of the explosion. Considering that injurious high pressures due to explosions propagate away from detonations in a roughly spherical manner, the volumes of water in which the threshold for onset mortality may be exceeded are generally less than a fifth for an adult animal versus a calf.

The use of onset mortality and onset slight lung injury is a conservative method to estimate potential mortality and recoverable (non-mortal, non-PTS) injuries, respectively. When analyzing impulse-based effects, all animals within the range to these thresholds are assumed to experience the effect. The onset mortality and onset slight lung injury criteria is based on the impulse at which these effects are predicted for 1 percent of animals; the portion of animals affected would increase closer to the explosion. All animals receive the effect vice a percentage; therefore, these criteria conservatively over-estimate the number of animals that could be killed or injured.

Impulse thresholds for onset mortality and slight injury are indexed to 75 and 93 lb. (34 and 42 kg) for mammals, respectively (Richmond et al. 1973). The regression curves based on these experiments were plotted such that a prediction of mortality to larger animals could be determined as a function of positive impulse and mass (Craig Jr. 2001a). After correction for atmospheric and hydrostatic pressures and based on the cube root scaling of body mass, as used in the Goertner injury model (Goertner 1982), the minimum impulse for predicting onset of extensive (50 percent) lung injury for "1 percent Mortality" (defined as most survivors had moderate blast injuries and should survive on their own) and slight lung injury for "zero percent Mortality" (defined as no mortality, slight blast injuries) (Yelverton and Richmond 1981) were derived for each species. As the mortality threshold, the Navy chose to use the minimum impulse level predictive of 50 percent lung injury, even though this injury is likely to result in mortality to only 1 percent of exposed animals. Because the mortality criteria represents a threshold at which 99 percent of exposed animals would be expected to recover, this analysis overestimates the impact on individuals and populations from exposure to impulse sources.

6.2.14.4 *Behavioral Responses*

The behavioral response criteria are used to estimate the number of animals that may exhibit a behavioral response. In this analysis, animals may be behaviorally harassed in each modeled scenario (using the Navy Acoustic Effects Model) or within each 24-hour period, whichever is shorter. Therefore, the same animal could have a behavioral reaction multiple times over the course of a year.

6.2.14.4.1 Sonar and other active acoustic sources

Potential behavioral effects to marine mammals from non-impulse sound sources underwater were predicted using a behavioral response function. The received sound level is weighted with Type I auditory weighting functions (Southall et al. 2007b) before the behavioral response function is applied. The behavioral response functions estimate the percentage of an exposed population that is likely to exhibit behaviors that would qualify as harassment (as that term is defined by the MMPA applicable to military readiness activities, such as the Navy's testing and training with mid-frequency active sonar) at a given received level of sound. This effects analysis assumes that the potential consequences of exposure to non-impulsive sound on

individual animals would be a function of the received sound pressure level (SPL; dB re 1 µPa). For example, at 165 dB SPL (dB re 1µPa root mean square), the risk (or probability) of harassment is defined according to this function as 50 percent. This means that 50 percent of the individuals exposed at that received level would be predicted to exhibit a significant behavioral response. The behavioral response function applied to mysticetes (Figure 23) differs from that used for odontocetes (Figure 24) in having a shallower slope, which results in the inclusion of more behavioral events at lower amplitudes, consistent with observational data from North Atlantic right whales (Nowacek and Tyack 2007). Although the response functions differ, the intercepts on each figure highlight that each function has a 50 percent probability of harassment at a received level of 165 dB SPL. These analyses assume that sound poses a negligible risk to marine mammals if they are exposed to sound pressure levels below a certain basement value.

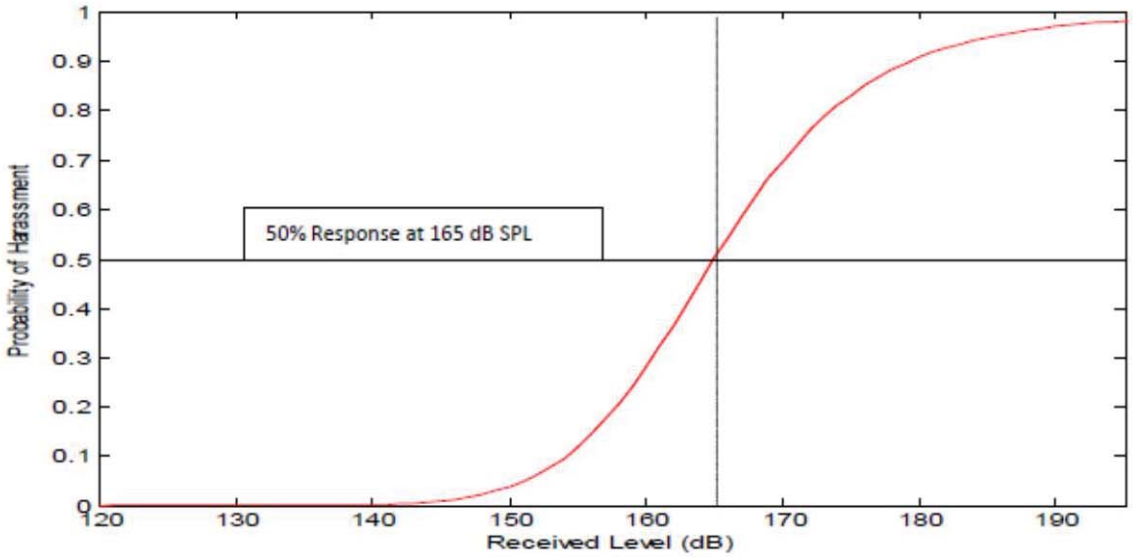

Figure 23. Behavioral response function applied to mysticetes.

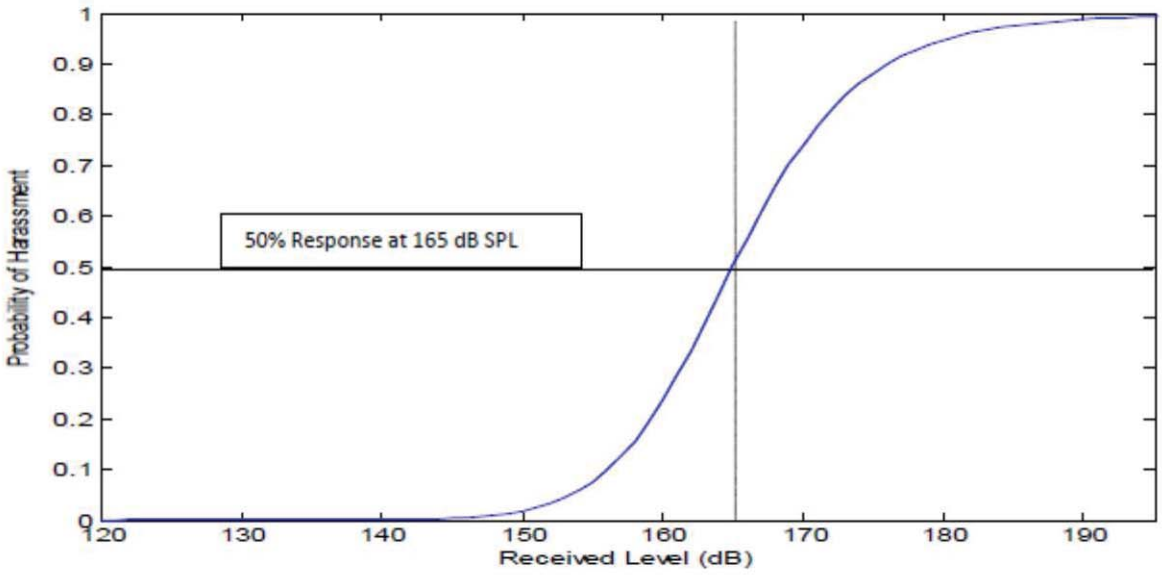

Figure 24. Behavioral response function applied to odontocetes and pinnipeds.

The distances over which the sound pressure level from four representative sonar sources is within the indicated 6-dB bins, and the percentage of animals that may exhibit a significant behavioral response under the mysticete and odontocete behavioral response function, are shown in Table 39 and Table 40 respectively.

Table 39. Range to Received Sound Pressure Level (SPL) in 6-dB Increments and Percentage of Behavioral Harassments for Low-Frequency Cetaceans under the Mysticete Behavioral Response Function for Four Representative Source Bins for the Action Area

Received in 6-dB Increments	Source Bin MF1 (e.g., SQS-53; Anti-Submarine Warfare Hull Mounted Sonar)		Source Bin MF4 (e.g., AQS- 22; Anti-Submarine Warfare Dipping Sonar)		Source Bin MF5 (e.g., SSQ-62; Anti-Submarine Warfare Sonobuoy)		Source Bin HF4 (e.g., SQQ- 32; Mine Integrated Warfare Sonar)	
	Approximate Distance (m)	% from SPL Increment Behavioral Harassment	Approximate Distance (m)	% from SPL Increment Behavioral Harassment	Approximate Distance (m)	% from SPL Increment Behavioral Harassment	Approximate Distance (m)	% from SPL Increment Behavioral Harassment
120 <= SPL <126	172,558 – 162,925	0.00%	40,000 – 40,000	0.00%	23,880 – 17,330	0.00%	3,100 – 2,683	0.00%
126 <= SPL <132	162,925 – 117,783	0.00%	40,000 – 40,000	0.00%	17,330 – 12,255	0.10%	2,683 – 2,150	0.01%
132 <= SPL <138	117,783 – 108,733	0.04%	40,000 – 12,975	3.03%	12,255 – 7,072	4.12%	2,150 – 1,600	0.48%
138 <= SPL <144	108,733 – 77,850	1.57%	12,975 – 12,800	0.14%	7,072 – 3,297	23.69%	1,600 – 1,150	4.20%
144 <= SPL <150	77,850 – 58,400	5.32%	12,800 – 6,525	27.86%	3,297 – 1,113	42.90%	1,150 - 575	24.79%
150 <= SPL <156	58,400 – 53,942	4.70%	6,525 – 2,875	36.83%	1,113 - 255	24.45%	575 - 300	28.10%
156 <= SPL <162	53,942 – 8,733	83.14%	2,875 – 1,088	23.78%	255 - 105	3.52%	300 - 150	24.66%
162 <= SPL <168	8,733 – 4,308	3.51%	1,088 - 205	7.94%	105 - <50	1.08%	150 - 100	9.46%
168 <= SPL <174	4,308 – 1,950	1.31%	205 - 105	0.32%	<50	0.00%	100 - <50	8.30%
174 <= SPL <180	1,950 – 850	0.33%	105 - <50	0.10%	<50	0.00%	<50	0.00%
180 <= SPL <186	850 – 400	0.06%	<50	0.01%	<50	0.13%	<50	0.00%
186 <= SPL <192	400 – 200	0.01%	<50	0.00%	<50	0.00%	<50	0.00%
192 <= SPL <198	200 – 100	0.00%	<50	0.00%	<50	0.00%	<50	0.00%

The range to 120 dB re 1 µPa varies by system, but can exceed 107 miles (172 km) for the most powerful hull mounted sonar; however, only a very small percentage of animals would be predicted to react at received levels between 120 and 130 dB re 1 µPa.

Table 40. Range to Received Sound Pressure Level (SPL) in 6-dB Increments and Percentage of Behavioral Harassments for Mid-Frequency and High Frequency Cetaceans under the Odontocete Response Function for Four Representative Source Bins

Received Level in 6-dB Increments	Source Bin MF1 (e.g., SQS-53; Anti-Submarine Warfare Hull Mounted Sonar)		Source Bin MF4 (e.g., AQS- 22; Anti-Submarine Warfare Dipping Sonar)		Source Bin MF5 (e.g., SSQ-62; Anti-Submarine Warfare Sonobuoy)		Source Bin HF4 (e.g., SQQ- 32; Mine Integrated Warfare Sonar)	
	Approximate Distance (m)	Behavioral Harassment % from SPL Increment	Approximate Distance (m)	Behavioral Harassment % from SPL Increment	Approximate Distance (m)	Behavioral Harassment % from SPL Increment	Approximate Distance (m)	Behavioral Harassment % from SPL Increment
120 <= SPL <126	172,592 – 162,933	0.00%	40,000 – 40,000	0.00%	24,205 – 18,872	0.00%	4,133 – 3,600	0.00%
126 <= SPL <132	162,933 – 124,867	0.00%	40,000 – 40,000	0.00%	18,872 – 12,697	0.10%	3,600 – 3,075	0.00%
132 <= SPL <138	124,867 – 108,742	0.07%	40,000 – 12,975	2.88%	12,697 – 7,605	3.03%	3,075 – 2,525	0.01%
138 <= SPL <144	108,742 – 78,433	1.54%	12,975 – 12,950	0.02%	7,605 – 4,080	17.79%	2,525 – 1,988	0.33%
144 <= SPL <150	78,433 – 58,650	5.41%	12,950 – 6,725	26.73%	4,080 – 1,383	46.83%	1,988 – 1,500	2.83%
150 <= SPL <156	58,650 – 53,950	4.94%	6,725 – 3,038	36.71%	1,383 - 300	27.08%	1,500 – 1,000	14.92%
156 <= SPL <162	53,950 – 8,925	82.62%	3,038 – 1,088	25.65%	300 - 155	3.06%	1,000 - 500	40.11%
162 <= SPL <168	8,925 – 4,375	3.66%	1,088 - 255	7.39%	155 - 55	2.02%	500 - 300	22.18%
168 <= SPL <174	4,375 – 1,992	1.34%	255 - 105	0.52%	55 - <50	0.00%	300 - 150	14.55%
174 <= SPL <180	1,992 – 858	0.34%	105 - <50	0.09%	<50	0.00%	150 - <50	5.07%
180 <= SPL <186	858 – 408	0.06%	<50	0.01%	<50	0.09%	<50	0.00%
186 <= SPL <192	408 – 200	0.01%	<50	0.00%	<50	0.00%	<50	0.00%
192 <= SPL <198	200 – 100	0.00%	<50	0.00%	<50	0.00%	<50	0.00%

6.2.14.4.2 Explosives

The thresholds for a behavioral response from explosives are listed in Table 41. Appropriate weighting values will be applied to the received impulse in one-third octave bands and the energy summed to produce a total weighted SEL value. For impulsive behavioral criteria, the

new weighting functions (Table 41) are applied to the received sound level before being compared to the threshold.

Table 41. Summary of behavioral response thresholds for marine mammals.

Group	Species	Behavioral thresholds for sonar and other active acoustic sources	Behavioral thresholds for explosions
Low-frequency cetaceans	All mysticetes	SPL: BRF (Type I Weighting)	167 dB re 1µPa2 -s SEL (Type II Weighting)
Mid-frequency cetaceans	Dolphins, beaked whales, and medium and large toothed whales	SPL: BRF (Type I Weighting)	167 dB re 1µPa2 -s SEL (Type II Weighting)
High-frequency cetaceans	Porpoises and *Kogia* spp.	SPL: BRF (Type I Weighting)	141 dB re 1µPa2 -s SEL (Type II Weighting)
Phocid seals (underwater)	Hawaiian monk seal	SPL: BRF (Type I Weighting)	172 dB re 1µPa2 -s SEL (Type I Weighting)
Otariid seals (underwater)	Guadalupe fur seal	SPL: BRF (Type I Weighting)	172 dB re 1µPa2 -s SEL (Type I Weighting)

BRF: Behavioral Response Function, SPL: Sound Pressure Level, SEL: Sound Exposure Level

If more than one explosive event occurs within any given 24-hour period within a training or testing activity, criteria are applied to predict the number of animals that may have a behavioral reactions. For events with multiple explosions, the behavioral threshold used in this analysis is 5 dB less than the TTS onset threshold (in SEL). Some multiple explosion events, such as certain gunnery exercises, may be treated as a single impulsive event because a few explosions occur closely spaced within a very short time (a few seconds). For single explosions at received sound levels below hearing loss thresholds, the most likely behavioral response is a brief alerting or orienting response. Since no further sounds follow the initial brief impulse, significant behavioral reactions would not be expected to occur.

Since impulse events can be quite short, it may be possible to accumulate multiple received impulses at sound pressure levels considerably above the energy-based criterion and still not be considered a behavioral take. All individual received impulses were treated as if they were 1 second long for the purposes of calculating cumulative SEL for multiple impulse events. For example, five air gun impulses, each 0.1 second long, received at 178 dB sound pressure level would equal a 175 dB SEL and would not be predicted as leading to a significant behavioral response. However, if the five 0.1 second pulses are treated as a 5-second exposure, it would yield an adjusted value of approximately 180 dB, exceeding the threshold. For impulses associated with explosions that have durations of a few microseconds, this assumption greatly overestimates effects based on SEL metrics such as TTS and PTS and behavioral responses.

6.3 Risk Assessment Framework - Sea Turtles

Direct injury to sea turtles from non-explosive sound sources, such as sonar, is unlikely because of relatively lower peak pressures and slower rise times than potentially injurious sources such as explosions. Nonexplosive sources also lack the strong shock waves that are associated with

explosions. Therefore, primary blast injury and barotrauma would not result from exposure to non-impulsive sources such as sonar, and are only considered for explosive detonations.

The potential for trauma in sea turtles exposed to explosive sources has been inferred from tests of submerged terrestrial mammals exposed to underwater explosions (Ketten et al. 1993; Richmond et al. 1973; Yelverton et al. 1973). The effects of an underwater explosion on a sea turtle depend upon several factors, including size, type, and depth of both the animal and the explosive, depth of the water column, and distance from the charge to the animal. Smaller sea turtles would generally be more susceptible to injury. The compression of blast-sensitive, gas-containing organs when a sea turtle increases depth reduces likelihood of injury to these organs. The location of the explosion in the water column and the underwater environment determines whether most energy is released into the water or the air and influences the propagation of the blast wave.

6.3.1 Primary Blast Injury and Barotrauma

The greatest potential for direct, non-auditory tissue impacts to sea turtles is primary blast injury and barotrauma after exposure to the shock waves of high-amplitude impulsive sources, such as explosions. Primary blast injuries result from the initial compression of a body exposed to the high pressure of a blast or shock wave. Primary blast injury is usually limited to gas-containing structures (e.g., lung and gut) and the pressure-sensitive components of the auditory system (discussed below) (Craig and Hearn 1998; SG 1991), although additional injuries could include concussive brain damage and cranial, skeletal, or shell fractures (Ketten 1995). Barotrauma refers to injuries caused when large pressure changes occur across tissue interfaces, normally at the boundaries of air-filled tissues such as the lungs. Primary blast injury to the respiratory system may be fatal depending on the severity of the trauma. Rupture of the lung may introduce air into the vascular system, producing air blockages that can restrict oxygen delivery to the brain and heart. Although often secondary in life-threatening severity to pulmonary blast trauma, the gastrointestinal tract can also suffer bruising and tearing from blast exposure, particularly in air-containing regions of the tract. Potential traumas include internal bleeding, bowel perforation, tissue tears, and ruptures of the hollow abdominal organs. Although hemorrhage of solid organs (e.g., liver, spleen, and kidney) from blast exposure is possible, rupture of these organs is rarely encountered. Non-lethal injuries could increase a sea turtle's risk of predation, disease, or infection.

6.3.2 Auditory Trauma

Components of the auditory system that detect smaller or more gradual pressure changes can also be damaged when overloaded at high pressures with rapid rise times. Rupture of the tympanic membrane, while not necessarily a serious or life-threatening injury, may lead to permanent hearing loss (Ketten 1993; Ketten 1995). No data exist to correlate the sensitivity of the tympanic membrane and middle and inner ear to trauma from shock waves from underwater explosions (Viada et al. 2008).

The specific impacts of bulk cavitation (the collapse of air spaces created by explosive detonations) on sea turtles are unknown. The presence of a sea turtle within the cavitation region created by the detonation of small charges could annoy, injure, or increase the severity of the injuries caused by the shock wave. The area of cavitation from a large charge, such as those used

in ship shock trials, is expected to result in mortality for smaller animals (Craig and Rye 2008). An animal located at (or near) the cavitation closure depth would be subjected to a short duration ("water hammer") pressure pulse; however, direct shock wave impacts alone would be expected to cause auditory system injuries and could cause internal organ injuries.

6.3.3 Hearing Loss

Hearing loss could effectively reduce the distance over which sea turtles can detect biologically relevant sounds. Both auditory trauma (a direct injury discussed above) and auditory fatigue may result in hearing loss, but the mechanisms responsible for auditory fatigue differ from auditory trauma. Hearing loss due to auditory fatigue is also known as threshold shift, a reduction in hearing sensitivity at certain frequencies. Threshold shift is the difference between hearing thresholds measured before and after an intense, fatiguing sound exposure. Threshold shift occurs when hair cells in the ear fatigue, causing them to become less sensitive over a small range of frequencies related to the sound source to which an animal was exposed. The actual amount of threshold shift depends on the amplitude, duration, frequency, and temporal pattern of the sound exposure. No studies are published on inducing threshold shift in sea turtles; therefore, the potential for the impact on sea turtles is inferred from studies of threshold shift in other animals.

Temporary threshold shift is a hearing loss that recovers to the original hearing threshold over a period. An animal may not even be aware of a TTS. It does not become deaf, but requires a louder sound stimulus (relative to the amount of TTS) to detect a sound within the affected frequencies. Temporary threshold shift may last several minutes to several days, depending on the intensity and duration of the sound exposure that induced the threshold shift (including multiple exposures).

Permanent threshold shift is a permanent hearing loss at a certain frequency range. Permanent threshold shift is non-recoverable due to the destruction of tissues within the auditory system. The animal does not become deaf, but requires a louder sound stimulus (relative to the amount of PTS) to detect a sound within the affected frequencies.

Little is known about how sea turtles use sound in their environment. Based on knowledge of their sensory biology (Bartol and Ketten 2006; Moein Bartol and Musick 2003), sea turtles may be able to detect objects within the water column (e.g., vessels, prey, predators) via some combination of auditory and visual cues. However, research examining the ability of sea turtles to avoid collisions with vessels shows they may rely more on their vision than auditory cues (Hazel et al. 2007). Similarly, while sea turtles may rely on acoustic cues to identify nesting beaches, they appear to rely on other non-acoustic cues for navigation, such as magnetic fields (Lohmann and Lohmann 1996a; Lohmann and Lohmann 1996b) and light (Avens and Lohmann 2003). Additionally, they are not known to produce sounds underwater for communication. As a result, we do not expect instances of TTS and PTS to have fitness consequences for individual turtles.

6.3.4 Auditory Masking

Auditory masking occurs when a sound prevents or limits the distance over which an animal detects other biologically relevant sounds. When a noise has a sound level above the sound of

interest, and in a similar frequency band, auditory masking could occur. Any sound above ambient noise levels and within an animal's hearing range could cause masking. The degree of masking increases with increasing noise levels; a noise that is just-detectable over ambient levels is unlikely to actually cause any substantial masking, whereas a louder noise may mask sounds over a wider frequency range. In addition, a continuous sound would have more potential for masking than a sound with a low duty cycle. In the open ocean, ambient noise levels are between about 60 and 80 dB re 1 µPa (NRC 2003), especially at lower frequencies (below 100 Hz) and inshore, ambient noise levels, especially around busy ports, can exceed 120 dB re 1 µPa.

Unlike hearing loss, which likely results in a stress response, behavioral changes resulting from auditory masking may not be coupled with a stress response. Another important distinction between masking and hearing loss is that masking only occurs in the presence of the sound stimulus, whereas hearing loss can persist after the stimulus is gone.

Little is known about how sea turtles use sound in their environment. Based on knowledge of their sensory biology (Bartol and Ketten 2006; Moein Bartol and Musick 2003), sea turtles may be able to detect objects within the water column (e.g., vessels, prey, predators) via some combination of auditory and visual cues. However, research examining the ability of sea turtles to avoid collisions with vessels shows they may rely more on their vision than auditory cues (Hazel et al. 2007). Similarly, while sea turtles may rely on acoustic cues to identify nesting beaches, they appear to rely on other non-acoustic cues for navigation, such as magnetic fields (Lohmann and Lohmann 1996a; Lohmann and Lohmann 1996b) and light (Avens and Lohmann 2003). Additionally, they are not known to produce sounds underwater for communication. As a result, sound may play a limited role in a sea turtle's environment. Therefore, the potential for masking may be limited.

6.3.5 Physiological Stress

Sea turtles may exhibit a behavioral response or combinations of behavioral responses upon exposure to anthropogenic sounds. If a sound is detected, a stress response (i.e., startle or annoyance) or a cueing response (based on a past stressful experience) can occur. Sea turtles naturally experience stressors within their environment and as part of their life histories. Changing weather and ocean conditions, exposure to diseases and naturally occurring toxins, lack of prey availability, social interactions with members of the same species, nesting, and interactions with predators all contribute to stress. Anthropogenic activities could provide additional stressors above and beyond those that occur in the absence of human activity.

Immature Kemp's ridley sea turtles show physiological responses to the acute stress of capture and handling through increased levels of the stress hormone corticosterone, along with biting and rapid flipper movement (Gregory and Schmid 2001). Though it should be noted that Kemp's ridley sea turtles are not found in the MITT Action Area, we would expect the turtles considered in this Opinion to have a similar physiological stress response. Captive olive ridley hatchlings showed heightened blood glucose levels indicating physiological stress (Zenteno et al. 2008). Repeated exposure to stressors, including human disturbance such as vessel disturbance and anthropogenic sound, may result in negative consequences to the health and viability of an individual or population (Gregory and Schmid 2001). Factors to consider when predicting a stress or cueing response is whether an animal is naïve or has prior experience with a stressor.

Prior experience with a stressor may be of particular importance as repeated experience with a stressor may dull the stress response via acclimation (Hazel et al. 2007).

6.3.6 Behavioral Reactions

Little is known about the hearing ability of sea turtles and their response to acoustic disturbance and thus analogous species for which data are available are used to estimate the potential behavioral reactions to sound. The response of a sea turtle to an anthropogenic sound will depend on the frequency, duration, temporal pattern, and amplitude of the sound, as well as the animal's prior experience with the sound and the context in which the sound is encountered (i.e., what the animal is doing at the time of the exposure). Distance from the sound source and whether it is perceived as approaching or moving away could also affect the way a sea turtle responds. Potential behavioral responses to anthropogenic sound could include startle reactions, disruption of feeding, disruption of migration, changes in respiration, alteration of swim speed, alteration of swim direction, and area avoidance.

It is also possible that behavioral reactions could lead to negative physiological consequences. For example, Garcia-Parraga et al. (2014) reported evidence of decompression sickness (DCS; e.g., gas embolism) in sea turtles following capture in trawls or gillnets, with a higher incidence of DCS when caught in deeper waters. It is possible that a sea turtle could have an extreme behavioral avoidance reaction (e.g., surfacing too quickly in an attempt to avoid noise) that could lead to DCS-like symptoms and fitness consequences. However, it should be noted that this is the first, and to our knowledge, only study that has documented DCS-like symptoms in sea turtles. Previous research has suggested sea turtles are protected against DCS through anatomical, physiological, and behavioral adaptations (Berkson 1967; Castellini 2012; Fossette et al. 2010b; Lutcavage and Lutz 1997; Piantadosi and Thalmann 2004). Given this uncertainty in the available literature and the lack of evidence that this sort of extreme behavioral avoidance reaction would be expected, we do not believe such a reaction is likely to occur and we do not consider DCS in sea turtles further in this Opinion.

6.3.6.1 *Behavioral Reactions to Impulsive Sound Sources*

Studies of sea turtle responses to sounds are limited, though a few studies examined sea turtle reactions to airguns, which produce broadband impulse sound. O'Hara and Wilcox (1990) attempted to create a sound barrier at the end of a canal using seismic airguns. They reported that loggerhead turtles kept in a 984 ft by 148 ft (300 m by 45 m) enclosure in a 10 m deep canal maintained a distance of 98 ft (30 m) from airguns fired every 15 seconds, with the strongest sound components within the 25 Hz to 1,000 Hz frequency range. McCauley et al. (2000) estimated that the received level at which turtles avoided sound in the O'Hara and Wilcox (1990) experiment was 175 to 176 dB re 1 µPa root mean square.

Moein Bartol et al. (1995) investigated the use of air guns to repel juvenile loggerhead sea turtles from hopper dredges. Sound frequencies of the airguns ranged from 100 Hz to 1,000 Hz at three levels: 175, 177, and 179 dB re 1 µPa at 1 m. The turtles avoided the airguns during the initial exposures (mean range of 24 m), but additional trials several days afterward did not elicit statistically significant avoidance. They concluded that this was due to either habituation or a temporary shift in the turtles' hearing capability.

McCauley et al. (2000) exposed caged green and loggerhead sea turtles to an approaching-departing single air gun to gauge behavioral responses. The trials showed that above a received level of 166 dB re 1 µPa root mean square, the turtles noticeably increased their swimming activity compared to non-operational periods, with swimming time increasing as air gun levels increased during approach. Above 175 dB re 1 µPa root mean square, behavior became more erratic, possibly indicating the turtles were in an agitated state (McCauley et al. 2000). The authors noted that the point at which the turtles showed erratic behavior and exhibited possible agitation would be expected to approximately equal the point at which active avoidance would occur for unrestrained turtles (McCauley et al. 2000).

No obvious avoidance reactions by free-ranging sea turtles, such as swimming away, were observed during a multi-month seismic survey using airgun arrays, although fewer sea turtles were observed when the seismic airguns were active than when they were inactive (Weir 2007). The author noted that sea state and the time of day affected both airgun operations and sea turtle surface basking behavior, making it difficult to draw conclusions from the data. Further, DeRuiter and Larbi Doukara (2012) noted diving behavior following airgun shots in loggerhead turtles, and noted a decreased dive probability with increasing distance from the airgun array.

6.3.6.2 *Behavioral Reactions to Non-Impulsive Sources*

No studies have been performed to examine the response of sea turtles to sonar. However, based on the limited range of hearing, they may respond to sources operating below 2 kHz but are unlikely to sense higher frequency sounds.

6.3.6.3 *Behavioral Reactions to Vessels*

Vessel noise and visual stimuli (vessels and shadows) could disturb sea turtles, and potentially elicit a startle response, avoidance, or other behavioral reaction. Sea turtles are frequently exposed to research, ecotourism, commercial, government, and private vessel traffic. Some sea turtles may habituate to vessel noise, and may be more likely to respond to the sight of a vessel rather than the sound of a vessel, although both may play a role in prompting reactions (Hazel et al. 2007).

6.3.6.4 *Behavioral Reactions to Aircraft and Missile Overflight*

Sea turtles may respond to both the physical presence (visual effects of the aircraft and shadows) and to the noise generated by aircraft. Helicopters may produce strong downdrafts, a vertical flow of air that becomes a surface wind, which can also affect an animal's behavior at or near the surface. In most cases, exposure of a sea turtle to fixed-wing or rotary-wing aircraft would last for only seconds as the aircraft quickly passes overhead. Animals would have to be at or near the surface at the time of an overflight to be exposed to appreciable sound levels or visual stimuli.

6.3.7 Repeated Exposures of Sea Turtles

Navy sonar systems are generally deployed from highly mobile vessels or in-water devices which do not directly target sea turtles. The typical duty cycle with most tactical anti-submarine warefare is about once per minute (Navy 2013). For example, a typical Navy vessel with hull mounted MFA sonar would travel over 0.3 kilometers between pings (based on a speed of 10 knots/hr and transmission rate of 1 ping/min). Based on this distance traveled and potential avoidance behavior of acoustically exposed animals, we expect repeat acoustic exposures

capable of eliciting a behavioral response to an individual over a brief period of time to be rare. For sonar devices that are stationary (e.g. dipped sonar), due to the duty cycle, duration of active transmission in a specific location, and mitigation measures (e.g. avoidance of visible sea turtles), we would not expect repeated exposures.

Establishing a causal link between anthropogenic noise and individual impacts as well as population viability is difficult to quantify and assess (McGregor 2013) (Read et al. 2014). Assessing the effects of sounds, both individually and cumulatively, on marine species is difficult because responses depend on a variety of factors incuding age class, prior experience, behavioral state at the time of exposure, and indirect effects. Responses may be also be influenced by other non-sound related factors (Ellison et al. 2011) (Kight and Swaddle 2011) (Goldbogen et al. 2013) (McGregor 2013) (Read et al. 2014) (Williams et al. 2014). Within the ocean environment, aggregate anthropogenic impacts have to be considered in context of natural variation and climate change (Boyd and Hutchins 2012). These contexts can include additive effects from two or more factors, multiplicity where response from two or more factors is greater than the sum of individual effects, synergism between factors and response, antagonism as a negative feedback between factors, acclimation as a short-term individual response, and adaptation as a long-term population change (Boyd and Hutchins 2012). To address aggregate impacts and responses from any changes due to processes such as habituation, tolerance, and sensitization, future experiments over an extended period of time still need further research (Bejder et al. 2009; Blickley et al. 2012) (Read et al. 2014).

Little is known about how sea turtles use sound in their environment. Based on knowledge of their sensory biology (Bartol and Ketten 2006; Moein Bartol and Musick 2003), sea turtles may be able to detect objects within the water column (e.g., vessels, prey, predators) via some combination of auditory and visual cues. However, research examining the ability of sea turtles to avoid collisions with vessels shows they may rely more on their vision than auditory cues (Hazel et al. 2007). Similarly, while sea turtles may rely on acoustic cues to identify nesting beaches, they appear to rely on other non-acoustic cues for navigation, such as magnetic fields (Lohmann and Lohmann 1996a; Lohmann and Lohmann 1996b) and light (Avens and Lohmann 2003). Additionally, they are not known to produce sounds underwater for communication. Therefore, repeated interruptions of a sea turtle's normal activity due to acoustic stressors is unlikely to lead to fitness consequences and long-term implications for the population. To result in significant fitness consequences we would have to assume that an individual turtle detects and responds to the acoustic source, and that it could not compensate for lost feeding opportunities by either immediately feeding at another location, by feeding shortly after cessation of acoustic exposure, or by feeding at a later time. There is no indication this is the case, particularly since foraging habitat would still be available in the environment following the cessation of acoustic exposure.

Sea turtles may habituate to, or become tolerant of, repeated exposures over time, such as ambient noise found in areas of high vessel traffic (Hazel et al. 2007). After initial avoidance reactions, loggerhead sea turtles habituated to repeated experimental exposures to airguns of up to a source level of 179 dB re 1 μPa in an enclosure. The habituation behavior was retained by the sea turtles when exposures were separated by several days (Moein Bartol et al. 1995). Individual sea turtles that are more tolerant may stay in a disturbed area, whereas individuals that

are more sensitive may leave for areas with less human disturbance. Animals that remain throughout the disturbance may be unable to leave the area for a variety of physiological or environmental reasons. However, given the highly migratory and wide ranging life histories of the species considered in this Opinion, we do not believe this will result from Navy training and testing activities in the MITT Action Area.

If sound exposure were to be concentrated in a relatively small geographic area over a long period of time (e.g., days or weeks during major training exercises), it would be possible for individuals confined to a specific area to be exposed to acoustic stressors (e.g., MFA sonar) multiple times during a relatively short time period. We do not expect this to occur as we would expect individuals to move and avoid areas where exposures to acoustic stressors are at higher levels (e.g., greater than 120 dB). Given sea turtles' mobility and large ranges, we would expect these individuals to temporaily select alternative foraging sites nearby until the exposure levels in their initially selected foraging area have decreased. Therefore, even temporary displacement from initially selected foraging habitat is not expected to impact the fitness of any individual animals because we would expect equivalent foraging to be available in close proximity. As a result of being capable of moving outside the range of behavioral responses from acoustic stressors, being physiologically less susceptible to acoustic stressors, and relying on senses other than hearing for important biological behaviors; we do not expect any fitness consequences from any individual animals nor do we expect any population level effects from behavioral responses.

6.3.8 Criteria for Predicting Acoustic and Explosive Impacts – Sea turtles

In this Opinion, we consider two primary categories of sound sources that the U.S. Navy used in its analyses of sound impacts on sea turtles: impulsive sources (e.g., explosives, airguns, weapons firing) and non-impulsive sources (e.g., sonar, pingers, and countermeasure devices). The Navy, in cooperation with NMFS, developed acoustic impacts criteria and thresholds for sea turtle exposures to various sound sources.

6.3.8.1 *Frequency weighting*

Animals generally do not hear equally well across their entire hearing range. Several studies using green, loggerhead, and Kemp's ridley turtles suggest sea turtles are most sensitive to low-frequency sounds, although this sensitivity varies slightly by species and age (Bartol et al. 1999a; Bartol and Ketten 2006; Lenhardt et al. 1994b; Ridgeway et al. 1969). Sea turtles possess an overall hearing range of approximately 100 Hz to 1 kHz, with an upper limit of 2 kHz (Bartol et al. 1999a; Bartol and Ketten 2006; Lenhardt et al. 1994b; Ridgeway et al. 1969). Because hearing thresholds are frequency-dependent, an auditory weighting function was developed for sea turtles (turtle-weighting, or T-weighting). The T-weighting function simply defines lower and upper frequency boundaries beyond which sea turtle hearing sensitivity decreases. The single frequency cutoffs at each end of the frequency range where hearing sensitivity begins to decrease are based on the most liberal interpretations of sea turtle hearing abilities (10 Hz and 2 kHz). These boundaries are precautionary and exceed the demonstrated or anatomy-based hypothetical upper and lower limits of sea turtle hearing. The T-weighting function adjusts the received sound level, based on sensitivity to different frequencies, emphasizing frequencies to which sea turtles are most sensitive and reducing emphasis on frequencies outside of their estimated useful range of hearing. For example, a 160 dB re 1 µPa tone at 10 kHz, far outside sea turtle best range of hearing, is estimated to be perceived by a sea turtle as a 130 dB re 1 µPa

sound (i.e., 30 dB lower). Stated another way, a sound outside of the range of best hearing would have to be more intense to have the same impact as a sound within the range of best hearing.

6.3.8.2 ***Hearing Loss – Temporary and Permanent Threshold Shift***

Whereas TTS represents a temporary reduction of hearing sensitivity, PTS represents tissue damage that does not recover and permanent reduced sensitivity to sounds over specific frequency ranges (see Section 6.3.8.2). To date, no known data are available on potential hearing impairments (i.e., TTS and PTS) in sea turtles. Sea turtles, based on their auditory anatomy (Lenhardt et al. 1985; Moein Bartol and Musick 2003; Wartzok and Ketten 1999; Wever 1978; Wyneken 2001), almost certainly have poorer absolute sensitivity (i.e., higher thresholds) across much of their hearing range than do the mid-frequency cetacean species. Therefore, applying TTS and PTS criteria derived from mid-frequency cetaceans to sea turtles provides a protective approach to estimating acoustic impacts to sea turtles (PTS and TTS data are not available for low-frequency cetaceans). Criteria for hearing loss due to onset of TTS and PTS are based on sound exposure level (for non-impulsive and impulsive sources) and peak pressure (for impulsive sources only).

To determine the sound exposure level, the turtle weighting function is applied to the acoustic exposure to emphasize only those frequencies within a sea turtle's hearing range. Multiple exposures within any 24-hour period are considered one continuous exposure for the purposes of calculating the received sound exposure level for a given individual. This conservatively assumes no recovery of hearing between exposures during a 24-hour period. The weighted sound exposure level is then compared to weighted threshold values for TTS and PTS. If the weighted exposure level meets or exceeds the weighted threshold, then the physiological impact (TTS or PTS) is assumed to occur. For impacts from exposures to impulsive sources, the metric (peak pressure or sound exposure level) and threshold level that results in the longest range to impact is used to predict impacts. Exposures are not calculated for sound sources with a nominal frequency outside the upper and lower frequency hearing limits for sea turtles.

In addition to being discussed below, thresholds for onset of TTS and PTS for impulsive and non-impulsive sounds are summarized in 6.3.8.2.2, 6.3.8.2.1, 6.3.8.2.4, and 6.3.8.2.3, respectively. As described in more detail below, it is critical to note that all turtle PTS and TTS thresholds were set too high. Therefore, quantitative impacts presented herein for PTS and TTS are conservative estimates.

Table 42. Sea Turtle Impact Threshold Criteria for Impulsive Sources

Impulsive Sound Exposure Impact	Threshold Value
Onset Mortality[1] (1% Mortality Based on Extensive Lung Injury)	$= 91.4M^{1/3}\left(1+\frac{D_{Rm}}{10.081}\right)^{1}/_{2}\ Pa-s$
Onset Slight Lung Injury[1]	$= 39.1M^{1/3}\left(1+\frac{D_{Rm}}{10.081}\right)^{1}/_{2}\ Pa-s$
Onset Slight Gastrointestinal Tract Injury	237 dB re 1 µPa SPL (104 psi)
Onset PTS	187 dB re 1 μPa^2 - s SEL (T^2) or 230 dB re 1 µPa Peak SPL
Onset TTS	172 dB re 1 μPa^2 - s SEL (T^2) or 224 dB re 1 µPa Peak SPL
Injury (Airguns)	190 dB re 1 µPa SPL root mean square[3]

dB: decibels, µPa: micropascals, PTS: permanent threshold shift, SEL: sound exposure level, SPL: sound pressure level, TTS: temporary threshold shift

[1] M=Mass of animals (kg) as shown for each species, DRm=depth of animal (m)

[2] (T): Turtle weighting function

[3] The time interval for determining the root mean square that which contains 90 percent of the total energy within the envelope of the pulse. This windowing procedure for impulse signals removes uncertainty about where to set the exact temporal beginning or end of the signal, which may be obscured by ambient noise.

Table 43. Sea Turtle Impact Threshold Criteria Used in Acoustic Modeling for Non-Impulse Sources

Physiological Thresholds	
Onset PTS	**Onset TTS**
198 dB SEL (T)	**178 dB SEL (T)**

dB: decibels; µPa: micropascals; PTS: permanent threshold shift; SEL: sound exposure level; SPL: sound pressure level; TTS: temporary threshold shift; (T): Turtle weighting function

Table 44 shows the average ranges to the potential effect from in-water explosions based on the thresholds for sea turtles. Some of the conservative assumptions made by the Navy for the impact modeling and criteria may cause the impact predictions to be overestimated, as follows:

- Many explosions from ordnance such as bombs and missiles actually explode upon impact with above-water targets. For this analysis, sources such as these were modeled as exploding at depths of 1 m, overestimating the amount of explosive and acoustic energy entering the water.

- For predicting TTS and PTS based on sound exposure level, the duration of an explosion is assumed to be 1 second. Actual detonation durations may be much shorter, so the actual sound exposure level at a particular distance may be lower.

- Mortality and slight lung injury criteria are based on juvenile turtle masses, which substantially increases that range to which these impacts are predicted to occur compared to the ranges that would be predicted using adult turtle masses.

- Animats are assumed to receive the full impulse of the initial positive pressure wave due to an explosion, although the impulse-based thresholds (onset mortality and onset slight lung injury)

Table 44. Range to impacts from In-Water Explosives on Sea Turtles from Representative Sources

Criteria Predicted Impact	Impact Predicted to Occur When Sea Turtle is at this Range (m) or Closer to a Detonation							
	Bin E-1 (0.0-0.5 lb. NEW)	Bin E-3 (0.6-2.6 lb. NEW)	Bin E-4 (2.6-6.0 lb. NEW)	Bin E-5 (6.0-10.0 lb. NEW)	Bin E-8 (21.0-60.0 lb. NEW)	Bin E-10 (251-500 lb. NEW)	Bin E-11 (501-1,000 lb. NEW)	Bin E-12 (1000-1,651 lb. NEW)
Onset Mortality (1% Mortality)	4	26	51	46	102	164	458	199
Onset Slight Lung Injury	17	50	130	85	179	284	816	343
Onset Slight GI Tract Injury	40	60	175	55	106	184	201	250
Permanent Threshold Shift[1]	67	196	215	162	424	873	809	1,251
Temporary Threshold Shift[1]	90	724	421	288	844	1,975	1,693	2,640
Behavioral Response	144	1,512	796	565	1,458	3,217	3,015	3,962

- **[1] Modeling for sound exposure level-based impulse criteria assumed explosive event durations of 1 second. Actual durations may be**
- **less, resulting in smaller ranges to impact.**
- **Notes: (1) lb. = pound(s), m = meters, NEW = net explosive weight; (2) Ranges determined using REFMS, the Navy's explosive**
- **propagation model.**

6.3.8.2.1 Temporary Threshold Shift – Non-impulsive sources

Based on best available science regarding TTS in marine vertebrates (Finneran et al. 2002; Southall et al. 2007c) and the lack of information regarding TTS in sea turtles, the total T-weighted sound exposure level of 178 dB re 1 micro Pascal squared second (µPa2 -s) is used to estimate exposures resulting in TTS for sea turtles. The T-weighting function is used in conjunction with this non-impulsive criterion, which effectively provides an upper cutoff of 2 kHz. The T-weighted non-impulsive TTS threshold of 178 dB re 1 µPa2 -s sound exposure

level was inadvertently based on Type II weighted cetacean TTS data rather than Type I weighted cetacean TTS data. This resulted in incorrectly lowering the turtle TTS threshold by 17 dB. The sea turtle non-impulsive TTS threshold, based on mid-frequency cetacean data, should be 17 dB higher than 178 dB re 1 µPa2 -s. Because an incorrectly lowered threshold was used to quantitatively analyze acoustic impacts on sea turtles, the quantitative impacts presented herein for non-impulsive TTS are conservative (i.e., over-predicted).

6.3.8.2.2 Temporary Threshold Shift – Impulsive sources

Based on best available science regarding TTS in marine vertebrates (Finneran et al. 2005b; Finneran et al. 2000; Finneran et al. 2002; Nachtigall et al. 2003; Nachtigall et al. 2004; Schlundt et al. 2000) and the lack of information regarding TTS in sea turtles, the respective total T-weighted sound exposure level of 172 dB re 1 μPa^2-s or peak pressure of 224 dB re 1 µPa (23 pounds per square inch [psi]) is used to estimate exposures resulting in TTS for sea turtles. The T-weighting function is applied when using the sound exposure level-based thresholds to predict TTS.

The T-weighted impulsive TTS threshold of 172 dB re 1 μPa^2-s sound exposure level was inadvertently based on Type II weighted cetacean TTS data rather than Type I weighted cetacean TTS data. This resulted in incorrectly lowering the turtle TTS threshold. The sea turtle impulsive TTS threshold, based on Type I mid-frequency cetacean data, should be 183 dB re 1 μPa^2-s. Because an incorrectly lowered threshold was used to quantitatively analyze acoustic impacts to sea turtles, the quantitative impacts presented herein for impulsive TTS are conservative (i.e., over-predicted).

6.3.8.2.3 Permanent Threshold Shift – Non-impulsive sources

Since no studies were designed to intentionally induce PTS in sea turtles, levels for onset of PTS for these animals must be estimated using TTS data and relationships between TTS and PTS established in terrestrial mammals. Permanent threshold shift can be estimated based on the growth rate of a threshold shift and the level of threshold shift required to potentially become non-recoverable. A variety of terrestrial and marine mammal data show that threshold shifts up to 40 to 50 dB may be recoverable, and that 40 dB is a reasonable upper limit of a threshold shift that does not induce PTS (Southall et al. 2007b) (Ward et al. 1958; Ward et al. 1959). This analysis assumes that continuous-type exposures producing threshold shifts of 40 dB or more always result in some amount of PTS. Data from terrestrial mammal testing (Ward et al. 1958, 1959) show TTS growth of 1.5 to 1.6 dB for every 1 dB increase in sound exposure level. The difference between minimum measureable TTS onset (6 dB) and the 40 dB upper safe limit of TTS yields a difference of 34 dB. When divided by a TTS growth rate of 1.6 dB TTS per dB sound exposure level, there is an indication that an increase in exposure of a 21.25 dB sound exposure level would result in 40 dB of TTS. For simplicity and conservatism, the number was rounded down to 20 dB sound exposure level. Therefore, non-impulsive exposures of 20 dB sound exposure level above those producing a TTS may be assumed to produce a PTS. The onset of TTS threshold of 195 dB re 1 μPa^2-s for sea turtles has a corresponding onset of PTS threshold of 198 dB re 1 μPa^2-s. The T-weighting function is applied when using the sound exposure level-based thresholds to predict PTS.

The T-weighted non-impulsive TTS threshold of 178 dB re 1 μPa^2-s sound exposure level was inadvertently based on Type II weighted cetacean TTS data rather than Type I weighted cetacean TTS data. This resulted in incorrectly lowering the turtle TTS threshold by 17 dB; consequently, also incorrectly lowering the sea turtle PTS threshold by 17 dB. The sea turtle non-impulsive PTS threshold, based on mid-frequency cetacean data, should be 17 dB higher than 198 dB re 1 μPa^2-s. Because an incorrectly lowered threshold was used to quantitatively analyze acoustic impacts to sea turtles, the quantitative impacts presented herein for non-impulsive PTS are conservative (i.e., overpredicted).

6.3.8.2.4 Permanent Threshold Shift – Impulsive sources

Because marine mammal and sea turtle PTS data from impulsive exposures do not exist, onset of PTS levels for these animals are estimated by adding 15 dB to the sound exposure level-based TTS threshold and adding 6 dB to the peak pressure-based thresholds. These relationships were derived by Southall et al. (Southall et al. 2007b) from impulsive noise TTS growth rates in chinchillas. This results in onset of PTS thresholds of total weighted sound exposure level of 187 dB re 1 μPa^2-s or peak pressure of 230 dB re 1 µPa for sea turtles. The T-weighting function is applied when using the sound exposure level-based thresholds to predict PTS.

The T-weighted impulsive PTS threshold of 187 dB re 1 μPa^2-s sound exposure level was inadvertently based on Type II weighted cetacean TTS data rather than Type I weighted cetacean TTS data. This resulted in incorrectly lowering the turtle TTS threshold. The sea turtle impulsive PTS threshold, based on Type I mid-frequency cetacean data, should be 198 dB re 1 μPa^2-s. Because an incorrectly lowered threshold was used to quantitatively analyze acoustic impacts to sea turtles, the quantitative impacts presented herein for impulsive PTS are conservative (i.e., over-predicted).

6.3.8.3 *Mortality and Injury from Explosions*

There is a considerable body of laboratory data on actual injuries from impulsive sounds, usually from explosive pulses, obtained from tests with a variety of vertebrate species (e.g., (Goertner et al. 1994; Richmond et al. 1973; Yelverton et al. 1973)). Based on these studies, potential impacts, with decreasing likelihood of serious injury or lethality, include onset of mortality, onset of slight lung injury, and onset of slight gastrointestinal injury. In the absence of data specific to sea turtles, criteria developed to assess impacts to protected marine mammals are also used to assess impacts to protected sea turtles. These criteria are discussed below.

6.3.8.3.1 Criteria for Mortality and Slight Lung Injury

In air or submerged, the most commonly reported internal bodily injury to sea turtles from explosive detonations is hemorrhaging in the fine structure of the lungs. The likelihood of internal bodily injury is related to the received impulse of the underwater blast (pressure integrated over time), not peak pressure or energy (Richmond et al. 1973; Yelverton and Richmond 1981; Yelverton et al. 1973; Yelverton et al. 1975). Therefore, impulse is used as a metric upon which internal organ injury can be predicted. Onset mortality and onset slight lung injury are defined as the impulse level that would result in one percent mortality (most survivors have moderate blast injuries and should survive) and zero percent mortality (recoverable, slight blast injuries) in the exposed population, respectively. Criteria for onset mortality and onset

slight lung injury were developed using data from explosive impacts on mammals (Yelverton and Richmond 1981).

The impulse required to cause lung damage is related to the volume of the lungs. The lung volume is related to both the size (mass) of the animal and compression of gas-filled spaces at increasing water depth. Turtles have relatively low lung volume to body mass and a relatively stronger anatomical structure compared to mammals; therefore application of the criteria derived from studies of impacts of explosions on mammals may be conservative. Table 45 provides a conservative body mass for each sea turtle species based on juvenile mass.

Juvenile body mass was selected for analysis given the early rapid growth of these reptiles (newborn turtles weigh less than 0.5 percent of maximum adult body mass). In addition, small turtles tend to remain at shallow depths in the surface pressure release zone, reducing potential exposure to injurious impulses. Therefore, use of hatchling weight would provide unrealistically low thresholds for estimating injury to sea turtles. The use of juvenile body mass rather than adult body mass was chosen to produce reasonably conservative estimates of injury.

Table 45. Species-Specific Sea Turtle Masses for Determining Onset of Extensive and Slight Lung Injury Thresholds

Common Name	Juvenile Mass (kg)	Reference
Loggerhead sea turtle	8.4	Southwood et al. (2007)
Green sea turtle	8.7	Wood and Wood (1993)
Hawksbill sea turtle	7.4	Okuyama et al. (2010)
Olive ridley sea turtle	6.3	McVey and Wibbels (1984) and Caillouet et al. (1986)
Leatherback sea turtle	34.8	Jones (2009)

The scaling of lung volume to depth is conducted because data come from experiments with terrestrial animals held near the water's surface. The calculation of impulse thresholds consider depth of the animal to account for compression of gas-filled spaces that are most sensitive to impulse injury. The impulse required for a specific level of injury (impulse tolerance) is assumed to increase proportionally to the square root of the ratio of the combined atmospheric and hydrostatic pressures at a specific depth with the atmospheric pressure at the (Goertner 1982).

Very little information exists about the impacts of underwater detonations on sea turtles. Impacts of explosive removal operations on sea turtles range from non-injurious impacts (e.g., acoustic annoyance, mild tactile detection, or physical discomfort) to varying levels of injury (i.e., non-lethal and lethal injuries) (Klima et al. 1988; Viada et al. 2008). Often, impacts of explosive events on turtles must be inferred from documented impacts on other vertebrates with lungs or other-gas containing organs, such as mammals and most fishes (Viada et al. 2008). The methods used by Goertner (1982) to develop lung injury criteria for marine mammals may not be directly applicable to sea turtles, as it is not known what degree of protection to internal organs from the shock waves is provided to sea turtles by their shell (Viada et al. 2008). However, the general principles of the Goertner model are applicable, and should provide a protective approach to assessing potential impacts on sea turtles. The Goertner method predicts a minimum primary positive impulse value for onset of slight lung injury and onset of mortality, adjusted for assumed

lung volume (correlated to animal mass) and depth of the animal. These equations are shown in Table 42.

6.3.8.3.2 Criteria for Onset of Gastrointestinal Tract Injury

Without data specific to sea turtles, data from tests with terrestrial animals are used to predict onset of gastrointestinal tract injury. Gas-containing internal organs, such as lungs and intestines, were the principle damage sites from shock waves in submerged terrestrial mammals (Richmond et al. 1973; Yelverton et al. 1973). Furthermore, slight injury to the gastrointestinal tract may be related to the magnitude of the peak shock wave pressure over the hydrostatic pressure, and would be independent of the animal's size and mass (Goertner 1982). Slight contusions to the gastrointestinal tract were reported during small charge tests (Richmond et al. 1973), when the peak was 237 dB re 1 µPa. Therefore, this value is used to predict onset of gastrointestinal tract injury in sea turtles exposed to explosions.

6.3.8.4 *Criteria for Behavioral Reactions*

A sea turtle's behavioral responses to sound are assumed to be variable and context specific. For instance, a single impulse may cause a brief startle reaction. A sea turtle may swim farther away from the sound source, increase swimming speed, change surfacing time, and decrease foraging if the stressor continues to occur. For each potential behavioral change, the magnitude of the change ultimately would determine the severity of the response; most responses would be short-term avoidance reactions.

A few studies reviewed in Section 6.3.6, investigated behavioral responses of sea turtles to impulsive sounds emitted by airguns (McCauley et al. 2000; Moein Bartol et al. 1995; O'Hara and Wilcox 1990). There are no studies of sea turtle behavioral responses to sonar. Cumulatively, available airgun studies indicate that perception and a behavioral reaction to a repeated sound may occur with sound pressure levels greater than 166 dB re 1 µPa root mean square, and that more erratic behavior and avoidance may occur at higher thresholds around 175 to 179 dB re 1 µPa root mean square (McCauley et al. 2000; Moein Bartol et al. 1995; O'Hara and Wilcox 1990). When exposed to impulsive acoustic energy from an airgun above 175 dB re 1 µPa root mean square, sea turtle behavior becomes more erratic, possibly indicating the turtles were in an agitated state (McCauley et al. 2000). A received level of 175 dB re 1 µPa root mean square is more likely to be the point at which avoidance may occur in unrestrained turtles, with a comparable sound exposure level of 160 dB re 1 µPa2 -s (McCauley et al. 2000). Airgun studies used sources that fired repeatedly over some duration. For single impulses at received levels below threshold shift (hearing loss) levels, the most likely behavioral response is assumed to be a startle response. Since no further sounds follow the initial brief impulse, the biological significance is considered to be minimal.

Behavioral responses of sea turtles to airgun exposures in caged enclosures are likely to be different than those from turtles exposed to impulsive acoustic sources from MITT activities in the open environment. Although information regarding the behavioral response of sea turtles to acoustic stressors is generally lacking, McCauley et al. (2000) provides an indication that 175 dB re 1 µPa root mean square is a reasonable threshold criterion in the absence of more rigorous experimental or observational data. The 175 dB re 1 µPa root mean square threshold criterion for behavioral take in sea turtles may change with better available information in the future, but

currently is the best available science. To assess the number of sea turtles expected to behaviorally respond to acoustic stress all turtles exposed to sound equal to, or greater than, 175 dB and less than the criterion for TTS were summed. No attempt to process these exposures or evaluate the effectiveness of mitigation measures was made, suggesting any behavioral take estimates of sea turtles from acoustic stressors are likely overestimates. We are unaware of any sea turtle response studies to non-impulsive acoustic energy; therefore, we used the same criteria as those for impulsive acoustic stressors.

6.4 Risk Assessment Framework – Scalloped Hammerhead Shark

This section is largely based on a technical report prepared for the Navy: Effects of Mid- and High-Frequency Sonars on Fish (Popper 2008b). Additionally, Popper and Hastings (Popper and Hastings 2009a; Popper and Hastings 2009b) provide a critical overview of some of the most recent research regarding potential effects of anthropogenic sound on fish.

Studies of the effects of human-generated sound on fish have been reviewed in numerous places (e.g., (Hastings and Popper 2005; NRC 1994; Popper 2003; Popper 2008a; Popper and Hastings 2009a; Popper and Hastings 2009b; Popper et al. 2004)). Most investigations, however, have been in the gray literature (non-peer-reviewed reports—see (Hastings and Popper 2005; Popper 2008a; Popper and Hastings 2009a) for extensive critical reviews of this material). Studies have been published assessing the effect on fish of short-duration, high-intensity signals such as might be found near high-intensity sonar, pile driving, or seismic air guns. The investigators in such studies examined short-term effects that could result in death to the exposed fish, as well as hearing loss and long-term consequences (Doksaeter et al. 2009; Govoni et al. 2003; McCauley et al. 2003; Popper et al. 2007; Popper et al. 2005). Information is also discussed from a technical report that resulted from a working group established by the Acoustical Society of America on sound exposure guidelines for fishes and sea turtles (Popper et al. 2014).

6.4.1 Direct Injury of Scalloped Hammerhead Sharks from Non-Impulsive Acoustic Stressors

Potential direct injuries from non-impulsive sound sources, such as sonar, are unlikely because of the relatively lower peak pressures and slower rise times than potentially injurious sources such as explosives. Non-impulsive sources also lack the strong shock wave such as that associated with an explosion. The theories of sonar induced acoustic resonance, bubble formation, neurotrauma, and lateral line system injury are discussed below, although these would likely occur only in fish very close to the sound source and are therefore unlikely to impact entire populations of fish or have an impact in a large area.

No studies have indicated any physiological damage to adult fish from mid-frequency active sonar. Kvadsheim and Sevaldsen (2005) showed that intense sonar activities in herring spawning areas affected less than 0.3 percent of the total juvenile stock. Jørgensen et al. (2005) exposed fish larvae and juveniles representing four species (of three families) to sounds that were designed to simulate mid-frequency sonar transmissions (1 to 6.5 kHz) to study the effects of the exposure on the survival, development, and behavior of the larvae and juveniles (the study used larvae and juveniles of Atlantic herring (*Clupea harengus*) Atlantic cod (*Gadus morhua*), saithe (*Pollachius virens),* and spotted wolffish (*Anarhichas minor*)). The researchers placed the fish in plastic bags three meters from the sound source and exposed them to between four and 100

pulses of one-second duration of pure tones at 1.5, 4, and 6.5 kHz. The fish in only two groups out of the 42 tested exhibited adverse effects beyond a behavioral response. These two groups were both composed of herring, a hearing specialist, and were tested with sound pressure levels of 189 dB re 1 µPa, which resulted in a post-exposure mortality of 20 to 30 percent. In the remaining 40 tests, there were no observed effects on behavior, growth (length and weight), or the survival of fish that were kept as long as 34 days post exposure. While statistically significant losses were documented in the two groups impacted, the researchers only tested that particular sound level once, so it is not known if this increased mortality was due to the level of the test signal or to other unknown factors.

Halvorsen et al. (2012) exposed rainbow trout to simulated MFA (2.8 to 3.8 kHz) sonar at received sound pressure levels of 210 dB re 1 uPa, resulting in cumulative sound exposure levels of 220 dB re 1 uPa. The authors did not observe any mortality or hearing sensitivity changes in rainbow trout and suggested that the frequency range of MFA sonar may be above the most sensitive hearing range of the species. Similarly, Kane et al. (2010) found that low-and mid-frequency exposure caused no acute, gross or histopathology, nor any mortality to rainbow trout, *I. punctatus*, or *Lepomis* sp. Popper et al. (2008c; 2007; Popper and Hastings 2009b) investigated the effects of exposing several fish species to the U.S. Navy's SURTASS LFA sonar, focusing on the hearing and on non-auditory tissues. Their study exposed the fish to LFA sonar pulses for time intervals that would be substantially longer than what would occur in nature, but the fish did not experience mortalities or damage to body tissues at the gross or histological level.

Swim bladder resonance is a function of the size and geometry of the air cavity, depth of the fish, and frequency of the transmitted signal. Wavelengths associated with mid-frequency sounds are shorter than wavelengths associated with lower frequency sounds. It is the lower frequencies that are expected to produce swim bladder resonance in adult fishes. Resonance frequencies for juvenile fish are 1 to 8 kHz and can escalate physiological impact (Kvadsheim and Sevaldsen 2005; Lovik and Hovem 1979). Scalloped hammerhead sharks do not have a swim bladder; therefore, they are likely less susceptible to acoustic stressors than many marine fish.

High sound pressure levels may cause bubbles to form from micronuclei in the blood stream or other tissues of animals, possibly causing embolism damage (Ketten 1998). Fish have small capillaries where these bubbles could be caught and lead to the rupturing of the capillaries and internal bleeding. It has also been speculated that this phenomena could also take place in the eyes of fish due to potentially high gas saturation within the fish's eye tissues (Popper and Hastings 2009b) (Popper and Hastings 2009a). As reviewed in Popper and Hastings (Popper and Hastings 2009a), Hastings (Hastings 1990; Hastings 1995) found 'acoustic stunning' (loss of consciousness) in blue gouramis (*Trichogaster trichopterus*) following an 8-minute exposure to a 150 Hz pure tone with a peak sound pressure level (SPL) of 198 dB re 1 µPa. This species of fish has an air bubble in the mouth cavity directly adjacent to the animal's braincase that may have caused this injury. Hastings (Hastings 1990; Hastings 1995) also found that goldfish exposed to two hours of continuous wave sound at 250 Hz with peak pressures of 204 dB re 1 µPa, and fathead minnows exposed to 0.5 hours of 150 Hz continuous wave sound at a peak level of 198 dB re 1 µPa did not survive. The only study on the effect of exposure of the lateral line system to continuous wave sound (conducted on one freshwater species) suggests no effect on these sensory cells by intense pure tone signals (Hastings et al. 1996).

Popper et al. (2014) developed sound exposure guidelines for fishes exposed to low and mid-frequency naval sonar. The authors did not did not provide evidence that injury or mortality could occur from naval sonar, and indicated that if injury or mortality occurs, it is thought to begin at higher sound levels than have been tested to date. The authors concluded that the relative risk of injury or mortality to fish with no swim bladders (e.g., scalloped hammerhead shark) exposed to low and mid-frequency sonar was low, no matter the distance from the source.

6.4.2 Primary Blast Injury and Barotrauma

The greatest potential for direct, non-auditory tissue effects in fish is primary blast injury and barotrauma following exposure to explosions. Primary blast injury refers to those injuries that result from the initial compression of a body exposed to a blast wave. Primary blast injury is usually limited to gas-containing structures (e.g., swim bladder) and the auditory system. Barotrauma refers to injuries caused when the swim bladder or other gas-filled structures vibrate in response to the signal, particularly if there is a relatively sharp rise-time and the walls of the structure strike near-by tissues and damage them. The relative risk of injury or mortality to scalloped hammerhead sharks with no swim bladders exposed to explosions is anticipated to be much lower than fish with swim bladders.

An underwater explosion generates a shock wave that produces a sudden, intense change in local pressure as it passes through the water (DoN 1998; DoN 2001). Pressure waves extend to a greater distance than other forms of energy produced by the explosion (i.e., heat and light) and are therefore the most likely source of negative effects to marine life from underwater explosions (Craig Jr. 2001b; DoN 2006; SIO 2005). The shock wave from an underwater explosion is lethal to fish at close range causing massive organ and tissue damage and internal bleeding (Keevin and Hempen 1997). At greater distance from the detonation point, the extent of mortality or injury depends on a number of factors including fish size, body shape, orientation, and species (Keevin and Hempen 1997; Wright 1982). Additional factors include the current physical condition of the fish and the presence of a swim bladder. Again, scalloped hammerhead sharks do not have swim bladders. At the same distance from the source, larger fish are generally less susceptible to death or injury, elongated forms that are round in cross-section are less at risk than deep-bodied forms, and fish oriented sideways to the blast suffer the greatest impact (Edds-Walton and Finneran 2006; O'Keefe and Young 1984; Wiley et al. 1981; Yelverton et al. 1975). Species with gas-filled organs have higher mortality than those without them (Continental Shelf Associates Inc. 2004; Goertner et al. 1994).

Two aspects of the shock wave appear most responsible for injury and death to fish: the received peak pressure and the time required for the pressure to rise and decay (Dzwilewski and Fenton 2002). Higher peak pressure and abrupt rise and decay times are more likely to cause acute pathological effects (Wright and Hopky 1998). Rapidly oscillating pressure waves might rupture the kidney, liver, spleen, and sinus and cause venous hemorrhaging (Keevin and Hempen 1997). They can also generate bubbles in blood and other tissues, possibly causing embolism damage (Ketten 1998). Oscillating pressure waves might also burst gas-containing organs. The swim bladder, the gas-filled organ used by most bony fish to control buoyancy, is the primary site of damage from explosives (Wright 1982; Yelverton et al. 1975). Gas-filled swim bladders resonate at different frequencies than surrounding tissue and can be torn by rapid oscillation between high- and low-pressure waves. The range over which damage may occur in a fish without a swim

bladder, such as the scalloped hammerhead shark, is on the order of 100 times less than that for swim bladder fish (Popper et al. 2014).

Studies that have documented fish killed during planned underwater explosions indicate that most fish that die do so within one to four hours, and almost all die within a day (Hubbs and Rechnitzer 1952; Yelverton et al. 1975). Fitch and Young (1948) found that the type of fish killed changed when blasting was repeated at the same marine location within 24 hours of previous blasting. They observed that most fish killed on the second day were scavengers, presumably attracted by the victims of the previous day's blasts. However, fishes collected during these types of studies have mostly been recovered floating on the water's surface. Gitschlag et al. (2001) collected both floating fish and those that were sinking or lying on the bottom after explosive removal of nine oil platforms in the northern Gulf of Mexico. They found that 3 to 87 percent (46 percent average) of the specimens killed during a blast might float to the surface. Other impediments to accurately characterizing the magnitude of fish mortality included currents and winds that transported floating fishes out of the sampling area and predation by seabirds or other fishes. Popper et al. (2014) developed sound exposure guidelines for fishes and generally estimated that mortality and mortal injury would occur when the peak sound pressure level from a single explosion exceeds 229 to 234 dB re 1 μPa.

There have been few studies of the impact of underwater explosions on early life stages of fishes (eggs, larvae, juveniles). Fitch and Young (1948) reported the demise of larval anchovies exposed to underwater blasts off California, and Nix and Chapman (1985) found that anchovy and eulachon larvae died following the detonation of buried charges. It has been suggested that impulsive sounds, such as that produced by seismic airguns, may cause damage to the cells of the lateral line in fish larvae and fry when in close proximity (15 ft. [5 m]) to the sound source (Booman et al. 1996). Similar to adult fishes, the presence of a swim bladder contributes to shock wave-induced internal damage in larval and juvenile fishes (Settle et al. 2002). Shock wave trauma to internal organs of larval pinfish and spot from shock waves was documented by Govoni et al. (2003). These were laboratory studies, however, and have not been verified in the field.

Interim criteria for injury of fish were discussed in Stadler and Woodbury (2009). The onset of physical injury would be expected if either the peak sound pressure level exceeds 206 dB re 1 μPa, or the cumulative sound exposure level, accumulated over all pile strikes generally occurring within a single day, exceeds 187 dB re 1 micropascal squared second (μPa^2-s) for fish two grams or larger, or 183 dB re 1 μPa^2-s for smaller fish (Stadler and Woodbury 2009). A more recent study by Halvorsen et al. (2011) used carefully controlled laboratory conditions to determine the level of pile driving sound that may cause a direct injury to the fish tissues (barotrauma). The investigators found that juvenile Chinook salmon (*Oncorhynchus tshawytscha*) received less than a single strike sound exposure level of 179 to 181 dB re 1μ Pa^2-s and cumulative sound exposure level of less than 211 dB re 1 μPa^2-s over the duration of the pile driving activity would sustain no more than mild, non-life-threatening injuries.

6.4.3 Hearing Loss

Exposure to high intensity sound can cause hearing loss, also known as a noise-induced threshold shift, or simply a threshold shift (Miller 1974). A TTS is a temporary, recoverable loss

of hearing sensitivity. A TTS may last several minutes to several weeks and the duration may be related to the intensity of the sound source and the duration of the sound (including multiple exposures). A permanent threshold shift (PTS) is non-recoverable, results from the destruction of tissues within the auditory system, and can occur over a small range of frequencies related to the sound exposure. As with temporary threshold shift, the animal does not become deaf but requires a louder sound stimulus (relative to the amount of PTS) to detect a sound within the affected frequencies; however, in this case, the effect is permanent.

Permanent hearing loss, or permanent threshold shift has not been documented in fish. The sensory hair cells of the inner ear in fish can regenerate after they are damaged, unlike in mammals where sensory hair cells loss is permanent (Lombarte et al. 1993; Smith et al. 2006a). As a consequence, any hearing loss in fish may be as temporary as the timeframe required to repair or replace the sensory cells.

As we discussed in the *Status of Listed Resources*, Scalloped hammerhead sharks have an inner ear capable of detecting high-frequency sounds and a lateral line capable of detecting water motion caused by low frequencies (Hastings and Popper 2005; Popper and Schilt 2009). Data for cartilaginous fish suggest detection of sounds from 20 Hz to 1000 Hz with the highest sensitivity to sounds at the lower ranges (Casper et al. 2003; Casper and Mann 2006; Myrberg Jr. 2001). Sharks generally react to low-frequency tones in this range and are particularly responsive to sounds lower than 375 Hz, which makes them able to perceive sounds including underwater movement and thrashing over long distances.

The “otoliths” or fish ear bones in teleosts (ray-finned, bony fishes) are generally composed of a solid calcium carbonate matrix, while elasmobranch ear structures are calcium carbonate, with exogenous siliceous material, in a gelatinous matrix. It has been suggested that ears with otoliths of a higher density are more sensitive to accelerations (Lychakov and Rebane 2005). Therefore, the solid, dense otoliths of ray-finned fishes should result in a more sensitive ear than the less dense, gelatinous otoliths of sharks including scalloped hammerhead sharks.

Sound is composed of two major components, the propagating sound pressure wave and particle motion. All fishes detect particle motion with their inner ear otoliths (otoconia in elasmobranchs) which act as accelerometers (Casper and Mann 2006). Sound pressure, however, can only be detected by fishes which have a pressure-to-displacement transducer, usually the swim bladder in some teleost fishes (Casper and Mann 2006). Some fishes have evolved a specialized connection between the swim bladder and the inner ear which can transmit the sound pressure signal being detected by the bladder. In the case of the otophysans such as goldfish, modified vertebrae known as the Weberian ossicles have evolved for this function. Scalloped hammerhead sharks (an elasmobranch) and other fishes without swimbladders or any other kind of hearing specialization can only detect the particle motion component of sound (Casper and Mann 2006).

6.4.3.1 Non-impulsive Sound Sources

Studies of the effects of long-duration sounds with sound pressure levels below 170 to 180 dB re 1 µPa indicate that there is little to no effect of long-term exposure on species such as the scalloped hammerhead shark that lack notable anatomical hearing specialization (Amoser and Ladich 2003; Scholik and Yan 2001; Smith et al. 2004a; Smith et al. 2004b; Wysocki et al.

2007). The longest of these studies exposed young rainbow trout (*Onorhynchus mykiss*), to a level of noise equivalent to one that fish would experience in an aquaculture facility (e.g., on the order of 150 dB re 1 µPa) for about 9 months. The investigators found no effect on hearing (i.e., TTS) as compared to fish raised at 110 dB re 1 µPa.

In contrast, studies on fish with hearing specializations (i.e., greater sensitivity to lower sound pressures and higher frequencies) have shown that there is some hearing loss after several days or weeks of exposure to increased background sounds, although the hearing loss seems to recover (e.g., (Scholik and Yan 2002; Smith et al. 2006a; Smith et al. 2004b)). Smith et al. (Smith et al. 2006a; Smith et al. 2004b) exposed goldfish to noise at 170 dB re 1 µPa and found a clear relationship between the amount of hearing loss (TTS) and the duration of exposure until maximum hearing loss occurred after 24 hours of exposure. A 10-minute exposure resulted in a 5 dB TTS, whereas a 3-week exposure resulted in a 28 dB TTS that took over 2 weeks to return to pre-exposure baseline levels (Smith et al. 2004b) (Note: recovery time not measured by investigators for shorter exposure durations).

Similarly, Wysocki and Ladich (2005) investigated the influence of noise exposure on the auditory sensitivity of two freshwater fish with notable hearing specializations, the goldfish and the lined Raphael catfish (*Platydoras costatus*), and on a freshwater fish without notable specializations, the pumpkinseed sunfish (*Lepomis gibbosus*). Baseline thresholds showed greatest hearing sensitivity around 0.5 kHz in the goldfish and catfish and at 0.1 kHz in the sunfish. For the goldfish and catfish, continuous white noise of approximately 130 dB re 1 µPa at 1 m resulted in a significant TTS of 23 to 44 dB. In contrast, the auditory thresholds in the sunfish declined by 7 to 11 dB. The duration of exposure and time to recovery was not addressed in this study. Scholik and Yan (2001) demonstrated TTS in fathead minnows *(Pimephales promelas*) after a 24-hour exposure to white noise (0.3 to 2.0 kHz) at 142 dB re 1 µPa that did not recover as long as 14 days post-exposure.

Studies have also examined the effects of the sound exposures from Surveillance Towed Array Sensor System Low-Frequency Active sonar on fish hearing (Kane et al. 2010; Popper et al. 2007). Hearing was measured both immediately post exposure and for several days thereafter. Maximum received sound pressure levels were 193 dB re 1 µPa for 324 or 628 seconds. Catfish and some specimens of rainbow trout showed 10 to 20 dB of hearing loss immediately after exposure to the low-frequency active sonar when compared to baseline and control animals; however, another group of rainbow trout showed no hearing loss. Recovery in trout took at least 48 hours, but studies were not completed. The different results between rainbow trout groups is difficult to understand, but may be due to developmental or genetic differences in the various groups of fish. Catfish hearing returned to, or close to, normal within about 24 hours after exposure to low-frequency active sonar. Furthermore, examination of the inner ears of the fish during necropsy (note: maximum time fish were held post exposure before sacrifice was 96 hours) revealed no differences from the control groups in cilliary bundles or other features indicative of hearing loss (Kane et al. 2010).

The study of mid-frequency active sonar by the same investigators also examined potential effects on fish hearing and the inner ear (Halvorsen et al. 2012; Kane et al. 2010). Out of the four species tested (rainbow trout, channel catfish, largemouth bass, and yellow perch) only one

group of channel catfish, tested in December, showed any hearing loss after exposure to mid-frequency active sonar. The signal consisted of a 2 second (s) long, 2.8 kHz to 3.8 kHz frequency sweep followed by a 3.3 kHz tone of 1 s duration.

The stimulus was repeated five times with a 25 second interval. The maximum received sound pressure level was 210 dB re 1 µPa. These animals, which have the widest hearing range of any of the species tested, experienced approximately 10 dB of threshold shift that recovered within 24 hours. Channel catfish tested in October did not show any hearing loss. The investigators speculated that the difference in hearing loss between catfish groups might have been due to the difference in water temperature of the lake where all of the testing took place (Seneca Lake, New York) between October and December.

Alternatively, the observed hearing loss differences between the two catfish groups might have been due to differences between the two stocks of fish (Halvorsen et al. 2012). Any effects on hearing in channel catfish due to sound exposure appear to be (Halvorsen et al. 2012; Kane et al. 2010). Investigators observed no damage to cilliary bundles or other features indicative of hearing loss in any of the other fish tested including the catfish tested in October (Kane et al. 2010). Some studies have suggested that there may be some loss of sensory hair cells due to high intensity sources; however, none of these studies concurrently investigated effects on hearing. Enger (1981) found loss of cilliary bundles of the sensory cells in the inner ears of Atlantic cod following 1 to 5 hours of exposure to pure tone sounds between 50 and 400 Hz with a sound pressure level of 180 dB re 1 µPa.

Hastings (1995) found auditory hair-cell damage in a species with notable anatomical hearing specializations, the goldfish (*Carassius auratus*) exposed to 250 Hz and 500 Hz continuous tones with maximum peak levels of 204 dB re 1 µPa and 197 dB re 1 µPa, respectively, for about 2 hours. Similarly, Hastings et al. (1996) demonstrated damage to some sensory hair cells in oscars (*Astronotus ocellatus*) following a 1-hour exposure to a pure tone at 300 Hz with a peak pressure level of 180 dB re 1 µPa. In none of the studies was the hair cell loss more than a relatively small percent (less than a maximum of 15 percent) of the total sensory hair cells in the hearing organs.

In his sounds exposure guidelines for fishes, Popper et al. (2014) estimate exposure to low frequency sonar > 193 dB_{rms} re 1 µPa may lead to TTS in bony fish. The authors were not able to estimate a sound exposure level for mid-frequency sonar at which they would expect TTS. As discussed above, studies of the effects of long-duration sounds with sound pressure levels below 170 to 180 dB re 1 µPa indicate that there is little to no effect of long-term exposure on species such as the scalloped hammerhead shark that lack notable anatomical hearing specialization.

6.4.3.2 Explosions and Other Impulsive Sound Sources

Popper et al. (2005) examined the effects of a seismic airgun array on a fish with hearing specializations, the lake chub (*Couesius plumbeus*), and two species that lack notable specializations, the northern pike (*Esox lucius*) and the broad whitefish (*Coregonus nasus*) (a salmonid). In this study the average received exposure levels were a mean peak pressure level of 207 dB re 1 µPa; sound pressure level of 197 dB re 1 µPa; and single-shot sound exposure level of 177 dB re 1 µPa2-s. The results showed temporary hearing loss for both lake chub and northern pike to both 5 and 20 airgun shots, but not for the broad whitefish. Hearing loss was

approximately 20 to 25 dB at some frequencies for both the northern pike and lake chub, and full recovery of hearing took place within 18 hours after sound exposure. Examination of the sensory surfaces of the ears by an expert on fish inner ear structure showed no damage to sensory hair cells in any of the fish from these exposures (Song et al. 2008).

McCauley et al. (2003) showed loss of a small percent of sensory hair cells in the inner ear of the pink snapper (*Pagrus auratus*) exposed to a moving airgun array for 1.5 hours. Maximum received levels exceeded 180 dB re 1 μPa2-s for a few shots. The loss of sensory hair cells continued to increase for up to at least 58 days post exposure to 2.7 percent of the total cells. It is not known if this hair cell loss would result in hearing loss since fish have tens or even hundreds of thousands of sensory hair cells in the inner ear (Lombarte and Popper 1994; Popper and Hoxter 1984) and only a small portion were affected by the sound. The question remains as to why McCauley et al. (2003) found damage to sensory hair cells while Popper et al. (2005) did not. There are many differences between the studies, including species, precise sound source, and spectrum of the sound that it is hard to speculate.

Hastings et al. (2008) exposed the pinecone soldierfish (*Myripristis murdjan*), a fish with anatomical specializations to enhance their hearing; and three species without notable specializations: the blue green damselfish (*Chromis viridis*), the saber squirrelfish (*Sargocentron spiniferum*), and the bluestripe seaperch (*Lutjanus kasmira*) to an airgun array. Fish in cages in 16 ft. (4.9 m) of water were exposed to multiple airgun shots with a cumulative sound exposure level of 190 dB re 1 μPa2-s. The authors found no hearing loss in any fish following exposures.

In his sound exposure guidelines for fishes, Popper et al. (2014) was not able to develop specific criteria (i.e., sound pressure levels that would result in an impact) for sound exposure from explosions that would lead to PTS, TTS, or behavioral responses. However, the authors did indicate that that individuals realtively close to the source would have a higher relative risk of being impacted than individuals further away.

6.4.4 Auditory Masking

Auditory masking refers to the presence of a noise that interferes with a fish's ability to hear biologically relevant sounds. Fish use sounds to detect predators and prey, and for schooling, mating, and navigating, among other uses (Myrberg Jr. 1980; Popper et al. 2003). Masking of sounds associated with these behaviors could have impacts to fish by reducing their ability to perform these biological functions.

Any noise (i.e., unwanted or irrelevant sound, often of an anthropogenic nature) detectable by a fish can prevent the fish from hearing biologically important sounds including those produced by prey or predators (Myrberg Jr. 1980; Popper et al. 2003). Auditory masking may take place whenever the noise level heard by a fish exceeds ambient noise levels, the animal's hearing threshold, and the level of a biologically relevant sound. Masking is found among all vertebrate groups, and the auditory system in all vertebrates, including fish, is capable of limiting the effects of masking noise, especially when the frequency range of the noise and biologically relevant signal differ (Fay 1988; Fay and Simmons 1999).

The frequency of the sound is an important consideration for fish because many marine fish are limited to detection of the particle motion component of low frequency sounds at relatively high sound intensities (Amoser and Ladich 2005). The frequency of the acoustic stimuli must first be compared to the animal's known or suspected hearing sensitivity to establish if the animal can potentially detect the sound.

One of the problems with existing fish auditory masking data is that the bulk of the studies have been done with goldfish, a freshwater fish with well-developed anatomical specializations that enhance hearing abilities. The data on other species are much less extensive. As a result, less is known about masking in marine species, many of which lack the notable anatomical hearing specializations. However, Wysocki and Ladich (2005) suggest that ambient sound regimes may limit acoustic communication and orientation, especially in animals with notable hearing specializations.

Tavolga studied the effects of noise on pure-tone detection in two species without notable anatomical hearing specializations, the pin fish (Lagodon rhomboids) and the African mouth-breeder (Tilapia macrocephala), and found that the masking effect was generally a linear function of masking level, independent of frequency (Tavolga 1974a; Tavolga 1974b). In addition, Buerkle studied five frequency bandwidths for Atlantic cod in the 20 to 340 Hz region and showed masking across all hearing ranges (Buerkle 1968; Buerkle 1969). Chapman and Hawkins (1973) found that ambient noise at higher sea states in the ocean has masking effects in cod, *Gadus morhua* (L.), haddock, *Melanogrammus aeglefinus* (L.), and pollock, *Pollochinus pollachinus* (L.), and similar results were suggested for several sciaenid species by Ramcharitar and Popper (2004). Thus, based on limited data, it appears that for fish, as for mammals, masking may be most problematic in the frequency region near the signal. There have been a few field studies that may suggest masking could have an impact on wild fish.

Gannon et al. (2005) showed that bottlenose dolphins (*Tursiops truncatus*) move toward acoustic playbacks of the vocalization of Gulf toadfish (*Opsanus beta*). Bottlenose dolphins employ a variety of vocalizations during social communication including low-frequency pops. Toadfish may be able to best detect the low-frequency pops since their hearing is best below 1 kHz, and there is some indication that toadfish have reduced levels of calling when bottlenose dolphins approach (Remage-Healey et al. 2006). Silver perch have also been shown to decrease calls when exposed to playbacks of dolphin whistles mixed with other biological sounds (Luczkovich et al. 2000). Results of the Luczkovich et al. (2000) study, however, must be viewed with caution because it is not clear what sound may have elicited the silver perch response (Ramcharitar et al. 2006). Astrup (1999) and Mann et al. (1998) hypothesized that high frequency detecting species (e.g., clupeids) may have developed sensitivity to high frequency sounds to avoid predation by odontocetes. Therefore, the presence of masking noise may hinder a fish's ability to detect predators and therefore increase predation.

Of considerable concern is that human-generated sounds could mask the ability of fish to use communication sounds, especially when the fish are communicating over some distance. In effect, the masking sound may limit the distance over which fish can communicate, thereby having an impact on important components of their behavior. For example, the sciaenids, which are primarily inshore species, are one of the most active sound producers among fish, and the

sounds produced by males are used to "call" females to breeding sights (Ramcharitar et al. 2001) reviewed in Ramcharitar et al. (2006). If the females are not able to hear the reproductive sounds of the males, there could be a significant impact on the reproductive success of a population of sciaenids. Since most sound production in fish used for communication is generally below 500 Hz (Slabbekoorn et al. 2010), sources with significant low-frequency acoustic energy could affect communication in fish.

Also potentially vulnerable to masking is navigation by larval fish, although the data to support such an idea are still exceedingly limited. There is indication that larvae of some reef fish (species not identified in study) may have the potential to navigate to juvenile and adult habitat by listening for sounds emitted from a reef (either due to animal sounds or non-biological sources such as surf action)(e.g., (Higgs 2005)).

In a study of an Australian reef system, the sound signature emitted from fish choruses was between 0.8 and 1.6 kHz (Cato 1978) and could be detected by hydrophones 3 to 4 nm from the reef (McCauley and Cato 2000). This bandwidth is within the detectable bandwidth of adults and larvae of the few species of reef fish, such as the damselfish, *Pomacentrus partitus*, and bicolor damselfish, *Eupomacentrus partitus*, that have been studied (Kenyon 1996; Myrberg Jr. 1980). At the same time, it has not been demonstrated conclusively that sound, or sound alone, is an attractant of larval fish to a reef, and the number of species tested has been very limited. Moreover, there is also evidence that larval fish may be using other kinds of sensory cues, such as chemical signals, instead of, or alongside of, sound (Atema et al. 2002).

Popper et al. (2014) evaluated the potential for masking in fishes and concluded there is no reason to expect masking from explosions because while the detection of biologically important sounds would be reduced, this effect would only occur during the brief duration of the sound. The authors did not find any data on masking by sonar in fishes, but concluded that if it were to occur, it would only occur during the sonar transmissions and would result in a narrow range of frequencies being masked (Popper et al. 2014).

6.4.5 Physiological Stress

As with masking, a fish must first be able to detect a sound above its hearing threshold for that particular frequency and the ambient noise before a behavioral reaction or physiological stress can occur.

Stress refers to biochemical and physiological responses to increases in background sound. The initial response to an acute stimulus is a rapid release of stress hormones into the circulatory system, which may cause other responses such as elevated heart rate and blood chemistry changes. Although an increase in background sound has been shown to cause stress in humans, only a limited number of studies have measured biochemical responses by fish to acoustic stress (Remage-Healey et al. 2006; Smith et al. 2004; Wysocki et al. 2007) (Wysocki et al. 2006) and the results have varied. There is evidence that a sudden increase in sound pressure level or an increase in background noise levels can increase stress levels in fish (Popper and Hastings 2009a, 2009b). Exposure to acoustic energy has been shown to cause a change in hormone levels (physiological stress) and altered behavior in some species such as the goldfish *(Carassius*

auratus) (Pickering 1981; Smith et al. 2004a, b), but not all species tested to date, such as the rainbow trout *(Oncorhynchus mykiss*) (Wysocki et al. 2007).

Remage-Healey et al. (2006) found elevated cortisol levels, a stress hormone, in Gulf toadfish exposed to low frequency bottlenose dolphin sounds. Additionally, the toadfish' call rates dropped by about 50 percent, presumably because the calls of the toadfish, a primary prey for bottlenose dolphins, give away the fish's location to the dolphin. The researchers observed none of these effects in toadfish exposed to an ambient control sound (i.e., low-frequency snapping shrimp 'pops').

Smith et al. (2004b) found no increase in corticosteroid, a stress hormone, in goldfish exposed to a continuous, band-limited noise (0.1 to 10 kHz) with a sound pressure level of 170 dB re 1 µPa for 1 month. Wysocki et al. (2007) exposed rainbow trout to continuous band-limited noise with a sound pressure level of about 150 dB re 1 µPa for 9 months with no observed stress effects. Growth rates and effects on the trout's immune system were not significantly different from control animals held at sound pressure level of 110 dB re 1 µPa.

6.4.6 Behavioral Reactions

There are little data available on the behavioral reactions of fish, and almost no research conducted on any long-term behavioral effects or the potential cumulative effects from repeated exposures to loud sounds (Popper and Hastings 2009a, 2009b). Behavioral effects to fish could include disruption or alteration of natural activities such as swimming, schooling, feeding, breeding, and migrating. Sudden changes in sound level can cause fish to dive, rise, or change swimming direction. There is a lack of studies that have investigated the behavioral reactions of unrestrained fish to anthropogenic sound, especially in the natural environment. Studies of caged fish have identified three basic behavioral reactions to sound: startle, alarm, and avoidance (McCauley et al. 2000; Pearson et al. 1992). Changes in sound intensity may be more important to a fish's behavior than the maximum sound level. Sounds that fluctuate in level tend to elicit stronger responses from fish than even stronger sounds with a continuous level (Schwartz 1985).

6.4.6.1 Non-impulsive Sound Sources

Gearin et al. (2000) studied responses of adult sockeye salmon (*Oncorhynchus nerka*) and sturgeon (*Acipenser* sp.) to pinger sounds produced by acoustic devices designed to deter marine mammals from gillnet fisheries. The pingers produced sounds with broadband energy with peaks at 2 kHz or 20 kHz. They found that fish did not exhibit any reaction or behavior change to the pingers, which demonstrated that the alarm was either inaudible to the salmon and sturgeon, or that neither species was disturbed by the mid-frequency sound (Gearin et al. 2000). Based on hearing threshold data, it is highly likely that the salmonids did not hear the sounds.

Culik et al. (2001) did a very limited number of experiments to determine the catch rate of herring in the presence of pingers producing sounds that overlapped with the frequency range of hearing for herring (2.7 kHz to over 160 kHz). They found no change in catch rates in gill nets with or without the higher frequency (greater than 20 kHz) sounds present, although there was an increase in the catch rate with the signals from 2.7 kHz to 19 kHz (a different source than the higher frequency source). The results could mean that the fish did not "pay attention" to the higher frequency sound or that they did not hear it, but that lower frequency sounds may be

attractive to fish. At the same time, it should be noted that there were no behavioral observations on the fish, and so how the fish actually responded when they detected the sound is not known.

Doksaeter et al. (2009) studied the reactions of wild, overwintering herring to Royal Netherlands Navy experimental mid-frequency active sonar and killer whale feeding sounds. The behavior of the fish was monitored using upward looking echosounders. The received levels from the 1 to2 kHz and 6 to 7 kHz sonar signals ranged from 127 to 197 dB re 1 µPa and 139 to 209 dB re 1 µPa, respectively. Escape reactions were not observed upon the presentation of the mid-frequency active sonar signals; however, the playback of the killer whale sounds elicited an avoidance reaction. The authors concluded that mid-frequency sonar could be used in areas of overwintering herring without substantially affecting the fish.

There is evidence that elasmobranchs respond to human-generated sounds. Myrberg and colleagues did experiments in which they played back sounds and attracted a number of different shark species to the sound source (Myrberg et al. 1969; Myrberg et al. 1976; Myrberg et al. 1972; Nelson and Johnson 1972). The results of these studies showed that sharks were attracted to low-frequency sounds (below several hundred Hz), in the same frequency range of sounds that might be produced by struggling prey.

However, sharks are not known to be attracted by continuous signals or higher frequencies (which they presumably cannot hear). Studies documenting behavioral responses of fish to vessels show that Barents Sea capelin (*Mallotus villosus*) may exhibit avoidance responses to engine noise, sonar, depth finders, and fish finders (Jørgensen et al. 2004). Avoidance reactions are quite variable depending on the type of fish, its life history stage, behavior, time of day, and the sound propagation characteristics of the water (Schwartz 1985). Misund (1997) found that fish ahead of a ship that showed avoidance reactions did so at ranges of 160 to 490 ft. (48.8 to 149.4 m). When the vessel passed over them, some species of fish responded with sudden escape responses that included lateral avoidance or downward compression of the school.

In a study by Chapman and Hawkins (1973) the low-frequency sounds of large vessels or accelerating small vessels caused avoidance responses by herring. Avoidance ended within 10 seconds after the vessel departed. Twenty-five percent of the fish groups habituated to the sound of the large vessel and 75 percent of the responsive fish groups habituated to the sound of small boats.

Popper et al. (2014) concluded that the relative risk of a fish illiciting a behavioral reaction in response to low-frequency sonar was low, regardless of the distance from the sound source. The authors expected a limited number of species may respond to mid-frequency sonar since most fish do not have specializations that enable them to hear above 2,500 Hz (Popper et al. 2014, Halvorsen et al 2012).

6.4.6.2 Explosions and Other Impulsive Sound Sources

Pearson et al. (1992) exposed several species of rockfish (*Sebastes spp.*) to a seismic airgun. The investigators placed the rockfish in field enclosures and observed the fish's behavior while firing the airgun at various distances for 10 minute trials. Dependent upon the species, rockfish exhibited startle or alarm reactions between peak to peak sound pressure level of 180 dB re 1 µPa

and 205 dB re 1 µPa. The authors reported the general sound level where behavioral alterations became evident was at about 161 dB re 1 µPa for all species. During all of the observations, the initial behavioral responses only lasted for a few minutes, ceasing before the end of the 10-minute trial.

Similarly, Skalski et al. (1992) showed a 52 percent decrease in rockfish (*Sebastes* sp.) caught with hook-and-line (as part of the study—fisheries independent) when the area of catch was exposed to a single airgun emission at 186 to 191 dB re 1 µPa (mean peak level) (See also (Pearson et al. 1987; Pearson et al. 1992)). They also demonstrated that fish would show a startle response to sounds as low as 160 dB re 1 µPa, but this level of sound did not appear to elicit decline in catch. Wright (1982) also observed changes in fish behavior as a result of the sound produced by an explosion, with effects intensified in areas of hard substrate.

Wardle et al. (2001) used a video system to examine the behaviors of fish and invertebrates on reefs in response to emissions from seismic airguns. The researchers carefully calibrated the airguns to have a peak level of 210 dB re 1 µPa at 16 m and 195 dB re 1 µPa at 109 m from the source. There was no indication of any observed damage to the marine organisms. They found no substantial or permanent changes in the behavior of the fish or invertebrates on the reef throughout the course of the study, and no marine organisms appeared to leave the reef.

Engås et al. (1996) and Engås and Løkkeborg (2002) examined movement of fish during and after a seismic airgun study by measuring catch rates of haddock (*Melanogrammus aeglefinus*) and Atlantic cod as an indicator of fish behavior using both trawls and long-lines as part of the experiment. These investigators found a significant decline in catch of both species that lasted for several days after termination of airgun use. Catch rate subsequently returned to normal. The conclusion reached by the investigators was that the decline in catch rate resulted from the fish moving away from the airgun sounds at the fishing site. However, the investigators did not actually observe behavior, and it is possible that the fish just changed depth.

The same research group showed, more recently, parallel results for several additional pelagic species including blue whiting and Norwegian spring spawning herring (Slotte et al. 2004). However, unlike earlier studies from this group, the researchers used fishing sonar to observe behavior of the local fish schools. They reported that fish in the area of the airguns appeared to go to greater depths after the airgun exposure compared to their vertical position prior to the airgun usage. Moreover, the abundance of animals 18 to 31 miles (29 to 50 km) away from the ensonification increased, suggesting that migrating fish would not enter the zone of seismic activity.

Alteration in natural behavior patterns due to exposure to impulsive noise (such as pile driving and explosions) has not been well studied. However, one study (Mueller-Blenkle et al. 2010), which took place with fish enclosed in a mesocosm (an enclosure providing a limited body of water with close to natural conditions), demonstrated behavioral reactions of cod and Dover sole (*Solea solea*) to impulsive sounds from pile driving. Sole showed a significant increase in swimming speed. Cod reacted, but not significantly, and both species showed directed movement away from the sources with signs of habituation after multiple exposures. For sole, reactions were seen with peak sound pressure levels of 144 to 156 dB re 1 µPa; and cod showed altered

behavior at peak sound pressure levels of 140 to 161 dB re 1 µPa. For both species, this corresponds to a peak particle motion between $6.51x10^{-3}$ and $8.62x10^{-4}$ meters per second squared (m/s^2).

Popper et al. (2014) indicated very little is known about the effects of explosions of wild fish behavior, but suggested that startle responses, likely lasting less than a second, could occur from exposure to explosives and that such responses would not necessarily result in significant changes to subsequent behavior.

6.4.7 Repeated Exposures of Fish

As noted previously, there is almost no research on any long-term behavioral effects or the potential cumulative effects from repeated exposures of fish to loud sounds (Popper and Hastings 2009a, 2009b). Assessing the effects of sounds, both individually and cumulatively, on marine species is difficult because responses depend on a variety of factors incuding age class, prior experience, behavioral state at the time of exposure, and indirect effects. Responses may be also be influenced by other non-sound related factors (Ellison et al. 2011; Goldbogen et al. 2013; Kight and Swaddle 2011; McGregor 2013; Williams et al. 2014) (Read et al. 2014). Within the ocean environment, aggregate anthropogenic impacts have to be considered in context of natural variation and climate change (Boyd and Hutchins 2012). To address aggregate impacts and responses from any changes due to processes such as habituation, tolerance, and sensitization, future experiments over an extended period of time still need further research (Bejder et al. 2009; Blickley et al. 2012) (Read et al. 2014).

Most of the scalloped hammerhead sharks that may be exposed to acoustic stressors would be exposed periodically or episodically over certain months or seasons when the Navy is training in the MITT Study Area. The majority of the proposed training and testing activities occur over a small spatial scale relative to the entire Action Area, have few participants, and are of a short duration (the order of a few hours or less). These periodic or episodic exposure and response scenarios most often allow sufficient time to return to baseline conditions and resumption of normal behavioral activities such as feeding and breeding. For example, Navy sonar systems are generally deployed from highly mobile vessels or in-water devices which do not directly target ESA-listed resources. A typical Navy vessel with hull mounted MFA sonar would travel over 0.3 kilometers between pings (based on a speed of 10 knots/hr and transmission rate of 1 ping/min) (Navy 2013). Based on this distance traveled and potential avoidance behavior of acoustically exposed animals, we expect repeat acoustic exposures capable of eliciting a behavioral response to an individual over a brief period of time to be rare. For sonar devices that are stationary (e.g. dipped sonar), due to the duty cycle, duration of active transmission in a specific location, and mitigation measures (e.g. avoidance of visible ESA-listed resources), we would not expect repeated exposures.

Repeated exposure to impulsive acoustic stressors may be more likely as successive detonations could occur in close proximity to one another. However, with the exception of those individuals that are close enough to be killed or seriously injured, we would expect the effect of repeated expsoures under this scenario to not impact the fitness of individual sharks. For example, anecdotal evidence indicates scalloped hammerhead sharks, particularly juveniles, may spend a considerable amount of time in Apra Harbor, a relatively small area where underwater

detonations are expected to occur. As suggested by Popper et al. (2014), most responses to detonations are expected to be temporary startle responses with the animal resuming normal activity shortly after exposure. The same would be expected if multiple startle responses occur resulting from successive detonations. It also may be possible for detonations to temporarily affect juvenile or adult shark refugia or foraging habitat selection. However, given these animal's mobility, we would expect individuals to temporarily select alternative refuge or forage sites nearby until the exposure levels in their initially selected location have decreased. To result in significant fitness consequences we would have to assume that an individual shark could not compensate for lost feeding opportunities by either immediately feeding at another location, by feeding shortly after cessation of acoustic exposure, or by feeding at a later time. Similarly, we would have to assume individuals could not find alternative refuge habitat nearby. There is no indication this is the case. Therefore, even temporary displacement from initially selected habitat is not expected to impact the fitness of any individual animals because we would expect equivalent habitat to be available in close proximity. Further, foraging generally occurs at night, when underwater detonations will not take place, suggesting feeding behavior is not likely to be affected. As noted previously, scalloped hammerhead sharks may also experience hearing loss if an individual is in close proximity to an underwater detonation. However, hearing loss would be temporary because unlike marine mammals, fish are capable of regenerating sensory hairs and no permanent hearing loss has ever been reported in fish (Lombarte et al. 1993) (Smith et al. 2006b). Because we do not expect any fitness consequences from any individual animals, we do not expect any population level effects from these responses.

Multiple stressors may also have synergistic effects. For example, fish that experience temporary hearing loss or injury from acoustic stressors could be more susceptible to physical strike and disturbance stressors via a decreased ability to detect and avoid threats. These interactions are speculative, and without data on the combination of multiple Navy stressors, the synergistic impacts from the combination of Navy stressors are difficult to predict in any meaningful way.

6.5 Delineation of Individuals of *Acropora globiceps*

In the following sections, we provide a summary of the available information used to assess the impacts of the proposed Navy activities on ESA-listed corals. A significant portion of this information is derived from the Final Listing Determinations on Proposal To List 66 Reef-Building Coral Species and To Reclassify Elkhorn and Staghorn Corals (79 FR 53877).

Reef-building corals are clonal organisms. A single larva will develop into a discrete unit (the primary polyp) that then produces modular units (*i.e.*, genetically-identical copies of the primary polyp) of itself, which are connected seamlessly through tissue and skeleton. These modular units may be solitary (*e.g.*, fungiid corals) or colonial. Most reef-building coral species are colonial, including all species covered in the final rule (79 FR 53877). Colony growth is achieved mainly through the addition of more polyps, and colony growth is indeterminate (see Figure 25 for an example of a coral colony). The colony can continue to exist even if numerous polyps die, or if the colony is broken apart or otherwise damaged. The biology of such clonal, colonial species creates ambiguity with regard to delineation of the individual in reef-building corals, specifically: (1) polyps versus colonies; (2) sexually-produced versus asexually-produced colonies; and (3) difficulty determining colony boundaries (79 FR 53877).

Summaries of how NMFS addressed these sources of ambiguity during the listing process are provided below, leading to a conclusion regarding the delineation of the "individual" for the species covered by the final rule.



Figure 25. Example of a Coral Colony, *Acropora globiceps.* (Veron, 2000) Source: (http://www.aims.gov.au/)

The "polyp" could be considered the smallest unit of the individual for reef-building corals. Each polyp in a coral colony consists of a column of tissue with a mouth and tentacles on the upper side, growing in a cup-like skeletal structure (the corallite) made of calcium carbonate that the polyp produces through calcification. The polyps are the building blocks of the colony, and most colony growth occurs by increasing the number of polyps and supporting skeleton. Polyps carry out the biological functions of feeding, calcification, and reproduction. However, because the polyps within a colony are modular units, and connected to one another physiologically (*i.e.*, via nerve net and gastrovascular cavity, and are the same sex), single polyps within a colony were not considered by NMFS to be individuals for purposes of the final listing.

Alternatively, only colonies originating from sexually-produced larvae could be considered as the individual for reef-building corals. Colonies are founded by either sexually-produced larvae that settle and become the primary polyp of a colony, or asexually-produced fragments of pre-existing colonies that break off to form a new colony. Fragments from the same colony can fuse back together into the same colony if they are close enough to grow together. Fragmentation in branching species may lead to a large number of asexually-produced, genetically identical colonies, commonly resulting in a population made up of more asexually-produced colonies than sexually-produced colonies (Hughes 1984). Sexually-produced colonies are important to the population by increasing the genetic diversity of the population, and colonies originating from asexually-produced fragments do not contribute to the effective population (*i.e.*, group of

genetically unique individuals). Asexual reproduction, though it does not create new genetic individuals, is likely the more critical mode for some species, especially branching species, allowing them to grow, occupy space, and persist between relatively rare events of sexual reproduction. Sexually- and asexually-produced colonies often cannot be distinguished from one another in the field, but are identifiable as an individual, in most cases. Thus, NMFS used the concept of the "physiological colony" as the entity considered to be an individual.

The physiological colony for reef-building colonial species is defined as any colony of the species, whether sexually or asexually produced (79 FR 53877). A physiological colony is generally autonomous from other colonies of the same species. However, colony morphology, partial colony mortality, and other colony growth characteristics (*e.g.*, formation of stands or thickets) can complicate the delineation of physiological colonies from one another in the field. In those cases, colony shape may not distinguish colonies from one another, and boundaries between separate encrusting colonies that have grown together may be difficult or impossible to make out visually. Partial mortality of colonies, especially larger colonies, can also mask the boundaries between colonies, because the algae-encrusted coral skeleton of a partially dead colony may appear to delineate two or more colonies. In addition, many reef-building coral species occur in stands or thickets that may be tens of meters or more in diameter (*e.g.*, some *Acropora* species), possibly consisting of multiple colonies or only one large colony, also masking the boundaries between colonies. In each of these instances, the actual number of genetically-distinct individuals can only be determined through genetic analysis.

NMFS' final rule considered the "individual" for each of the proposed species including *Acropora globiceps*, to be the "physiological colony," as defined above. That is, polyps are not considered individuals, but sexually- and asexually-produced colonies are considered individuals because they are a type of physiological colony and are the unit that can be identified in the field.

6.6 Marine Species Density Estimates

Marine mammal and sea turtle density estimates that were used in NAEMO modeling for acoustic effects and our risk analyses on the effects of various stressors from Navy training and testing activities are discussed below. Estimates of abundance or density for corals and scalloped hammerhead shark in the MITT Action Area were not available.

6.6.1 Marine Mammal Density Estimates

Esimates of marine mammal densities from the Pacific NMSDD (See Section 3.4.2) are summarized in Table 46 below.

Table 46. NMSDD Estimates for Marine Mammals in the MITT Action Area and Transit Corridor

Species	Location	Spring	Summer	Fall	Winter
Blue whale	MITT Action Area	0.00001	0.00001	0.00001	0.00001
	Transit Corridore	0.00001	0.00001	0.00001	0.00001
Fin whale	MITT Action Area	0.00001	0.00001	0.00001	0.00001
	Transit	0.00001	0.00001	0.00001	0.00001

	Corridor				
Sei whale	MITT Action Area	0.00029	0	0.00029	0.00029
	Transit Corridor	0.00013	0	0.00013	0.00013
Humpback whale	MITT Action Area	0.00089	0.00089	0.00089	0.00089
	Transit Corridor	0.00089	0.00089	0.00089	0.00089
Sperm whale	MITT Action Area	0.00291	0.00291	0.00291	0.00291
	Transit Corridor	0.00176	0.00176	0.00176	0.00176

The units for numerical values are animals/km2. 0 = species is not expected to be present

6.6.2 Sea Turtle Density Estimates

Species-specific sea turtle density estimates for the MITT Action Area are derived from scientific literature and Navy monitoring and surveying efforts. For more information regarding the specific data sources used to estimate density for each sea turtle species in the MITT Action Area, see the Pacific Navy Marine Species Density Database Technical Report (Hanser et al. 2013).

The species-specific density estimates used in the NAEMO model are detailed in Table 47. For green and hawksbill turtles, available information allowed the Navy to estimate density by geographic location or habitat type (e.g., nearshore Guam, Pelagic and transit corridor, etc). Leatherback and loggerhead are much less common in the MITT Action Area and a low density was assumed to represent the occasional transit of the Action Area. The density values below represent year round estimates. Density estimates by season are not available for sea turtles. For the MITT Action Area, an area was selected along the transit corridor to represent the range of different habitats that could occur along the corridor, including both island (Wake Island) and open ocean habitats. This is referred to as the "Transit Corridor" and assigned specific density estimates.

Table 47. NMSDD Estimates for Sea Turtles in the MITT Action Area and Transit Corridor

Species	Location	Density
Hawksbill	Nearshore FDM	1.0734
	Nearshore other islands	0.1342
	Pelagic and Transit Corridor	0.000024
Green	Nearshore Guam	0.2968
	Nearshore Tinian and other Islands	11.8
	Pelagic and Transit Corridor	0.000391
Loggerhead	MITT Action Area	0.000022
Leatherback	MITT Action Area	0.00022

The units for numerical values are animals/km^2.

6.7 Stressors Not Likely to Adversely Affect ESA-listed Species

The following section discusses stressors that are not likely to adversely affect ESA-listed species. If a stressor is likely to adversely affect any of the ESA-listed species in the MITT Action Area, it is discussed further in Section 6.8 and carried forward in our effects analysis. We address the specific species that are not likely to be adversely affected by respective stressors in those sections.

6.7.1 Effects of Weapons Firing, Launch and Impact Noise

Ship fired munitions can create blast waves from the gun muzzle and along the trajectory of the shell but it is expected the noise will only be detectable to marine mammals, sea turtles, and scalloped hammerhead sharks within a very small footprint along the trajectory. Aircraft fired munitions are not expected to have sound waves emanating from the firing source that would be of sufficient intensity to propogate a sound wave into the water. Non-explosive ordnance can also impact the water with substantial force and produce loud noises but no TTS exposures of ESA-listed marine mammals are predicted from navy modeling efforts. Marine mammals, sea turtles, and scalloped hammerhead sharks within the audible range of munition firing, launching and impact may exhibit a behavioral startle response but are expected to quickly return to normal behavior. Munitions firing, launch, and impacts are sporadic events of short duration reducing the likelihood of subjecting individual marine mammals, sea turtles, or scalloped hammerhead sharks to prolonged or repeated exposures. Due to the short duration and sporadic nature of munition firing, the low likelihood of an ESA-listed animal being within close enough proximity to detect sound from firing above water, and the high likelihood an ESA-listed animal that does detect noise from munition firing would react very briefly, we do not expect an increase in the likelihood of injury from significant disruption of breeding, feeding, or sheltering is expected for ESA-listed marine mammals, sea turtles, or scalloped hammerhead sharks. Therefore, the effects of weapon firing, launching, and impact noise on ESA-listed marine mammals, sea turtles, and scalloped hammerhead sharks would not rise to the level of take and any behavioral impacts would be insignificant.

Corals are not biologically capable of detecting noise except as vibrations of water particles caused by low frequency sounds, therefore effects to ESA-listed corals from noise stressors associated with weapon firing and impacts are not reasonably expected to occur.

6.7.2 Effects of Aircraft Noise

Studies have shown that aircraft presence and operation can result in changes in behavior of cetaceans (Arcangeli and Crosti 2009; Holt et al. 2009; Luksenburg and Parsons 2009; Noren et al. 2009; Patenaude et al. 2002; Richter et al. 2006; Richter et al. 2003; Smultea et al. 2008). Many of the activities the U.S. Navy conducts in the MITT Action Area involve some level of activity from aircraft that include helicopters, maritime patrols, and fighter jets. Low-flying aircraft produce sounds that marine mammals can hear when they occur at or near the ocean's surface. Helicopters generally tend to produce sounds that can be heard at or below the ocean's surface more than fixed-wing aircraft of similar size and larger aircraft tend to be louder than smaller aircraft. Underwater sounds from aircraft are strongest just below the surface and directly under the aircraft. Sounds from aircraft would not have physical effects on marine mammals but represent acoustic stimuli (primarily low-frequency sounds from engines and rotors) that have been reported to affect the behavior of some marine mammals and sea turtles.

We did not estimate the number of endangered or threatened species that are likely to be exposed to noise from aircraft overflight, take-offs and landings from carriers, or other fixed or rotary-wing aircraft operations at altitudes low enough for the sounds to be salient at or immediately below the ocean's surface. Nevertheless, we assume any ESA-listed species that occur in the Action Area during training exercises and testing activities that involve aircraft are likely to be exposed to minor acoustic stimuli associated with aircraft traffic.

There are few studies of the responses of marine animals to air traffic and the few that are available have produced mixed results. Some investigators report responses while others report no responses. Richardson et al. (1995c) reported that there is no evidence that single or occasional aircraft flying above large whales and pinnipeds in-water cause long-term displacement of these mammals. Several authors have reported that sperm whales did not react to fixed-wing aircraft or helicopters in some circumstances (Au and Perryman 1982, Clarke 1956b, Green et al. 1992) (Gambell 1968) and reacted in others (Clarke 1956b, Fritts et al. 1983, Patenaude et al. 2002, Richter et al. 2003, 2006, Smultea et al. 2008, Würsig et al. 1998) (Mullin et al. 1991). Richardson et al. (1985) reported that bowhead whales responded behaviorally to fixed-wing aircraft that were used in their surveys and research studies when the aircraft were less than 457 m above sea level; their reactions were uncommon at 457 m, and were undetectable above 610 meters. They also reported that bowhead whales did not respond behaviorally to helicopter overflights at about 153 m above sea level.

Smultea et al. (2008) studied the response of sperm whales to low-altitude (233 to 269 m) flights by a small fixed-wing airplane near Kaua'i and reviewed data available from other studies. They concluded that sperm whales responded behaviorally to aircraft passes in about 12 percent of encounters. All of the reactions consisted of sudden dives and occurred when the aircraft was less than 360 m from the whales (lateral distance). They concluded that the sperm whales had perceived the aircraft as a predatory stimulus and responded with defensive behavior. In at least

one case, Smultea et al. (2008) reported that the sperm whales formed a semi-circular "fan" formation that was similar to defensive formations reported by other investigators.

In a review of aircraft noise effects on marine mammals, Luksenburg and Parsons (2009) determined that the sensitivity of whales and dolphins to aircraft noise may depend on the animals' behavioral state at the time of exposure (e.g. resting, socializing, foraging or travelling) as well as the altitude and lateral distance of the aircraft to the animals. While resting animals seemed to be disturbed the most, low flying aircraft with close lateral distances over shallow water elicited stronger disturbance responses than higher flying aircraft with greater lateral distances over deeper water (Patenaude et al. 2002, Smultea et al. 2008 in Luksenburg and Parsons (2009).

Based on sea turtle sensory biology (Bartol et al. 1999b; Ketten and Bartol 2005; Ketten and Bartol 2006; Lenhardt et al. 1994a; Ridgway et al. 1969), sound from low flying aircraft could be heard by a sea turtle at or near the surface. Turtles might also detect low flying aircraft via visual cues such as the aircraft's shadow. Hazel et al. (2007) suggested that green turtles rely more on visual cues than auditory cues when reacting to approaching water vessels. This suggests that sea turtles might not respond to aircraft overflights based on noise alone.

Based on limited morphological and scientific study, scalloped hammerhead sharks are likely less sensitive to above-water acoustic noise, such as that originating from aircraft, than marine mammals. Corals are not biologically capable of detecting noise except as vibrations of water particles caused by low frequency sounds, therefore effects to ESA-listed corals from noise stressors are not reasonably expected to occur.

In conclusion, the low number of aircraft flights, typical altitudes of flights, sporadic occurrence of flights, limited duration of flights, and the lack of substantial sound propagation into the water column from aircraft indicates there is a low probability of exposing marine mammals, sea turtles, scalloped hammerhead sharks and corals to aircraft noise at perceivable levels. In the event an ESA-listed species was exposed to aircraft noise, it would likely result in temporary behavioral responses. These behavioral responses would not increase the likelihood of injury from significantly disrupting breeding, feeding, or sheltering and would not rise to the level of take. Therefore, the effects of aircraft noise on ESA-listed species is insignificant and not likely to adversely affect them.

6.7.3 Effects of Vessel Noise

Sounds emitted by large vessels can be characterized as low-frequency, continuous, or tonal, and sound pressure levels at a source will vary according to speed, burden, capacity and length (Richardson et al. 1995c) (Kipple and Gabriele 2007; McKenna et al. 2012). Vessels ranging from 135 to 337 m (Nimitz-class aircraft carriers, for example, have lengths of about 332 m) generate peak source sound levels from 169 to 200 dB between 8 Hz and 430 Hz. Source levels for 593 container ship transits were estimated from long-term acoustic recording received levels in the Santa Barbara shipping channel, and a simple transmission loss model using Automatic Identification System data for source-receiver range (McKenna et al. 2013). Ship noise levels could vary 5 to 10 dB depending on transit conditions. Given the sound propagation of low frequency sounds, a large vessel in this sound range can be heard 139 to 463 km away (Polefka

2004). Hatch et al. (2008) measured commercial ship underwater noise levels and reported average source level estimates (71 to 141 Hz, root-mean-square pressure re 1 uPa ± SE) for individual vessels ranged from 158 ± 2 dB (research vessel) to 186 ± 2 dB (oil tanker). McKenna et al (2012) in a study off Southern California documented different acoustic levels and spectral shapes observed from different modern ship-types.

Numerous studies of interactions between surface vessels and marine mammals have demonstrated that free-ranging marine mammals engage in avoidance behavior when surface vessels move toward them. It is not clear whether these responses are caused by the physical presence of a surface vessel, the underwater noise generated by the vessel, or an interaction between the two (Amaral and Carlson 2005; Au and Green 2000; Bain et al. 2006; Bauer 1986; Bejder et al. 1999; Bejder and Lusseau. 2008; Bejder et al. 2009; Bryant et al. 1984; Corkeron 1995; Erbe 2002b; Félix 2001; Goodwin and Cotton 2004; Lemon et al. 2006; Lusseau 2003; Lusseau 2006; Magalhaes et al. 2002; Nowacek et al. 2001; Richter et al. 2003; Scheidat et al. 2004; Simmonds 2005; Watkins 1986; Williams et al. 2002b; Wursig et al. 1998). However, several authors suggest that the noise generated during motion is probably an important factor (Blane and Jaakson 1994; Evans et al. 1992; Evans et al. 1994). These studies suggest that the behavioral responses of marine mammals to surface vessels are similar to their behavioral responses to predators.

Based on the suite of studies of cetacean behavior to vessel approaches (Au and Perryman 1982; Bain et al. 2006; Bauer and Herman 1986; Bejder et al. 1999; Bejder et al. 2006a; Bejder et al. 2006b; Bryant et al. 1984; Corkeron 1995; David 2002; Felix 2001; Goodwin and Cotton 2004; Hewitt 1985b; Lusseau 2003; Lusseau 2006; Magalhaes et al. 2002; Nowacek et al. 2001; Richter et al. 2006; Richter et al. 2003; Scheidat et al. 2004; Simmonds 2005; Watkins 1986; Williams and Ashe 2007; Williams et al. 2002b; Wursig et al. 1998) (Aguilar Soto et al. 2006; Arcangeli and Crosti 2009; Au and Green 2000; Christiansen et al. 2010; Erbe 2002b; Noren et al. 2009; Stensland and Berggren 2007; Stockin et al. 2008; Williams et al. 2009)(Acevedo 1991), the set of variables that help determine whether marine mammals are likely to be disturbed by surface vessels include:

- *Number of vessels*. The behavioral repertoire marine mammals have used to avoid interactions with surface vessels appears to depend on the number of vessels in their perceptual field (the area within which animals detect acoustic, visual, or other cues) and the animal's assessment of the risks associated with those vessels (the primary index of risk is probably vessel proximity relative to the animal's flight initiation distance) (Sims et al. 2012).

- Below a threshold number of vessels (which probably varies from one species to another, although groups of marine mammals probably share sets of patterns), studies have shown that whales will attempt to avoid an interaction using horizontal avoidance behavior. Above that threshold, studies have shown that marine mammals will tend to avoid interactions using vertical avoidance behavior, although some marine mammals will combine horizontal avoidance behavior with vertical avoidance behavior (Bryant et al.

1984; David 2002; Kruse 1991a; Lusseau 2003; Nowacek et al. 2001; Stensland and Berggren 2007; Williams and Ashe 2007);

- *The distance between vessel and marine mammals* when the animal perceives that an approach has started and during the course of the interaction (Au and Perryman 1982; David 2002; Hewitt 1985b; Kruse 1991a; Lundquist et al. 2012; Lusseau 2003; Tseng et al. 2011);

- *The vessel's speed and vector* (David 2002);

- *The predictability of the vessel's path*. That is, cetaceans are more likely to respond to approaching vessels when vessels stay on a single or predictable path (Acevedo 1991a; Angradi et al. 1993; Browning and Harland. 1999; Lusseau 2003; Lusseau 2006; Williams et al. 2002a) than when it engages in frequent course changes (Evans et al. 1994; Lusseau 2006; Williams et al. 2002a);

- *Noise associated with the vessel* (particularly engine noise) and the rate at which the engine noise increases (which the animal may treat as evidence of the vessel's speed) (David 2002; Lusseau 2003; Lusseau 2006; Polagye et al. 2011);

- *The type of vessel* (displacement versus planing), which marine mammals may be interpret as evidence of a vessel's maneuverability (Goodwin and Cotton 2004);

- *The behavioral state of the marine mammals* (David 2002; Lusseau 2003; Lusseau 2006; Wursig et al. 1998). For example, Würsig et al. (Wursig et al. 1998) concluded that whales were more likely to engage in avoidance responses when the whales were milling or resting than during other behavioral states.

Most of the investigations reported that animals tended to reduce their visibility at the water's surface and move horizontally away from the source of disturbance or adopt erratic swimming strategies (Corkeron 1995; Lundquist et al. 2012; Lusseau 2003; Lusseau 2004; Nowacek et al. 2001; Van Parijs and Corkeron 2001; Williams et al. 2002a; Williams et al. 2002b). In the process, their dive times increased, vocalizations and jumping were reduced (with the exception of beaked whales), individuals in groups move closer together, swimming speeds increased, and their direction of travel took them away from the source of disturbance (Baker and Herman 1989; Edds and Macfarlane 1987; Evans et al. 1992; Kruse 1991a). Some individuals also dove and remained motionless, waiting until the vessel moved past their location. Most animals finding themselves in confined spaces, such as shallow bays, during vessel approaches tended to move towards more open, deeper waters (Kruse 1991a). We assume that this movement would give them greater opportunities to avoid or evade vessels as conditions warranted.

Although most of these studies focused on small cetaceans (for example, bottlenose dolphins, spinner dolphins, spotted dolphins, harbor porpoises, beluga whales, and killer whales), studies

of large whales have reported similar results for fin and sperm whales (David 2002). Baker et al. (1983) reported that humpbacks in Hawaii responded to vessels at distances of 2 to 4 km. Richardson et al. (1985) reported that bowhead whales (*Balaena mysticetus*) swam in the opposite direction of approaching seismic vessels at distances between 1 and 4 km and engage in evasive behavior at distances under 1 km. Fin whales also responded to vessels at a distance of about 1 km (Edds and Macfarlane 1987). A study by Lundquist (2012) on dusky dolphins concluded that repeated disturbance from tour vessel traffic may interrupt social interactions, and postulated that those repeated disturbances may carry energetic costs, or otherwise affect individual fitness. However, they were unable to determine if such disturbances were likely to cause long-term harm. For behavioral responses to result in energetic costs that result in long-term harm, such disturbances would likely need to be sustained for a significant duration or extent where individuals exposed would not be able to select alternate habitat to recover and feed. Typical Navy training and testing activities would not likely result in such prolonged exposures and preclusion of individuals from feeding, breeding, or sheltering habitat.

Würsig et al. (1998) studied the behavior of cetaceans in the northern Gulf of Mexico in response to survey vessels and aircraft. They reported that false killer whales either did not respond or approached the ship (most commonly to ride the bow). Four of 15 sperm whales avoided the ship while the remainder appeared to ignore its approach.

For surface vessels, the set of variables that help determine whether marine mammals are likely to be disturbed include: (1) the number of vessels in a marine mammal's perceptual field and the animal's assessment of the risks associated with those vessels; (2) the distance between vessels and marine mammals; (3) the vessel's speed and path; (4) the predictability of the vessel's path; (5) noise associated with the vessel and the rate at which the engine noise increases; (6) the type of vessel; and (7) the behavioral state of the animal. Because of the number of vessels involved in U.S. Navy training exercises and testing activities, the vessel speed, and the use of course changes as a tactical measure with the associated sounds, the available evidence leads us to expect marine mammals to treat Navy vessels as stressors. Further, without considering differences in sound fields associated with any active sonar that is used during these exercises, the available evidence suggests that major training exercises, unit- and intermediate-level exercises, and testing activities would represent different stress regimes because of differences in the number of vessels involved, vessel maneuvers, and vessel speeds.

We recognize that Navy vessels almost certainly incorporate quieting technologies that reduce their acoustic signature (relative to the acoustic signature of similarly sized vessels) in order to reduce their vulnerability to detection by enemy vessels (Southall 2005). Nevertheless, we do not assume that any quieting technology would be sufficient to prevent marine mammals from detecting sounds produced by approaching Navy vessels and perceiving those sounds as predatory stimuli. We also consider evidence that factors other than received sound level, including the activity state of animals exposed to different sounds, the nature and novelty of a sound, and spatial relations between sound source and receiving animals (i.e., the exposure context) strongly affect the probability of a behavioral response (Ellison et al. 2012).

We considered the research and reports cited above and conclude that ESA-listed marine mammals, sea turtles, and scalloped hammerhead sharks are likely to either not react or exhibit

an avoidance behavior. Most avoidance responses would consist of slow movements away from vessels the animals perceive are on an approaching course, perhaps accompanied by slightly longer dives in marine mammals and turtles. Most of the changes in behavior would consist of a temporary shift from behavioral states that have low energy requirements (resting or milling) to behavioral states with higher energy requirements (active swimming or traveling) and then returning to the resting or milling behavior.

Behavioral disruptions of ESA-listed species resulting from the presence of vessels or submarines are expected to be temporary. Animals are expected to resume their migration, feeding, or other behaviors with no significant impact to their breeding, feeding or sheltering. Marine mammals react to vessels in a variety of ways and seem to be generally influenced by the activity the marine mammal is engaged in when a vessel approaches (Richardson et al. 1995c). Some respond negatively by retreating or engaging in antagonistic responses while other animals ignore the stimulus altogether (Terhune and Verboom 1999; Watkins 1986). Given the short duration of vessel noise stressors, the infrequency of this stressor, and the temporary nature of biological responses of marine mammals, sea turtles and scalloped hammerhead sharks to this stressor, these ESA-listed species are either not likely to respond or are not likely to respond in ways that might be adverse (the responses might represent an approach or attentive movement, a small change in orientation in the waters, etc.).

Corals are not biologically capable of detecting noise except as vibrations of water particles caused by low frequency sounds, therefore effects to ESA-listed corals from noise stressors are not reasonably expected to occur.

In conclusion, ESA-listed species are either not likely to respond to vessel noise or are not likely to measurably respond in ways that would significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering. Therefore, the effects of noise from Navy vessels on ESA-listed species would not rise to the level of take and is considered insignificant.

6.7.4 Effects of Fiber Optic Cables, Guidance Wires, and Decelarators/Parachutes from Entanglement

Expended materials from U.S. Navy training and testing may pose a risk of entanglement or ingestion to marine mammals and sea turtles in the MITT Action Area. These interactions could occur at the sea surface, in the water column, or on the seafloor. Similar to interactions with other types of marine debris (e.g., fishing gear, plastics), interactions with military expended materials could result in negative sub-lethal effects, mortality, or result in no impact.

Expended materials from Navy training and testing may include the following: fiber optic cables, guidance wires, parachutes, 55 gallon drums, sonobuoy tubes, unrecovered aircraft stores (e.g., fuel tanks, carriages, dispensers, racks), ship hulks, and targets. At-sea targets are usually remotely-operated airborne, surface, or subsurface traveling units, most of which are designed to be recovered for reuse. However, if they are used during activities that utilize high-explosives, they may fragment. Expendable targets that may fragment include air-launched decoys, surface targets (such as marine markers, paraflares, cardboard boxes, and 10 ft. diameter red balloons), and mine shapes. Most expended materials and target fragments are expected to sink quickly to

the seafloor. Floating material, such as Styrofoam, may be lost from target boats and remain at the surface for some time.

There has never been a reported or recorded instance of marine mammals or sea turtles entangled in military expended materials. Though there is a potential for ESA-listed species to encounter military expended material, given the large geographic area involved, and the presumeably low densities of threatened or endangered species in the MITT Action Area, we do not believe such interactions are likely to occur. Additionally, most expended materials are expected to sink upon release, and relatively few ESA-listed animals feed in the deepwater benthic habitats where most expended materials are likely to settle. While disturbance or strike from any expended material as it falls through the water column is possible, it is not likely because the objects will slow in velocity as they sink toward the bottom (e.g., guidance wires sink at an estimated rate of 0.7 ft. [0.2 m] per second), and can be avoided by highly mobile organisms such as marine mammals, sharks, and sea turtles. Bottom feeding animals have an increased likelihood of encountering expended materials because they may find them during feeding long after the training or testing event has occurred. If encountered, foraging animals may ingest the item or become entangled by it.

If encountered, it is unlikely that an animal would get entangled in a fiber optic cable, guidewire, parachute, or other expended material while it was sinking or upon settling to the seafloor. An animal would have to swim through loops or become twisted within the cable or wire to become entangled, and given the properties of the expended cables and wires (low breaking strength and sinking rates) the probability of injury or mortality from expended materials is low. Specifically, fiber optic cable is brittle and would be expected to break if kinked, twisted or sharply bent. Thus, the physical properties of the fiber optic cable would not allow the cable to loop, greatly reducing the likelihood of entanglement of ESA-listed species. Based on degradation times, guidance wires would break down within one to two years and no longer pose an entanglement risk. The length of the guidance wires vary, but greater lengths increase the likelihood that a marine mammal or sea turtle could become entangled. Parachutes used by the Navy range in size from 18 to 48 in. (46 to 122 cm), but the vast majority of expended decelerator/parachutes are small (18 in.) cruciform shaped decelerators used with sonobuoys. They have short attachment lines and, upon water impact, may remain at the surface for 5 to 15 seconds before the decelerator/parachute and its housing sink to the seafloor. Entanglement of an animal in a parachute assembly at the surface or within the water column would be unlikely, since the parachute would have to land directly on an animal, or an animal would have to swim into it before it sinks. It is possible that a bottom feeding animal (e.g., sperm whale, sea turtle) could become entangled when they are foraging in areas where parachutes have settled on the seafloor. For example, if bottom currents are present, the canopy may temporarily billow and pose a greater entanglement threat. However, the likelihood of curents causing a billowing of a parachute and being encountered by an ESA-listed species is so unlikely as to be considered discountable. Fiber optic cables, guidance wires, and decelarators/parachutes will be used over deep water, reducing the likelihood of settling on coral reefs and ESA-listed corals. It is not reasonably predicted ESA-listed corals will be exposed to these items.

In conclusion, based on their deep-water location of use, their sinking rate, their degredation rate, and the presumably low density of ESA-listed species, the likelihood of ESA-listed species

becoming entangled in expended materials is so low as to be discountable. Therefore, entanglement is not likely to adversely affect ESA-listed species.

6.7.5 Effects of Munitions and Other Military Expended Materials from Ingestion

The only munitions and other materials small enough to be ingested by ESA-listed marine mammals, sea turtles, and scalloped hammerhead sharks are small- and medium-caliber projectiles, broken pieces of firing targets, chaff, flare caps, decelerators/parachutes, and shrapnel fragments from explosive ordnance. Most expendable materials will be used over deep water and these items will sink quickly and settle on the seafloor with the exception of chaff and some firing target materials. Given the limited time most items will spend in the water column it is not reasonably expected these items will be accidentally ingested by ESA-listed species not accustomed to foraging on the sea floor. The ESA-listed species potentially exposed to expended munitions and shrapnel fragments while foraging on the sea floor is limited to sperm whales, sea turtles, and the scalloped hammerhead shark. Although scalloped hammerhead sharks and green, loggerhead, and hawksbill sea turtles are known to forage along the sea floor they are restricted to doing so in relatively shallow, near shore areas where expendable material use is not normally conducted. In contrast, sperm whales are capable of foraging along the sea floor in deep water. However, the relatively low density of both sperm whales and expended materials along the vast sea floor suggests ingestion would be rare. In cases where sperm whales, sea turtles, and scalloped hammerhead sharks do accidentally ingest expended materials small enough to be eaten it is likely they will pass through the digestive tract and not result in an increased likelihood of injury from significant disruption of breeding, feeding, or sheltering. ESA-listed corals are likely not capable of ingesting expended materials due to their size and their exposure would be limited due to corals primarily existing in near shore areas. Therefore, ingestion of expended materials by corals is not reasonably expected to occur.

Chaff is composed of fine fibers of silicon dioxide coated with aluminum alloy. Due to their light weight and small size they float and can be carried great distances in both air and water currents. Their dispersal in wind and water results in chaff fibers likely occur in low densities on the ocean surface. Given the small size, low densities, and low toxicity of chaff, any accidental ingestion by ESA-listed species feeding at the ocean surface is not expected to result in an increased likelihood of injury from significant disruption of breeding, feeding, or sheltering. Firing target materials are normally retrieved before sinking and it is not reasonable to expect ingestion of these items to occur.

In conclusion, ESA-listed species are either so unlikely to ingest expended material as to be discountable, or in the case of bottom-feeding species, any ingested materials are likely to pass through the digestive tract without causing injury or any effects rising to the level of take. Therefore, the effects of ingested expended materials on ESA-listed species is either discountable, or insignificant, and not likely to adversely affect them.

6.7.6 Effects of Electromagnetic Devices

Normandeau et al. (Normandeau et al. 2011) concluded there was behavioral, anatomical, and theoretical evidence indicating cetaceans sense magnetic fields. Most of the evidence in this regard is indirect evidence from correlation of sighting and stranding locations suggesting that cetaceans may be influenced by local variation in the earth's magnetic field (Kirschvink 1990)

(Klinowska 1985) (Walker et al. 1992). Results from one study in particular showed that long-finned and short-finned pilot whales, striped dolphin, Atlantic spotted dolphin, Atlantic white-sided dolphin, fin whale, common dolphin, harbor porpoise, sperm whale, and pygmy sperm whale were found to strand in areas where the earth's magnetic field was locally weaker than surrounding areas (negative magnetic anomaly) (Kirschvink 1990). Results also indicated that certain species may be able to detect total intensity changes of only 0.05 microtesla (Kirschvink et al. 1986). This gives insight into what changes in intensity levels some species are capable of detecting, but does not provide experimental evidence of levels to which animals may physiologically or behaviorally respond. Further,not all physiological or behavioral responses are biologically significant and rise to the level of take as defined in the ESA.

Impacts to marine mammals associated with electromagnetic fields are dependent on the animal's proximity to the source and the strength of the magnetic field. Electromagnetic fields associated with naval training exercises and testing activities are relatively weak (only 10 percent of the earth's magnetic field at 79 ft.), temporary, and localized. Once the source is turned off or moves from the location, the electromagnetic field is gone. A marine mammal would have to be present within the electromagnetic field (approximately 656 ft. [200 m] from the source) during the activity in order to detect it. Again, detection does not necessarily signify a significant biological response rising to the level of take as defined under the ESA. Given the small area associated with mine fields, the infrequency and short duration of magnetic energy use, the low intensity of electromagnetic energy sources, and the density of cetaceans in these areas, the likelihood of ESA-listed cetaceans being exposed to electromagnetic energy at sufficient intensities to create a biologically relevant response is so low as to be discountable. Therefore, electromagnetic energy from mine neutralization equipment is not likely to adversely affect ESA-listed cetaceans and will not be considered further in this Opinion.

Sea turtles use geomagnetic fields to navigate at sea, and therefore changes in those fields could impact their movement patterns (Lohmann and Lohmann 1996a) (Lohmann and Lohmann 1996b) (Lohmann et al. 1997). Turtles in all life stages orient to the earth's magnetic field to position themselves in oceanic currents; this helps them locate seasonal feeding and breeding grounds and to return to their nesting sites (Lohmann and Lohmann 1996a) (Lohmann and Lohmann 1996b) (Lohmann et al. 1997). Experiments show that sea turtles can detect changes in magnetic fields, which may cause them to deviate from their original direction (Lohmann and Lohmann 1996a) (Lohmann and Lohmann 1996b) Lohmann et al. 1997). For example, Lohmann and Lohmann (Lohmann and Lohmann 1996a) (Lohmann and Lohmann 1996b) found that loggerhead hatchlings tested in a magnetic field of 52,000 nanoteslas (nT) swam eastward, and when the field was decreased to 43,000 nT, the hatchlings swam westward. Sea turtles also use nonmagnetic cues for navigation and migration, and these additional cues may compensate for variations in magnetic fields. Experimental studies show that hatchlings and juvenile turtles are sensitive to the earth's natural magnetic field and they can distinguish magnetic inclination in different places during their migration routes (Lohmann 1991) (Luschi et al. 2007). Sea turtles can distinguish magnetic differences lighter than 9 milliteslas (or 9,000 microteslas (μT)) (Lohmann et al. 1999) (Lohmann et al. 2001).

If located in the immediate area (within about 650 ft. [200 m]) where electromagnetic devices are being used, sea turtles could deviate from their original movements. Even if detectable, the

electromagnetic devices used in training exercises and testing activities are not expected to cause more than a short-term behavioral disturbance to sea turtles because of the: (1) relatively low intensity of the magnetic fields generated (0.2 μT [or 200 nT] at 200 m [656.2 ft.] from the source), (2) very localized potential impact area, and (3) temporary duration of the activities (hours). Impacts of exposure to electromagnetic stressors are not expected to result in substantial changes to an individual's behavior, growth, survival, annual reproductive success, lifetime reproductive success (fitness), or species recruitment, and are not expected to result in population-level impacts. Therefore, the effects of electromagnetic energy from mine neutralization equipment are insignificant and not likely to adversely affect ESA-listed sea turtles.

In a recent literature review on the effects of electromagnetic fields on marine species (Fisher and Slater 2010) elasmobranchs including scalloped hammerhead sharkes were noted to have extreme sensitivity to low-frequency AC electric fields but little is known about their sensitivity to magnetic fields. Elasmobranchs, scalloped hammerhead sharks use natural electromagnetic fields in their daily lives and, as a result, are at a higher risk of influence from anthropogenic sources . These species receive electrical information about the positions of their prey, the drift of ocean currents, and their magnetic compass headings. In general, elasmobranchs experience sensitivity to E-fields between 5 x 10-7 to 10-3 V/m (Fisher and Slater 2010). At this level, these species are generally attracted to the source; however, at 1 μV/cm or greater, elasmobranchs typically avoid the source (Kalmijn 1982) (Gill and Taylor 2002). However, there are discrepancies between the findings of Gill and Taylor (2002) and Kalmijn (1982) on the lower threshold for elasmobranchs sensitivity to E-fields. Gill and Taylor report this threshold at 5 x 10-7 V/m, while Kalmijn reports it to be 5 x 10-9 V/m. Elasmobranchs attacking submarine cables has been observed (Marra 1989). In 1982, off the coast of Massachusetts, an experiment determined the sensitivity of dogfish (*Mustelus canis*), stingray (*Urolophus halleri*), and blue shark (*P. glauca*) to E-fields. Each species attacked the Efield sources (Kalmijn 1982).

A CMACS (2003) discussion indicated that the strength of the electromagnetic fields emitted by submerged AC cables are substantially lower than those associated with the Earth's geomagnetic field. Therefore, they may be undetectable to magneto-sensitive species, such as scalloped hammerhead sharks, that are attuned to naturally occurring field strengths. While some elasmobranch species such as sharks can detect and respond to electromagnetic fields that are within the range induced by submerged power cables and other anthropogenic sources, no studies were found describing whether such levels affect the behavior of elasmobranchs under field conditions (Fisher and Slater 2010). We assume that scalloped hammerhead sharks most likely avoid sources of strong electromagnetic fields and that any potetial behavioral responses would be very minor and only occur very near the source. Therefore, we conclude that scalloped hammerhead sharks are not likely to be adversely affected by electromagnetic devices during Navy training and testing activities.

Reef-building corals grown in an electromagnetic field generally have higher growth rates and less mortality as shown by experimental studies with *Acropora pulchra* and *Acropora yongei* (Borell et al. 2010). Electromagnetic fields presumeably aid in the accretion of calcium carbonate, allowing reef building corals to grow at a faster rate. ESA-listed corals are not

expected to experience negative effects from the use of electromagnetic devices and any effects may be beneficial.

6.7.7 Effects of In-water Devices from direct physical strikes

Despite thousands of Navy exercises in which torpedoes and in-water devices (unmanned surface vehicles, unmanned undersea vehicles, towed devices) have been used there have been no recorded instances of marine species strikes. Therefore, the likelihood of striking a marine mammal, sea turtle, or scalloped hammerhead shark is so unlikely as to be discountable. Any ESA-listed marine mammal, sea turtle, or shark species is likely to exhibit behavioral avoidance of in-water devices in the event they are within range to detect them. Any such avoidance behavior would be of short duration and intensity that it will not increase the likelihood of injury from disruption of breeding, feeding, or sheltering and would not rise to the level of take. The likelihood of in-water devices striking a coral reef would be considered rare and discountable.

Although the direct strike of coral reefs is rare and discountable, corals (including ESA-listed corals) broadcast spawn eggs and larvae into the water column where fertilization and early embryonic development occurs. The eggs, sperm, and larval stage of ESA-listed corals could remain in the water column for extended periods where they may be subjected to cavitation that are similar to natural processes. The effect from cavitation caused by in-water devices is discussed in Section 6.7.7.1 below.

6.7.7.1 Effects of Cavitation from Vessels and In-Water Devices on Juvenile Corals

Three ESA-listed species are known to occur within the immediate surroundings of Guam or the CNMI including *Acropora globiceps*, *Acropora retusa*, and *Seriatopora aculeata*. Although the direct strike of coral reefs with vessel hulls is rare and discountable, corals (including ESA-listed corals) broadcast spawn eggs and larvae into the water column where fertilization and early embryonic development occurs. In Section 6.5, we defined an individual coral as a colony and outlined the lifestages of coral that are pertinent to this assessement. Here, we address the potential effects to individuals from impacts to reproduction and recruitment from cavitation stressors.

6.7.7.1.1 Exposure of Juvenile Coral Life Stages to Cavitation

Three ESA-listed species are known to occur within the immediate surroundings of Guam or the CNMI including *Acropora globiceps*, *Acropora retusa*, and *Seriatopora aculeata*. Given the nature of ESA-listed coral spawning, it is reasonable to assume vessels and in-water devices will pass through water containing eggs, sperm, early embryonic stages, or planula larvae of the ESA-listed species occurring near Guam and the CNMI, where higher concentrations of vessel traffic and these life stages are likely to occur.

The eggs, sperm, and larval stage (Figure 15) of ESA-listed corals could remain in the water column for extended periods. Each individual polyp of an *Acropora* coral can produce 16 eggs and concentrations of sperm can be as high as 1 million per milliliter of seawater during spawning. Fertilized eggs develop into planula larvae within 5 days in *Acropora* species but these larvae can also remain in the water column over 200 days before settling. Although the reproductive effort and developmental timing of *Seriatopora* species are not as well known it is possible they are similar to *Acropora* species.

We assume that individuals in these life stages (eggs, sperm, early embryonic stages, or planula larvae) that occur offshore are less likely to come into contact with this stressor due to lower densities (greater volume of water), and a lower concentration of training and testing activities as compared to nearshore Guam and potentially the mouth of Apra Harbor.

6.7.7.1.2 Response of Corals to Cavitation

The eggs of *Acropora millepora*, a congeneric species to two of the ESA-listed species in the Action Area, are known to disintegrate into irregular groups or individual blastomeres when subjected to even very light shearing forces and turbulence (Heyward and Negri 2012). Under laboratory conditions these disintegrated cells commonly reorganized and continued development into eventual juveniles (Heyward and Negri 2012). Therefore, the disassociation of embryonic cells can be beneficial through the creation of more juveniles, although it is suspected others suffered direct mortality from being disassociated. In a manual for coral larvae rearing for reef rehabilitation, Guest et al. (2010), suggests rough handling of broadcast spawning coral embryos during early cell division stages (up to 36 hours post fertilization) will result in many embryo deaths or embryos being smaller than normal. Mead and Denny (1995) found turbulent water decreased successful fertilization of broadcast spawned eggs in the purple sea urchin, likely due to mechanical separation of eggs and sperm. The authors also found fertilized eggs exposed to high shear stresses of turbulent water showed abnormal development and low survival (Mead and Denny 1995). Shear stress from water turbulence has also been reported to cause increased mortality in fish eggs (Bunn et al. 2000; Eshenroder et al. 1994; Morgan et al. ; Sutherland and Ogle 1975).

Life stages subjected to cavitation from vessels and in-water devices could be deformed, die, or experience a decreased likelihood of fertilization. However, as described above, the reproductive biology of *Acropora globiceps*, and other coral species, results in prolific larval production and high natural mortality from a combination of factors including predation and dispersal to areas within the ocean without appropriate settlement habitat (e.g., deeper water, colder water, inappropriate substrate). Any anthropogenic mortality from the Navy's actions is likely to be infinitesimally small by comparison (L. Smith, personal communication, May 6, 2015) and biologically insignificant. Additionally, of the 19 threats to coral identified in the 2011 status review report of the 82 candidate coral species petitioned under the U.S. Endangered Species Act (Brainard et al. 2011a) and the top 9 threats to coral analyzed in the final rule (79 FR 53851), none include mortality of larvae by physical contact such as cavitation. While cavitation from vessels and in-water devices may result in the mortality of the developmental stages of *Acropora globiceps* (and other ESA-listed coral species), it likely would have an insignificant effect on the reproductive potential for an individual (i.e., colony) of the species or recruitment at the population level of this species. Since this level of effect is not expected to be signficant and detectable at the individual level (i.e., colony) we would not consider this effect to be a reduction in fitness of any colony of *Acropora globiceps* and thus we do not anticipate any population-level effects.

6.8 Stressors That Are Likely to Adversely Affect ESA-Listed Species

The following sections discuss stressors that are likely to adversely affect ESA-listed species. If a stressor is likely to adversely affect any of the ESA-listed species in the MITT Action Area, it

is discussed further in this Section. We address the specific species that are not likely to be adversely affected by the stressor in respective sections.

6.8.1 Effects of Collisions with Vessels

Navy vessels could strike ESA-listed animals during the course of training and testing activities. For example, within the SOCAL Range Complex, Navy vessels conducting training and testing have struck three whales over the last 10 years and in the Hawaii Range Complex, the Navy struck two whales over the last ten years. However, these are areas where the number of military vessels is generally much higher and training and testing activities occur more often than in the MITT Action Area. The Navy has been training and testing in the MITT Action Area for many years, and there has never been a documented case of a vessel striking an ESA-listed animal.

Vessels strikes could occur from surface operations or sub-surface operations (excluding bottom crawling, unmanned underwater vehicles). Vessels include ships, submarines and boats ranging from 16 ft (5 m) Rigid Hull Inflatable Boats (RHIB) to aircraft carriers (CVN) with lengths up to 1,092 ft (333 m). Navy ships greater than 60 ft (18 m) in length generally operate at 10 to 15 knots for fuel conservation when cruising. Submarines generally operate at 8 to 13 knots during surface transits and slower for certain tactical maneuvers, and greater speeds when submerged. Craft less than 60 ft (18 m) in length have more variable speeds, dependent on the mission. While these speeds are representative, some vessels operate outside of these speeds due to unique training and testing or safety requirements for a given event. Examples include increased speeds needed for flight operations, full speed runs to test engineering equipment, and time critical positioning needs. Examples of decreased speeds of less than 5 knots or completely stopped include launching small boats, certain tactical maneuvers, and target launch or retrievals.The number of participating vessels in the Action Area varies based on training and testing schedules. Most activities include either one or two vessels, with an average of one vessel per activity, and last from a few hours up to 2 weeks. Multiple ships, however, can be involved with major training events, although ships can often operate for extended periods beyond the horizon and out of visual sight from each other. A majority of vessel transit in the Action Area will occur in concentrated locations near docks and ports, particularly in and around Apra Harbor.

The Navy employs several actions to minimize to minimize collisions between surface vessels and ESA-listed animals that might occur in the Action Area. These measures include lookouts and watchstanders on the bridge of ships, requirements for course and speed adjustments to maintain safe distances from whales, and having any ship that observes whales to alert other ships in the area. Navy policy (Chief of Naval Operations Instruction 3100.6H) requires participating vessels to report all whale strikes. That information is collected by the Office of the Chief of Naval Operations Energy and Environmental Readiness Division and cumulatively provided to NMFS on an annual basis. In addition, the Navy and NMFS have standardized regional reporting protocols for communicating to NMFS stranding coordinators information on any ship strikes as soon as possible. These communication procedures will remain in place as part of this proposed action.

6.8.1.1 Cetaceans

Vessel strikes from commercial, recreational, and Navy vessels are known to affect large whales and have resulted in serious injury and occasional fatalities to cetaceans (Lammers et al. 2003) (Laggner 2009) (Calambokidis 2012) (Douglas et al. 2008) (Berman-Kowalewski et al. 2010). Reviews of the literature on ship strikes mainly involve collisions between commercial vessels and whales (e.g., Laist et al. (2001) Jensen and Silber (2004)). The ability of any ship to detect a marine mammal and avoid a collision depends on a variety of factors, including environmental conditions, ship design, size, speed, and manning, as well as the behavior of the animal. Records of collisions date back to the early 17th century, and the worldwide number of collisions appears to have increased steadily during recent decades (Laist et al. 2001; Ritter 2012) (IWC, 2008).

Vessel speed, size and mass are all important factors in determining potential impacts of a vessel strike to marine mammals. For large vessels, speed and angle of approach can influence the severity of a strike. Based on modeling, Silber et al. (2010) found that whales at the surface experienced impacts that increased in magnitude with the ship's increasing speed. Results of the study also indicated that potential impacts were not dependent on the whale's orientation to the path of the ship, but that vessel speed may be an important factor. At ship speeds of 15 knots or higher (7.7 m/second), there was a marked increase in intensity of centerline impacts to whales. Results also indicated that when the whale was below the surface (about one to two times the vessel draft), there was a pronounced propeller suction effect. This suction effect may draw the whale into the hull of the ship, increasing the probability of propeller strikes (Silber et al. 2010).

Key points in discussion of participating vessels in relationship to potential ship strike include:

- Many military ships have their bridges positioned closer to the bow, offering better visibility ahead of the ship (compared to a commercial merchant vessel).
- There are often aircraft associated with the training or testing activity, which can more readily detect cetaceans in the vicinity of a vessel or ahead of a vessel's present course before crew on the vessel would be able to detect them.
- Military ships are generally more maneuverable than commercial merchant vessels, and if cetaceans are spotted in the path of the ship, would be capable of changing course more quickly. Military ships operate at the slowest speed possible consistent with either transit needs or training or testing needs. While minimum speed is intended as a fuel conservation measure particular to a certain ship class, secondary benefits include better ability to spot and avoid objects in the water including marine mammals. In addition, a standard operating procedure for Navy vessels is to maneuver the vessel to maintain a distance of at least 500 yd. (457 m) from any observed whale and to avoid approaching whales head-on, as long as safety of navigation is not imperiled.
- The crew size on military vessels is generally larger than merchant ships, allowing for the possibility of stationing more trained Lookouts on the bridge. At all times when vessels are underway, trained Lookouts and bridge navigation teams are used to detect objects on the surface of the water ahead of the ship, including cetaceans. Additional Lookouts, beyond those already stationed on the bridge and on navigation teams, are positioned as Lookouts during some training events.
- Lookouts receive extensive training including Marine Species Awareness Training, which instructs Lookouts to recognize marine species detection cues (e.g., floating

vegetation or flocks of seabirds) as well as provides additional information to aid in the detection of cetaceans.

While it is possible for a Navy vessel to strike a cetacean during the course of training and testing activities in MITT Action Area, we do not believe this is reasonably certain to occur. As stated previously, the Navy has been training in the Action Area for years and no such incident has occurred. Additionally, the Navy employs minimization measures to reduce the likelihood for a surface vessel to strike a large whale. For these reasons, we consider the likelihood that a cetacean will be struck during Navy training and testing activities so low as to be discountable. Therefore, this stressor is not likely to adversely affect ESA-listed cetaceans and will not be considered further in this Opinion.

6.8.1.2 Sea turtles

The following sections discuss the effects of vessel strike on ESA-listed turtles.

6.8.1.2.1 Exposure of sea turtles to vessel strike

Any of the sea turtles species present in the Action Area can occur at or near the surface of the water, and therefore may be susceptible to vessel strike. There are no reported cases of a sea turtle being struck by a Navy vessel in the MITT Action Area. However, unlike when a vessel strikes a large whale, it is difficult to detect when a vessel strikes a turtle. This is largely due to the relatively small size of a sea turtle compared to the vessels used by the Navy in military readiness training and testing.

As described in Table 47, densities of leatherback and loggerhead sea turtles are very low in the MITT Action Area (i.e., < 0.00022 animals/km^2), particularly in the inshore environment near docks and ports where most of the vessel traffic is concentrated. Because of these low densities and the low amount of Navy vessel traffic that will occur in the MITT Action Area, we consider the likelihood for an individual of any of these species to be struck during Navy training and testing activities in the MITT Action Area to be so low as to be discountable.

Green and hawksbill sea turtles are more common in the Action Area, particularly in the nearshore environment (Table 47), and have a much higher likelihood of encountering moving Navy vessels. It is possible that green and hawksbill sea turtles will exhibit avoidance behavior in the event they encounter a Navy vessel in transit. If this occurs, the turtle would be expected to resume normal activities shortly after the initial avoidance response. This brief avoidance behavior of green and hawksbill sea turtles will not increase the likelihood of injury from significant disruption of breeding, feeding, or sheltering. Hazel et al. (2007) studied the behavioral responses of green turtles to vessels approaching at varying speeds. With the assumption that how quickly a turtle responds to an oncoming vessels is dependent on how soon the turtle can detect the oncoming vessel, they determined that the majority of turtles will likely not be able to avoid vessels traveling faster than 4 km/hr. While Navy vessels in nearshore areas, particularly around docks and ports are expected to travel at slower speeds than in offshore environments, some green and hawksbill turtles in these nearshore areas are expected to be susceptible to vessel strike because some vessels in these areas are likely to be traveling at speeds greater than 4km/hr.

Previous NMFS Biological Opinions have relied on sea turtle stranding network data to estimate mortality from vessel strike (e.g., Hawaii Troll and Handline BiOp; Hawaii-Southern California Training and Testing). Navy vessel movement is expected to be most concentrated in and around Apra Harbor, where major docking facilities exist. Outside of Apra Harbor, including deep-water, offshore areas, vessel traffic is assumed to be much less dense. Therefore, we expect Apra Harbor to be the only area in which sea turtle strikes are reasonably expected to occur. Although little information exists to quantify this impact, vessel collision has been implicated as the cause of three green turtle strandings in Apra Harbor between November 2002 and April 2008 (DAWR unpublished data). Corraborating that Apra Harbor is the most likely location for vessel strike to occur, stranding data around Saipan and Tinian found evidence of vessel strike in only two of 70 green sea turtle, and zero of three hawksbill sea turtle strandings between from 2005 to 2015 (sea turtle stranding network, unpublished data). Military activities around Saipan and Tinian are not associated with heavy vessel traffic. Though available information does not allow us to estimate the percentage of vessel struck turtles that are observed stranded in Apra Harbor, we expect this observed stranding rate to be fairly high due to the human population along the Harbor and that it is relatively enclosed. Therefore, using stranding rates from Hawaii as proxy (i.e., 20 to 40 percent of struck turtles are likely to strand), we assume 40 percent of vessel struck sea turtles will strand (NMFS 2008c). From the 3 observed strandings in Apra Harbor with evidence of vessel strike between November 2002 and April 2008, we estimate a total of 8 turtles were struck by vessels during this time period (3 turtles / 0.4 = 7.5 turtles). This comes to an annual strike rate of 1.36 green sea turtles per year (7.5 turtles / 5.5 years = 1.36 turtles per year).

Navy vessels account for a large percentage of the vessel traffic in Apra Harbor, but substantial traffic also occurs from recreational and commercial vessels. The of Port of Guam had 635 non-Navy vessel calls in 2013, while the Navy reports 389 Navy vessel calls in 2014 (1,024 total vessel calls). Therefore, Navy vessels account for approximately 38 percent of the large vessel traffic in and out of the Port of Guam on an annual basis. Since we do not have data to indicate how many smaller, recreational boats transit through Apra Harbor, we conservatively estimate that Navy vessel traffic accounts for 38 percent of the vessel movement within Apra Harbor. Therefore, we expect that on average, the Navy will strike up to 1 green turtle per year (1.36 turtles per year x 0.38 = 0.52; rounded up to 1 turtle).

After further analysis, given the lack of stranding data associated with vessel strikes in the Action Area, and the lower abundance and sighting data of hawksbill sea turtles in Apra Harbor, it is not reasonable to expect Navy vessels will strike this species. Therefore, the likelihood of Navy vessels striking a hawksbill sea turtle is so low as to be discountable.

6.8.1.2.2 Response of sea turtles to vessel strike

Ship strikes are known to injure and kill sea turtles (Work et al. 2010a). Stranding networks that keep track of sea turtles that wash up dead or injured have consistently recorded vessel propeller strikes as a cause or possible cause of death (Chaloupka et al. 2008b). We conclude that collisions with vessels would likely result in blunt trauma, lacerations, and mortality.

6.8.1.3 Scalloped Hammerhead Shark – Indo-West Pacific DPS

Scalloped hammerhead sharks in the Action Area may encounter moving Navy vessels. However, it is expected that this highly mobile and fast swimming species will exhibit evasive

behavior in the event they encounter a Navy vessel at close range and will be able to avoid being struck. Further, it is expected that sharks will return to normal behavior shortly after avoiding the oncoming vessel as with other natural evasive responses where the perceived threat has passed. Any temporary avoidance behavior will not increase the likelihood of injury from significant disruption of breeding, feeding, or sheltering and is not expected to rise to the level of take. For these reasons, scalloped hammerhead sharks are not likely to be adversely affected by vessel strike stressors since brief behavioral avoidance is considered insignificant.

6.8.1.4 Corals

Though unlikely (with the exception of Amphibious Assault and Amphibious Raid Operations, as described below), Navy vessels may contact the benthos, including coral reefs, during training and testing activities. If a Navy vessel struck an ESA-listed coral colony, this could result in colony fragmentation, injury, or mortality. However, we do not believe vessel strike of coral colonies is reasonably certain to occur. In nearshore habitats, where a large percentage of the vessel traffic is concentrated, most Navy vessel movements are confined to established channels, ports, or transit lanes. These areas are frequently used by vessels (Navy and non-Navy), and have water deep enough to where vessels do not contact coral reef or other substrate types. For movement in nearshore habitats not in established channels or transit lanes, vessels are not expected to contact coral reef habitats because they are equipped with appropriate navigational equipment and vessel operators actively avoid running aground (this excludes Amphibious Assault and Amphibious Raid operations). Additionally, Navy vessels are not expected to strike coral reefs in offshore habitats because waters are deep enough to where vessels will not contact coral reef or other substrate types. For these reasons, we consider the likelihood of an ESA-listed coral being struck by a Navy vessel during training and testing activities (excluding Amphibious Assault and Amphibious Raid Operations, which is addressed below) to be so low as to be discountable.

Navy vessels could contact benthic habitat in areas adjacent to corals in the surf zone during Amphibious Assault and Amphibious Raid operations. However, due to the minimization measures described below, vessels are expected to avoid direct contact with coral colonies. Amphibious Assault and Amphibious Raid training activities would be conducted in the nearshore area, including the surf zone, up to the high tide line. Prior to conducting any amphibious over-the-beach training activity with larger amphibious vehicles such as Landing Craft Air Cushions (LCACs) or Amphibious Assault Vehicles (AAVs), surveys would be conducted to identify and designate boat lanes and beach landing areas that are clear of coral, hard bottom substrate, and obstructions. Based on the surveys, if the beach landing area and boat lane is clear, the activity could be conducted, and crews would follow procedures to avoid obstructions to navigation, including coral reefs. However, if the survey indicates there is any potential for impacts on corals or hard bottom substrate, the Navy will coordinate with applicable resource agencies before conducting the activity. Further, LCAC and AAV landing and departure activities would be scheduled at high tide, decreasing the likelihood that a vessel would contact coral colonies. If necessary to traverse over areas with coral or other hard-bottom substrate, LCACs and AAVs would hover over, but avoid direct contact with such habitats. Surveys would not be necessary for beach landings with small boats, such as RHIBs. We do not expect small boats to contact coral reefs during this activity because it would be a navigational and safety

hazard for vessels of this size to strike exposed or near-surface substrate. For reasons described above, we consider the likelihood of an ESA-listed coral being struck by a Navy vessel during Amphibious Assault and Amphibious Raid operations to be so low as to be discountable.

Precision anchoring will occur in Apra Harbor and other existing anchorages in the Mariana Islands. Except in existing anchorages and near-shore training areas around Guam and within Apra Harbor, Navy vessels will not anchor within the anchor swing diameter of surveyed shallow coral reefs, live hardbottom, articificial reefs, or shipwrecks. Recent studies have identified evidence of anchor and/or anchor chain damage to coral in Apra Harbor, including the formation of a rubble field on the southern side of the floating dry dock. Movement of mooring chains on the southern side of the floating dry dock has produced a significant rubble field, although mooring chains on the northern (outer) side of the floating dry dock do not appear to have caused similar damage (DoN 2010b). Available data suggests ESA-listed corals do not occur at existing Navy anchorages in Apra Harbor or other locations. Therefore, we consider the likelihood of Navy anchorage impacting ESA-listed coral species to be so low as to be discountable.

ESA-listed corals are not expected to be affected by vessel strike; therefore, no response analysis is necessary.

6.8.2 Overview of Effects of Acoustic Stressors

The U.S. Navy grouped approximately 300 individual sources of underwater acoustic sound or explosive energy, into a series of source classifications, or source bins. There are two primary types of source classes: "Impulsive" and "Non-impulsive" acoustic. A description of each source classification analyzed for marine mammals is provided in Table 48 and Table 49 below.

Table 48. Training and Testing Non-Impulsive Acoustic Sources Analyzed for Marine Mammals

Source Class Category	Source Class	Description
Low-Frequency (LF): Sources that produce low-frequency (less than 1 kHz) signals	LF4	Low-frequency sources equal to 180 dB and up to 200 dB
	LF5	Low-frequency sources less than 180 dB
	LF6	Low-frequency sonar currently in development (e.g., ASW sonar associated with the LCS)
Mid-Frequency (MF): Tactical and non-tactical sources that produce mid-frequency (1–10 kHz) signals	MF1	Hull-mounted surface ship sonar (e.g., AN/SQS-53C and AN/SQS-60)
	MF2	Hull-mounted surface ship sonar (e.g., AN/SQS-56)
	MF3	Hull-mounted submarine sonar (e.g., AN/BQQ-10)
	MF4	Helicopter-deployed dipping sonar (e.g., AN/AQS-22 and AN/AQS-13)
	MF5	Active acoustic sonobuoys (e.g., DICASS)
	MF6	Active underwater sound signal devices (e.g., MK-84)
	MF8	Active sources (greater than 200 dB)

		not otherwise binned
	MF9	Active sources (equal to 180 dB and up to 200 dB)
	MF20	Active sources (greater than 160 dB, but less than 180 dB) not otherwise binned
	MF11	Hull-mounted surface ship sonars with an active duty cycle greater than 80%
	MF12	High duty cycle – variable depth sonar
High-Frequency (HF) and Very High-Frequency (VHF): Tactical and non-tactical sources that produce high-frequency (greater than 10 kHz but less than 200 kHz) signals	HF1	Hull-mounted submarine sonar (e.g., AN/BQQ-10)
	HF4	Mine detection, classification, and neutralization sonar (e.g., AN/SQS-20)
	HF5	Active sources (greater than 200 dB)
	HF6	Active sources (equal to 180 dB and up to 200 dB)
Anti-Submarine Warfare (ASW): Tactical sources such as active sonobuoys and acoustic countermeasures systems used during the conduct of anti-submarine warfare testing activities	ASW1	Mid-frequency DWADS
	ASW2	Mid-frequency MAC sonobuoy (e.g., AN/SSQ-125)
	ASW3	Mid-frequency towed active acoustic countermeasure systems (e.g., AN/SLQ-25)
Torpedoes (TORP): Source classes associated with the active acoustic signals produced by torpedoes	TORP1	Lightweight torpedo (e.g., MK-46, MK-54, or Anti-Torpedo Torpedo)
	TORP2	Heavyweight torpedo (e.g., MK-48)
Acoustic Modems (M): Systems used to transmit data acoustically through water	M3	Mid-frequency acoustic modems (greater than 190 dB)
Swimmer Detection Sonar (SD): Systems used to detect divers and submerged swimmers	SD1	High-frequency sources with short pulse lengths, used for the detection of swimmers and other objects for the purpose of port security.

Notes: dB = decibels, DICASS = Directional Command Activated Sonobuoy System, DWADS = Deep Water Active Distributed System, kHz = kilohertz, LCS = Littoral Combat Ship, MAC = Multi-static Active Coherent

Table 49. Training and Testing Explosive Sources Analyzed for Marine Mammals

Source Class	Representative Munitions	Net Explosive Weight (lb.)[1]
E1	Medium-caliber projectiles	0.1–0.25
E2	Medium-caliber projectiles	0.25–0.5
E3	Large-caliber projectiles	> 0.5–2.5
E4	Improved Extended Echo Ranging Sonobuoy	> 2.5–5.0
E5	5-inch projectiles	> 5–10
E6	15 lb. shaped charge	> 10–20
E8	250 lb. bomb	> 60–100
E9	500 lb. bomb	> 100–250

E10	1,000 lb. bomb	> 250–500
E11	650 lb. mine	> 500–650
E12	2,000 lb. bomb	> 650–1,000

[1]**Net Explosive Weight refers to the amount of explosives; the actual weight of a munition may be larger due to other components**

Activities and acoustic source classes modeled for sea turtles are provide in the Table 50 below:

Table 50. Activities and Active Acoustic Sources Modeled and Quantitatively Analyzed by the U.S. Navy for Acoustic Impacts on Sea Turtles (Reference FEIS/OEIS V2, June 2014)

Activity	Acoustic Source Class
Training Activity	
Joint Expeditionary Exercise	ASW2, ASW3, MF1, MF12, MF2, MF3, MF4, MF5
Joint Multi-Strike Group Exercise	ASW2, ASW3, ASW4, MF1, MF11, MF12, MF2, MF3, MF4, MF5
Marine Air Ground Task Force Exercise (Amphibious)	ASW3, MF1, MF12, MF2, MF3, MF4
TRACKEX/TORPEX – MPA Advanced Extended Echo Ranging Sonobuoys	ASW2
TRACKEX/TORPEX – Surface	ASW3, MF1, MF11, MF12, MF2, TORP1
Testing Activity	
Anti-Submarine Warfare Tracking Test – Maritime Patrol Aircraft	ASW2, MF5, MF6, TORP1
ASW Mission Package Testing	ASW1, ASW3, LF6, MF12, MF4, MF5
At-Sea Sonar Testing	ASW1, LF5, M3, MF1, MF10, MF11, MF3, MF9
Pierside Integrated Swimmer Defense	LF4, MF8, SD1

In order to better organize and facilitate the analysis of about 300 sources of underwater non-impulsive sound or impulsive energy, the Navy developed a series of source classifications, or source bins. This method of analysis provides the following benefits:

- Allows for new sources to be covered under existing authorizations, as long as those sources fall within the parameters of a "bin;"
- Simplifies the data collection and reporting requirements anticipated under the MMPA;
- Ensures a conservative approach to all impact analysis because all sources in a single bin are modeled as the loudest source (e.g., lowest frequency, highest source level, longest duty cycle, or largest net explosive weight within that bin);
- Allows analysis to be conducted more efficiently, without compromising the results; and
- Provides a framework to support the reallocation of source usage (hours/explosives) between different source bins, as long as the total number and severity of marine mammal takes remain within the overall analyzed and authorized limits. This flexibility

is required to support evolving Navy training and testing requirements, which are linked to real world events.

Non-impulsive sources are grouped into bins based on the frequency, source level when warranted, and how the source would be used. Impulsive bins are based on the net explosive weight of the munitions or explosive devices. The following factors further describe how non-impulsive sources are divided:

Frequency of the non-impulsive source:

- Low-frequency sources operate below 1 kilohertz (kHz)
- Mid-frequency sources operate at or above 1 kHz, up to and including 10 kHz
- High-frequency sources operate above 10 kHz, up to and including 100 kHz
- Very high-frequency sources operate above 100 kHz, but below 200 kHz

Source level of the non-impulsive source:

- Greater than 160 decibels (dB), but less than 180 dB
- Equal to 180 dB and up to 200 dB
- Greater than 200 dB

How a sensor is used determines how the sensor's acoustic emissions are analyzed. Factors to consider include pulse length (time source is on); beam pattern (whether sound is emitted as a narrow, focused beam, or, as with most explosives, in all directions); and duty cycle (how often a transmission occurs in a given time period during an event).

There are also non-impulsive sources with characteristics that are not anticipated to result in takes of marine mammals under the MMPA or ESA. These sources have low source levels, narrow beam widths, downward directed transmission, short pulse lengths, frequencies beyond known hearing ranges of marine mammals, or some combination of these factors. These sources were not modeled by the Navy, but are qualitatively analyzed in the MITT FEIS/OEIS, May 2015.

Understanding the number of munitions detonating in water is critical to assessing potential impacts from acoustic stressors, potential strike and fragments resulting from exploded munitions. Table 51 below provides the number and source of these munitions.

Table 51. Proposed Annual Number of Impulsive Source Detonations During Training and Testing in the MITT Action Area

Explosive Class	Net Explosive Weight (NEW)	Annual In-Water Detonations
E1	(0.1 lb. – 0.25 lb.)	10,140
E2	(0.26 lb. – 0.5 lb.)	106
E3	(>0.5 lb. – 2.5 lb.)	932
E4	(>2.5 lb. – 5 lb.)	420
E5	(>5 lb. – 10 lb.)	684
E6	(>10 lb. – 20 lb.)	76
E8	(>60 lb. – 100 lb.)	16
E9	(>100 lb. – 250 lb.)	4
E10	(>250 lb. – 500 lb.)	12
E11	(>500 lb. – 650 lb.)	6
E12	(>650 lb. – 2,000 lb.)	184

Understanding the frequency and duration of active sonar sources is imperative in our risk analysis for stressors resulting from non-impulsive sound sources. Table 52 below provide the annual hours of these sources in the MITT Action Area.

Table 52. Annual hours and items of non-impulsive sources used during training and testing within the MITT Action Area

Source Class Category	Source Class	Average Annual Use
Low-Frequency (LF) Sources that produce signals less than 1 kilohertz (kHz)	LF4	123 hours
	LF5	11 hours
	LF6	40 hours
Mid-Frequency (MF) Active sources from 1 to 10 kHz	MF1	1,872 hours
	MF2	625 hours
	MF3	192 hours
	MF4	214 hours
	MF5	2,588 hours
	MF6	33 hours
	MF8	123 hours
	MF9	47 hours
	MF10	231 hours
	MF11	324 hours
	MF12	656 hours

Source Class Category	Source Class	Average Annual Use
High-Frequency (HF) and Very High-Frequency (VHF) Tactical and non-tactical sources that produce signals greater than 10kHz but less than 200kHz	HF1	113 hours
	HF4	1,060 hours
	HF5	336 hours
	HF6	1,173 hours
Anti-Submarine Warfare (ASW) Tactical sources used during anti-submarine warfare training and testing activities	ASW1	144 hours
	ASW2	660 hours
	ASW3	3,935 hours
	ASW4	32 hours
Torpedoes (TORP) Source classes associated with active acoustic signals produced by torpedoes	TORP1	115 hours
	TORP2	62 hours
Acoustic Modems (M) Transmit data acoustically through the water	M3	112 hours
Swimmer Detection Sonar (SD) Used to detect divers and submerged swimmers	SD1	2,341 hours
Airgun (AG)1	AG	308 hours

Notes: dB = decibels, DICASS = Directional Command Activated Sonobuoy System, DWADS = Deep Water Active Distributed System, kHz = kilohertz, LCS = Littoral Combat Ship, MAC = Multi-static Active Coherent

6.8.3 Effects of Non-Impulsive Acoustic Stressors - Cetaceans

For this consultation, we considered exposure estimates from the Navy Acoustic Effects Model at two output points for marine mammals. First, the total number of ESA-listed species (animats) that would be exposed to acoustic sources greater than 120dB prior to the application of a dose-response curve or criteria. We term these the "unprocessed" estimates. This estimate is the number of times individual animats or animals are likely to be exposed to the acoustic environment that is a result of training exercises and testing activities, regardless of whether they are "taken" as a result of that exposure. In most cases, the number of animals "taken" by an action would be a subset of the number of animals that are exposed to the action because (1) in some circumstances, animals might not respond to an exposure and (2) some responses may be negative for an individual animal without constituting a form of "take" (for example, some physiological stress responses only have fitness consequences when they are sustained and would only constitute a "take" as a result of cumulative exposure).

The second set (Table 55) of predicted exposures ("processed") of listed species were generated and processed using dose-response curves and criteria for temporary and permanent threshold shift developed by the Navy and NMFS' Permits Division for the purpose of identifying

harassment pursuant to the MMPA. Neither sets of exposure estimates, the unprocessed or processed, consider standard mitigation actions that NMFS' Permits Division would require under the MMPA rule to avoid marine mammals or that the Navy proposes for marine mammals, nor did the estimates consider any avoidance responses that might be taken by individual animals once they sense the presence of Navy vessels or aircraft.

Our estimation of take is derived from the processed exposure estimates on an annual basis, cumulatively over the five-year period, and cumulatively for the reasonably foreseeable future to derive a final estimate of anticipate levels of take by training activity and species.

6.8.3.1 Exposures to Non-impulsive Acoustic Stressors During Training

The following sections discuss the exposure of ESA-listed species to non-impulsive acoustic stressors.

6.8.3.1.1 Unprocessed Exposures to Non-Impulsive Acoustic Stressors During Training

Navy model output estimates of whales that will be exposed to sonar and other non-impulsive acoustic stressors associated with training activities above received levels of 120 dB throughout the year are summarized in Table 53 and discussed below. Exposures at levels above 120 dB may result in behavioral or physiological responses (see Section 6.2).

Table 53. Model-Predicted Exposures of Cetaceans to Non-Impulsive Sound During Training Activities

Species	Number of Model-Predicted Exposures >120 dB Per Year
blue whale	195
fin whale	208
humpback whale	10,862
sei whale	3,378
sperm whale	14,813

Blue whale. The model output estimates that blue whales will be exposed to sonar and other non-impulsive acoustic stressors associated with training activities throughout the year. The NAEMO provided an unprocessed estimate of 195 blue whale exposure events annually to non-impulsive sounds associated with annual training at levels above 120 dB SPL. Thirty-seven (37) percent of the estimated 195 exposures to blue whales during training activities will result from TRACKEX/TORPEX – Surface exercises while 13 percent will result from Joint Expeditionary Exercises and 10 percent result from Joint Multi-Strike Group Exercises.

Fin whale. The model output estimates that fin whales will be exposed to sonar and other non-impulsive acoustic stressors associated with training activities throughout the year. The NAEMO provided an unprocessed estimate of 208 fin whale exposure events annually to non-impulsive sounds associated with annual training at levels above 120 dB SPL. Forty (40) percent of the estimated 208 exposures to fin whales during training activities will result from TRACKEX/TORPEX – Surface exercises while 12 percent will result from Joint Expeditionary Exercises and 12 percent result from Joint Multi-Strike Group Exercises.

Humpback whale. The model output estimates that humpback whales will be exposed to sonar and other non-impulsive acoustic stressors associated with training activities throughout the year. The NAEMO provided an unprocessed estimate of 10,862 blue whale exposure events annually to non-impulsive sounds associated with annual training at levels above 120 dB SPL. Forty-nine (49) percent of the estimated 10,862 exposures to humpback whales during training activities will result from TRACKEX/TORPEX – Surface exercises while 10 percent will result from Joint Expeditionary Exercises and 12 percent result from Joint Multi-Strike Group Exercises.

Sei whale. The model output estimates that sei whales will be exposed to sonar and other non-impulsive acoustic stressors associated with training activities throughout the year. The NAEMO provided an unprocessed estimate of 3,378 sei whale exposure events annually to non-impulsive sounds associated with annual training at levels above 120 dB SPL. Forty-seven (47) percent of the estimated 3,378 exposures to sei whales during training activities will result from TRACKEX/TORPEX – Surface exercises while 10 percent will result from Joint Expeditionary Exercises and 13 percent result from Joint Multi-Strike Group Exercises.

Sperm whale. The model output estimates that blue whales will be exposed to sonar and other non-impulsive acoustic stressors associated with training activities throughout the year. The NAEMO provided an unprocessed estimate of 14,813 sperm whale exposure events annually to non-impulsive sounds associated with annual training at levels above 120 dB SPL. Forty-nine (49) percent of the estimated 14,813 exposures to sperm whales during training activities will result from TRACKEX/TORPEX – Surface exercises while 11 percent will result from Joint Expeditionary Exercises and 13 percent result from Joint Multi-Strike Group Exercises.

6.8.3.1.2 Unprocessed Exposures to Non-Implusive Acoustic Stressors During Testing

Navy model output estimates of whales that will be exposed to sonar and other non-impulsive acoustic stressors associated with testing activities throughout the year are summarized in Table 54 and discussed below.

Table 54. Model-Predicted Exposures of Cetaceans to Non-Impulsive Sound During Testing Actvities

Species	Number of Model-Predicted Exposures >120 dB Per Year
blue whale	102
fin whale	115
humpback whale	4,179
sei whale	1,330
sperm whale	5,941

Blue whale. The model output estimates that blue whales will be exposed to sonar and other non-impulsive acoustic stressors associated with testing activities throughout the year. The NAEMO provided an unprocessed estimate of 102 blue whale exposure events annually to non-impulsive sounds associated with annual training at levels above 120 dB SPL. Forty-seven (47) percent of the estimated 102 exposures to blue whales during testing activities will result from Anti-submarine Warfare Tracking Test – Marine Patrol Aircraft while 33 percent will result from ASW Mission Package Testing and 15 percent result from At-Sea Sonar Testing.

Fin whale. The model output estimates that fin whales will be exposed to sonar and other non-impulsive acoustic stressors associated with testing activities throughout the year. The NAEMO provided an unprocessed estimate of 115 fin whale exposure events annually to non-impulsive sounds associated with annual training at levels above 120 dB SPL. Fifty (50) percent of the estimated 115 exposures to fin whales during training activities will result from Anti-submarine Warfare Tracking Test – Marine Patrol Aircraft while 32 percent will result from ASW Mission Package Testing and 13 percent result from At-Sea Sonar Testing.

Humpback whale. The model output estimates that humpback whales will be exposed to sonar and other non-impulsive acoustic stressors associated with testing activities throughout the year. The NAEMO provided an unprocessed estimate of 4,179 humpback whale exposure events annually to non-impulsive sounds associated with annual training at levels above 120 dB SPL. Thirty-seven (37) percent of the estimated 4,179 exposures to humpback whales during training activities will result from Anti-submarine Warfare Tracking Test – Marine Patrol Aircraft while 46 percent will result from ASW Mission Package Testing and 14 percent result from At-Sea Sonar Testing.

Sei whale. The model output estimates that sei whales will be exposed to sonar and other non-impulsive acoustic stressors associated with testing activities throughout the year. The NAEMO provided an unprocessed estimate of 1,330 sei whale exposure events annually to non-impulsive sounds associated with annual training at levels above 120 dB SPL. Thirty-seven (37) percent of the estimated 1,330 exposures to sei whales during training activities will result result from Anti-submarine Warfare Tracking Test – Marine Patrol Aircraft while 46 percent will result from ASW Mission Package Testing and 13 percent result from At-Sea Sonar Testing.

Sperm whale. The model output estimates that sperm whales will be exposed to sonar and other non-impulsive acoustic stressors associated with testing activities throughout the year. The NAEMO provided an unprocessed estimate of 5,941 sperm whale exposure events annually to non-impulsive sounds associated with annual training at levels above 120 dB SPL. Thirty-two (32) percent of the estimated 5,941 exposures to sperm whales during training activities will result result from Anti-submarine Warfare Tracking Test – Marine Patrol Aircraft while 50 percent will result from ASW Mission Package Testing and 14 percent result from At-Sea Sonar Testing.

6.8.3.1.3 Processed Exposures to Non-Impulsive Acoustic Stressors During Training and Testing

Humpback whale, blue whale, fin whale, and sei whale are all mysticetes. Research and observations show that if mysticetes are exposed to sonar or other active acoustic sources they may react in a number of ways depending on the characteristics of the sound source, their experience with the sound source, and whether they are migrating or on seasonal grounds (i.e., breeding or feeding grounds). Reactions may include alerting, breaking off feeding dives and surfacing, diving or swimming away, or no response at all (Southall et al. 2007b) (Southall et al. 2012) (Goldbogen et al. 2013; Melcon et al. 2012). Additionally, migrating mysticetes (such as humpback whales moving through the Action Area) may divert around sound sources that are located within their path or may ignore a sound source depending on the context of the exposure.

Animals that experience TTS may have reduced ability to detect relevant sounds such as predators, prey, or social vocalizations until their hearing recovers. Recovery from a threshold shift (i.e., TTS; temporary partial hearing loss) can take a few minutes to a few days depending on the severity of the initial shift. Threshold shifts do not necessarily affect all hearing frequencies equally, so some threshold shifts may not interfere with an animal's ability to hear biologically relevant sounds. For exposures resulting in TTS, long-term consequences for individuals or populations would not be expected.

Predicted effects (processed values) from sonar and other active acoustic sources on ESA-listed marine mammals are shown in Table 55. Only behavioral responses (non-TTS effects) and TTS effects are anticipated. Based on the exposure levels modeled, no PTS level detections are expected.

Table 55. Predicted Effects (processed values) on Endangered Species Act-Listed Marine Mammals from Annual Training and Testing Use of Sonar and Other Active Acoustic Sources

Species	Non-TTS (Behavioral)	TTS	PTS
Mysticetes			
Blue whale	3	25	0
Fin whale	4	24	0
Humpback whale	181	679	0
Sei whale	61	258	0
Odontocetes			
Sperm whale	452	54	0

6.8.3.2 Response of ESA-Listed Species to Non-Impulsive Acoustic Stressors

The following sections discuss the response of ESA-listed species to non-impulsive acoustic stressors.

6.8.3.2.1 Blue Whale

Temporary Threshold Shift (TTS) - As mentioned previously, TTS can last from a few minutes to days, be of varying degree, and occur across various frequency bandwidths, all of which determine the severity of the impacts on the affected individual, which can range from minor to more severe. The TTS sustained by an animal is primarily classified by three characteristics:

1. Frequency—Available data (of midfrequency hearing specialists exposed to mid- or high-frequency sounds; (Southall et al. 2007b)) suggest that most TTS occurs in the frequency range of the source up to one octave higher than the source (with the maximum TTS at ½ octave above). The more powerful mid-frequency sources used have center frequencies between 3.5 kHz and 8 kHz and the other unidentified mid-frequency sources are, by definition, less than 10 kHz, which suggests that TTS induced by any of these mid frequency sources would be in a frequency band somewhere between approximately 2 and 20 kHz. As discussed above, blue whales are low-frequency hearing specialists, producing low-frequency vocalizations that include moans in the range from 12.5 Hz to 400 Hz, with dominant frequencies from 16 Hz to 25 Hz. Therefore, even though recent studies (discussed below) indicate that blue whales hear and respond to mid-frequency sounds, it is unlikely that TTS caused by mid-frequency active sonar transmissions would

interfere with an animal's ability to hear vocalizations or most other biologically important sounds. There are fewer hours of high frequency source use and the sounds would attenuate more quickly, plus they have lower source levels, but if an animal were to incur TTS from these sources, it would cover a higher frequency range (sources are between 20 kHz and 100 kHz, which means that TTS could range up to 200 kHz; however, high frequency systems are typically used less frequently and for shorter time periods than surface ship and aircraft mid-frequency systems, so TTS from these sources is even less likely).

2. Degree of the shift (i.e., how many dB is the sensitivity of the hearing reduced by)—Generally, both the degree of TTS and the duration of TTS will be greater if the marine mammal is exposed to a higher level of energy (which would occur when the peak dB level is higher or the duration is longer). The threshold for the onset of TTS was discussed previously in this document. An animal would have to approach closer to the source or remain in the vicinity of the sound source appreciably longer to increase the received SEL, which would be difficult considering the lookouts, the sightability of blue whales and other listed mysticetes, and the nominal speed of an active sonar vessel (10 to 15 knots). In the TTS studies, some using exposures of almost an hour in duration or up to 217 SEL, most of the TTS induced was 15 dB or less, though Finneran et al. (2007) induced 43 dB of TTS with a 64-second exposure to a 20 kHz source. However, mid-frequency active sonar emits a nominal ping every 50 seconds, and incurring those levels of TTS is highly unlikely.

3. Duration of TTS (recovery time)—In the TTS laboratory studies, some using exposures of almost an hour in duration or up to 217 SEL, almost all individuals recovered within 1 day (or less, often in minutes), though in one study (Finneran et al. 2007), recovery took 4 days. Based on the range of degree and duration of TTS reportedly induced by exposures to non-pulse sounds of energy higher than that to which freeswimming marine mammals in the field are likely to be exposed during mid-frequency/high-frequency active sonar training exercises in the Action Area, it is unlikely that blue whales or other listed cetaceans would ever sustain a TTS from MFAS that alters their sensitivity by more than 20 dB for more than a few days (and any incident of TTS would likely be far less severe due to the short duration of the majority of the exercises and the speed of a typical vessel). Also, because of the short distance within which animals would need to approach the sound source, it is unlikely that animals would be exposed to the levels necessary to induce TTS in subsequent time periods such that their recovery is impeded.

In addition, the mitigation zones prescribed in the final MMPA rule encompass the ranges to PTS for the most sensitive marine mammal functional hearing group, which is usually the high-frequency cetacean hearing group. Therefore, the mitigation zones are even more protective for blue whales and other low-frquency cetaceans, and likely cover a larger portion of the potential range to onset of TTS. Accordingly, the prescribed mitigation and the sightability of blue whales and other mysticetes (due to their large size) reduce the potential for a significant TTS or behavioral reaction threshold shift to occur.

Therefore, for blue whales and other listed mysticetes analyzed in this Opinion, even though the modeled TTS estimates may change from year to year over baseline conditions, NMFS does not anticipate TTS of a long duration or severe degree to occur as a result of exposure to mid- or high-frequency active sonar utilized in the MITT Action Area.

The classification of modeled effects from acoustic stressors, such as TTS, are performed in a manner as to conservatively overestimate the impacts of those effects. Acoustic stressors are binned and all stressors within each bin are modeled as the loudest source, overestimating impacts within each bin. Therefore, the temporary duration of many TTS exposures may be on the shorter end of the range and last only a few minutes. Even longer duration TTS are expected to typically last hours. Given the brief amount of time blue whales are expected to experience TTS, it is unlikely to significantly impair their ability to communicate, forage, or breed and will not have fitness level consequences at the individual or population level. Results from 2 years (2009 and 2010) of intensive monitoring by independent scientists and Navy observers in the Southern California (SOCAL) and Hawaii Range Complexes have recorded an estimated 161,894 marine mammals with no evidence of distress or unusual behavior observed during Navy activities, supporting that TTS is unlikely to significantly impair the ability of blue whales to communicate, forage, or breed and will not have fitness level consequences at the individual or population level.

Behavioral Responses - As discussed, the Navy uses the behavioral response function to quantify the number of behavioral responses that would qualify as Level B behavioral harassment under the MMPA. As the statutory definition is currently applied, a wide range of behavioral reactions may qualify as Level B harassment under the MMPA, including but not limited to avoidance of the sound source, temporary changes in vocalizations or dive patterns, temporary avoidance of an area, or temporary disruption of feeding, migrating, or reproductive behaviors. The estimates calculated using the behavioral response function do not differentiate between the different types of potential reactions. Nor do the estimates provide information regarding the potential fitness or other biological consequences of the reactions on the affected individuals. We therefore consider the available scientific evidence to determine the likely nature of the modeled blue whale behavioral responses and the potential fitness consequences for affected individuals.

While we recognize that animal hearing evolved separately from animal vocalizations and, as a result, it may be inappropriate to make inferences about an animal's hearing sensitivity from their vocalizations, we have no data on blue whale hearing so we assume that blue whale vocalizations are partially representative of their hearing sensitivities. Blue whales are not likely to respond to high-frequency sound sources associated with the proposed training exercises and testing activities because of their hearing sensitivities. Despite previous assumptions based on vocalizations and anatomy that blue whales predominantly hear low-frequency sounds below 400 Hz (Croll et al. 2001b; Oleson et al. 2007b; Stafford and Moore 2005a), recent research has indicated blue whales not only hear mid-frequency active sonar transmissions, in some casesthey respond to those transmissions (Goldbogen et al. 2013; Melcon et al. 2012; Southall et al. 2011a).

As summarized in Section 6.2.10 and Section 6.2.10.2, blue whales may hear some sounds in the mid-frequency range and exhibit behavioral responses to sounds in this range depending on

received level and context (Goldbogen et al. 2013; Melcon et al. 2012). However, both Goldbogen et al. (2013) and Melcon et al. (2012) indicated that behavioral responses to simulated or operational MFA sonar were temporary, with whales resuming normal behavior quickly after the cessation of sound exposure. Further, responses were discernible for whales in certain behavioral states (i.e., deep feeding), but not in others (i.e., surface feeding). As stated in Goldbogen et al. (2013) when summarizing the response of blue whales to simulated MFA sonar, "We emphasize that elicitation of the response is complex, dependent on a suite of contextual (e.g., behavioral state) and sound exposure factors (e.g., maximum received level), and typically involves temporary avoidance responses that appear to abate quickly after sound exposure."

Melcon et al. (2012) reported that blue whales exposed to mid-frequency sonar in the Southern California Bight were less likely to produce low frequency calls (D calls) usually associated with feeding behavior. However, they they were unable to determine if suppression of D calls reflected a change in their feeding performance or abandonment of foraging behavior and indicated that implications of the documented responses are unknown. Goldbogen et al. (2013) speculated that if the documented temporary behavioral responses interrupted feeding behavior, this could have impacts on individual fitness and eventually, population health. However, for this to be true, we would have to assume that an individual whale could not compensate for this lost feeding opportunity by either immediately feeding at another location, by feeding shortly after cessation of acoustic exposure, or by feeding at a later time. There is no indication this is the case, particularly since unconsumed prey would likely still be available in the environment in most cases following the cessation of acoustic exposure.

Moreover, there are important differences between the acoustic sources used in the authors' Controlled Exposure Experiments. As discussed previously, perhaps the most significant reponse documented in the study occurred during a controlled exposure experiments involving pseudo-random noise rather than simulated sonar, which corresponded with a blue whale terminating a foraging bout. The more significant reaction to PRN may be indicative of habituation to mid-frequency sonar signals; the authors noted that the responses they documented were in a geographical region with a high level of naval activity and where mid-frequency sonar use is common.In addition, during the controlled exposure experiments, sound sources were deployed from a stationary source vessel positioned approximately 1,000 m from the focal animals, with one transmission onset every 25 seconds (Southall et al. 2012). In contrast, most Navy sonar systems are deployed from highly mobile vessels or in-water devices which do not directly target marine mammals. Further, the typical duty cycle with most tactical anit-submarine warefare is lower than used in the controlled exposure experiments described above, transmitting about once per minute minute with most active sonar pulses lasting no more than a few seconds (Navy 2013). Moreover, a typical Navy vessel with hull mounted MFA sonar would travel over 0.3 kilometers between pings (based on a speed of 10 knots/hr and transmission rate of 1 ping/min). Based on this distance traveled and potential avoidance behavior of acoustically exposed animals, we expect repeat acoustic exposures capable of eliciting a behavioral response to an individual over a brief period of time to be rare. In the event an individual is exposed to multiple sound sources that elicit a behavioral response (e.g., disruption of feeding) in a short amount of time, we do not expect these exposures to have fitness consequences as individuals will resume

feeding upon cessation of the sound exposure and unconsumed prey will still be available in the environment.

As noted in Southall et al. (Southall et al. 2007b), substantive behavioral reactions to noise exposure (such as disruption of critical life functions, displacement, or avoidance of important habitat) are considered more likely to be significant if they last more than 24 hours, or recur on subsequent days. Major training exercises conducted in the MITT Action Area can last several weeks, and during those exercises there may be periods of continuous sonar use. Not every major training exercise has anti-submarine warfare events where sonar is used. However, even the longest periods of "continuous" active sonar use rarely last longer than 12 hours, and active sonar use is not truly continuous because a sonar system is actively transmitting a small portion of the time (once per minute for approximately 10 seconds). For Navy active sonar use, a period of concentrated, near continuous anti-submarine warfare sonar use means that sound energy is being put in the water nearly 2 percent of the time. Sonar sound is not transmitting when trying to listen for returns of a detection of a submarine or contact of something else in the water column. Vessels equipped with the most powerful sonar systems would also generally be moving at speeds of 10 to15 knots separated in distances when using active sonar. Thus, even during major training exercises, it is unlikely that a specific geographic area or water column would be ensonified at high levels for prolonged periods of time, which could increase the risk of significant behavioral responses or repeated disturbances in close temporal proximity. Even if sound exposure were to be concentrated in a relatively small geographic area over a long period of time (e.g., days or weeks during major training exercises), we would expect that some individual whales would most likely respond by temporarily avoiding areas where exposures to acoustic stressors are at higher levels (e.g., greater than 120 dB). For example, Goldbogen et al. (2013) indicated some horizontal displacement of deep foraging blue whales in response to simulated MFA sonar. However, given these animal's mobility and large ranges, we would expect these individuals to temporaily select alternative foraging sites nearby until the exposure levels in their initially selected foraging area have decreased. Therefore, even temporary displacement from initially selected foraging habitat is not expected to impact the fitness of any individual animals because we would expect similar foraging to be available in close proximity. Because we do not expect any fitness consequences from any individual animals, we do not expect any population level effects from these behavioral responses.

On a related point, for purposes of this Opinion, we assume that the Navy's activities and associated impacts will continue into the reasonably foreseeable future at the annual levels discussed herein. This raises the question of whether the annual instances of modeled TTS or behavioral disturbances could indirectly lead to more serious aggregate or long-term impacts over time. Under certain conditions, chronic exposure to acoustic sources or other stimuli that can cause individual stress or behavioral responses can also lead to additional long-term adverse impacts. For example, investigators concluded that gray whales and humpback whales abandoned some of their coastal habitat in California and Hawaii, respectively, because of persistent underwater noise associated with extensive vessel traffic (Gard 1974) (Reeves 1977) (Salden 1988). Another study of terrestrial mammals suggests that while short-term stress responses are often beneficial, conditions of chronic or long-term stress can lead to adverse physiological effects (Romero, et al. 2007). However, because acoustic disturbances caused by

Navy sonar and explosives are short-term, intermittent, and (in the case of sonar) transitory, even during major training exercises, we would not expect the Navy's activities to create conditions of long-term, continuous underwater noise leading to habitat abandonment or long-term hormomal or physicological stress responses in marine mammals. Moreover, as discussed previously, Navy testing and training activities, including the use of MFA sonar, have been ongoing in the MITT Action Area for decades, and there is no evidence that the activities have caused blue whales or other listed species evaluated in this Opinion to abandon important habitat or any other severe adverse impacts.

Further, recent evidence indicates that the Eastern North Pacific blue whale population, which includes blue whales in Southern California, has likely reached carrying capacity (Monnahan et al. 2014). As stated previously, Navy training and testing activities in that area as with similar activities in the MITT Action Area, include the use of MFA sonar, and have been ongoing for decades. Therefore, any potential temporary behavioral impacts on blue whales from the use of MFA during Navy training and testing activities in the MITT Action Area are also likely to have not prevented the recovery of the blue whales throughout its range. The TTS and behavioral response estimates may change from year to year, which could mean an increase in the number of individual animals exposed per year or an increase in the number of times per year some animals are exposed. However, the severity of individual responses, and the consequences of those responses on the fitiness of affected individuals, is not expected to change.

Establishing a causal link between anthropogenic noise, animal communication, and individual impacts as well as population viability is difficult to quantify and assess (McGregor 2013) (Read et al. 2014). It is difficult to assess the effects of sounds individually and cumulatively on marine species because a number of factors can influence these effects including: indirect effects, age class, prior experience, behavioral state at the time of exposure, and that responses may be influenced by other non-sound related factors (Ellison et al. 2011; Goldbogen et al. 2013; Kight and Swaddle 2011; McGregor 2013; Williams et al. 2014) (Read et al. 2014). However, although there is significant uncertainty, based upon the available evidence and the foregoing analysis, we conclude that continuation of annual modeled instances of TTS and behavioral disturances into the reasonably foreseeable future is unlikely to cause aggregate or long-term adverse effects on blue whales, such as abandonment of important habitat or adverse physiological effects resulting from chronic or long-term stress.

Non-impulsive acoustic stressors from Navy training activities conducted during five-year period of proposed MMPA Rule and into the reasonably foreseeable future are not likely to reduce the viability or recovery of these populations. We anticipate temporary behavioral responses and TTS, but do not anticipate any injury or mortality from acoustic stressors. We do not anticipate those behavioral responses to result in fitness consequences to any individuals and therefore, we do not expect acoustic stressors to result in substantial changes in reproduction, numbers, or distribution of these populations. This conclusion is further supported by Monnahan et al. (2014) which concluded that the ENP blue whale population has likely reached carrying capacity despite decades of Navy training and testing activities, including MFA sonar, in the Hawaii and Southern California Training Ranges.

6.8.3.2.2 Fin Whale

Except as provided herein, our analysis of the modeled TTS and behavioral responses for blue whales applies equally to fin whales. Fin whales are not likely to respond to high-frequency sound sources associated with the proposed training and testing activities because of their hearing sensitivities. While we recognize that animal hearing evolved separately from animal vocalizations and, as a result, it may be inappropriate to make inferences about an animal's hearing sensitivity from their vocalizations, we have no data on fin whale hearing so we assume that fin whale vocalizations are partially representative of their hearing sensitivities. Those vocalizations include a variety of sounds described as low frequency moans or long pulses in the 10 Hz to 100 Hz band (Edds 1988; Thompson and Friedl 1982b; Watkins 1981b). The most typical signals are very long, patterned sequences of tonal infrasonic sounds in the 15 Hz to 40 Hz range. Ketten (1997a) reports the frequencies of maximum energy between 12 Hz and 18 Hz. Short sequences of rapid calls in the 30 to 90 Hz band are associated with animals in social groups (Clark personal observation and McDonald personal communication cited in Ketten 1997). The context for the 30 Hz to 90 Hz calls suggests that they are used to communicate but do not appear to be related to reproduction. Fin whale moans within the frequency range of 12.5 Hz to 200 Hz, with pulse duration up to 36 seconds, have been recorded off Chile (Cummings and Thompson 1994). The whale produced a short, 390 Hz pulse during the moan.

Results of studies on blue whales (Goldbogen et al. 2013) (Southall et al. 2011a), which have similar auditory physiology compared to fin whales, indicate that some individuals hear some sounds in the mid-frequency range and exhibit behavioral responses to sounds in this range depending on received level and context. However, as described in Section 6.8.3.2.1, regarding the response of blue whales to MFA sonar, we expect any behavioral response to be temporary and to not result in any fitness consequences to individual whales. Without more specific information, we assume the response of fin whales to TTS to be similar to that of blue whales. Additionally, several fin whales were tagged during the Southern California-10 BRS and no obvious responses to the controlled exposure to a mid-frequency sound source were detected by the visual observers or in the initial tag analysis (Southall et al. 2011a).

Further, work by Moore and Barlow (2011) indicate that since 1991, there is strong evidence of increasing fin whale abudance in the California Current area, which includes the Southern California Range Complex, an area in which Navy training and testing activities, including the use of MFA sonar, have been ongoing for decades. The authors predict continued increases in fin whale numbers over the next decade in that area, and that perhaps fin whale densities are reaching "current ecosystem limits." This indicates that any potential temporary behavioral impacts on fin whales from the use of MFA during Navy training and testing activities have not prevented fin whale numbers from increasing and potentially nearing ecosystem limits in Southern California. Since training and testing activities in the MITT Action Area are similar to those in Southern California, we would expect the effects to be similar in the MITT Action Area and thus not a limiting factor in the recovery of fin whales. The TTS and behavioral response estimates may change over baseline conditions from year to year, which could mean an increase in the number of individual animals exposed per year or an increase in the number of times per year some animals are exposed. However, the severity of individual responses, and the

consequences of those responses on the fitiness of affected individuals, is not expected to change.

Non-impulsive acoustic stressors from Navy training exercises and testing activities conducted during the five-year year period of the proposed MMPA Rule and into the reasonably foreseeable future are not likely to significantly interact (exposure and response) with a sufficient number of fin whales to reduce the viability or recovery of these populations. We anticipate temporary behavioral responses, but do not anticipate any injury or mortality from acoustic stressors. Therefore, we do not anticipate those behavioral responses to result in substantial changes in reproduction, numbers, or distribution of these populations.

6.8.3.2.3 Humpback Whale

Except as provided herein, our analysis of the modeled TTS and behavioral responses for blue whales applies equally to humpback whales. Humpback whales are not likely to respond to high-frequency sound sources associated with the proposed training exercises and testing activities because of their hearing sensitivities. We recognize animal hearing evolved separately from animal vocalizations and, as a result, it may be inappropriate to make inferences about an animal's hearing sensitivity from their vocalizations. However, we have no data on humpback whale hearing so we assume that humpback whale vocalizations are partially representative of their hearing sensitivities. As discussed in the *Status of Listed Resources* narrative for humpback whales, these whales produce a wide variety of sounds.

Humpback whales vocalize less frequently in their summer feeding areas than in their winter ranges at lower latitudes. Feeding groups produce distinctive sounds ranging from 20 Hz to 2 kHz, with median durations of 0.2 to 0.8 seconds and source levels of 175 to 192 dB (Thompson et al. 1986). These sounds are attractive and appear to rally animals to the feeding activity (D'Vincent et al. 1985; Sharpe and Dill 1997). To summarize, humpback whales produce at least three kinds of sounds:

1. Complex songs with components ranging from 20Hz to 4 kHz with estimated source levels from 144 to 174 dB; these are mostly sung by males on the breeding grounds (Payne and McVay 1971; Winn et al. 1970)

2. Social sounds in the breeding areas that extend from 50Hz to more than 10 kHz with most energy below 3 kHz (Richardson et al. 1995c; Tyack and Whitehead 1983); and

3. Feeding area vocalizations that are less frequent, but tend to be 20Hz to 2 kHz with estimated source levels in excess of 175 dB re 1 µPa-m (Richardson et al. 1995c; Thompson et al. 1986). Sounds often associated with possible aggressive behavior by males (Silber 1986; Tyack 1983) are quite different from songs, extending from 50 Hz to 10 kHz (or higher), with most energy in components below 3 kHz. These sounds appear to have an effective range of up to 9 km (Tyack and Whitehead 1983).

Au et al. (2006b) conducted field investigations of humpback whale songs that led these investigators to conclude that humpback whales have an upper frequency limit reaching as high as 24 kHz. Based on this information, it is reasonable to assume that the active mid-frequency

sonar the U.S. Navy uses during active sonar training exercises and testing activities in the MITT Action Area are within the hearing and vocalization ranges of humpback whales. There is limited information on how humpback whales are likely to respond upon being exposed to mid-frequency active sonar (most of the information available addresses their probable responses to low-frequency active sonar or impulsive sound sources). Maybaum (Maybaum 1993) conducted sound playback experiments to assess the effects of mid-frequency active sonar on humpback whales in Hawaiian waters. Specifically, she exposed focal pods to sounds of a 3.3-kHz sonar pulse, a sonar frequency sweep from 3.1 to 3.6 kHz, and a control (blank) tape while monitoring their behavior, movement, and underwater vocalizations. The two types of sonar signals differed in their effects on the humpback whales, although the whales exhibited avoidance behavior when exposed to both sounds. The whales responded to the sounds by increasing their distance from the sound; however, the frequency or duration of their dives or the rate of underwater vocalizations did not change. Similar to the conclusions drawn in Section 6.8.3.2.1 regarding responses of blue whales to MFA sonar, we expect any behavioral response to be temporary and to not result in any fitness consequences to individual humpback whales. Without more specific information, we assume the response of humpback whales to TTS to be similar to that of blue whales.

Humpback whales have been known to react to low frequency industrial noises at estimated received levels of 115 to 124 dB (Malme et al. 1985), and to calls of other humpback whales at received levels as low as 102 dB (Frankel et al. 1995). Malme et al. (1985) found no clear response to playbacks of drill ship and oil production platform noises at received levels up to 116 dB re 1 Pa. Studies of reactions to airgun noises were inconclusive (Malme et al. 1985). Humpback whales on the breeding grounds did not stop singing in response to underwater explosions (Payne and McVay 1971). Humpback whales on feeding grounds did not alter short-term behavior or distribution in response to explosions with received levels of about 150 dB re 1 Pa/Hz at 350 Hz (Lien et al. 1993; Todd et al. 1996b). However, at least two individuals were probably killed by the high-intensity, impulse blasts and had extensive mechanical injuries in their ears (Ketten et al. 1993; Todd et al. 1996b). The explosions may also have increased the number of humpback whales entangled in fishing nets (Todd et al. 1996b). Frankel and Clark (1998) showed that breeding humpbacks showed only a slight statistical reaction to playbacks of 60 to 90 Hz sounds with a received level of up to 190 dB. Although these studies have demonstrated that humpback whales will exhibit short-term behavioral reactions to boat traffic and playbacks of industrial noise, the long-term effects of these disturbances on the individuals exposed to them are not known. Humpback whales in Stellwagen Bank National Marine Sanctuary reduced their calling rates coincident with an Ocean Acoustic Waveguide Remote Sensing experiment 200 km away with FM pulses centered at 415, 734, and 949 Hz (Risch et al. 2012). However, Gong et al. (2014), disputes these findings, suggesting that Risch et al. (2012) mistakes natural variations in humpback whale song occurrence for changes caused by OAWRS activity approximately 200 km away. Risch et al. (2014) responded to Gong et al. (2014) and highlighted the context-dependent nature of behavioral responses to acoustic stressors.

The overall abundance of humpback whales in the south Pacific has continued to increase and is now greater than some pre-whaling abundance estimates. The TTS and behavioral response estimates may change from year to year over baseline conditions, which could mean an increase

in the number of individual animals exposed per year or an increase in the number of times per year some animals are exposed. However, the severity of individual responses, and the consequences of those responses on the fitness of affected individuals, is not expected to change.

Acoustic stressors from Navy training and testing activities conducted during the five-year period of the proposed MMPA Rule and into the reasonably foreseeable future are not likely to significantly interact (exposure and response) with a sufficient number of humpback whales to reduce the viability of these populations or adversely impact species recovery. We anticipate temporary behavioral responses, but do not anticipate any injury or mortality from acoustic stressors. Therefore, we do not anticipate those behavioral responses to result in substantial changes in reproduction, numbers, or distribution of these populations.

6.8.3.2.4 Sei Whale

Except as provided herein, our analysis of the modeled TTS and behavioral responses for blue whales applies equally to sei whales. Like blue and fin whales, sei whales are not likely to respond to high-frequency sound sources associated with the proposed training exercises and testing activities because of their hearing sensitivities. As discussed in the *Status of Listed Resources* section of this Opinion, we have no specific information on the hearing sensitivity of sei whales. Based on their anatomical and physiological similarities to both blue and fin whales, we assume that the hearing thresholds of sei whales will be similar as well and will be centered on low-frequencies in the 10 to 200 Hz.

Results of studies on blue whales (Goldbogen et al. 2013) (Southall et al. 2011a), which have similar auditory physiology compared to sei whales, indicate that some individuals hear some sounds in the mid-frequency range and exhibit behavioral responses to sounds in this range depending on received level and context. However, as described in Section 6.8.3.2.1, regarding the response of blue whales to MFA sonar, we expect any behavioral response to be temporary and to not result in any fitness consequences to individual whales. Without more specific information, we assume the response of fin whales to TTS to be similar to that of blue whales (see Section 6.8.3.2.1). The TTS and behavioral response estimates may change from year to year over baseline conditions, which could mean an increase in the number of individual animals exposed per year or an increase in the number of times per year some animals are exposed. However, the severity of individual responses, and the consequences of those responses on the fitness of affected individuals, is not expected to change.

Acoustic stressors from Navy training exercises and testing activities conducted during the five-year period of the proposed MMPA Rule and into the reasonably foreseeable future are not likely to significantly interact (exposure and response) with a sufficient number of sei whales to reduce the viability of these population ot their ability to recover. We anticipate temporary behavioral responses, but do not anticipate any injury or mortality from acoustic stressors. Therefore, we do not anticipate those behavioral responses to result in substantial changes in reproduction, numbers, or distribution of these populations.

6.8.3.2.5 Sperm Whale

Temporary Threshold Shift (TTS) - As mentioned previously, TTS can last from a few minutes to days, be of varying degree, and occur across various frequency bandwidths, all of which determine the severity of the impacts on the affected individual, which can range from minor to more severe. The TTS sustained by an animal is primarily classified by three characteristics:

1. Frequency—Available data (of midfrequency hearing specialists exposed to mid- or high-frequency sounds; (Southall et al. 2007b)) suggest that most TTS occurs in the frequency range of the source up to one octave higher than the source (with the maximum TTS at ½ octave above). The more powerful mid-frequency sources used have center frequencies between 3.5 kHz and 8 kHz and the other unidentified mid-frequency sources are, by definition, less than 10 kHz, which suggests that TTS induced by any of these mid frequency sources would be in a frequency band somewhere between approximately 2 and 20 kHz. Although there is no published audiogram for sperm whales, sperm whales would be expected to have good, high frequency hearing because their inner ear resembles that of most dolphins, and appears tailored for ultrasonic (>20 kHz) reception (Ketten 1994). The only data on the hearing range of sperm whales are evoked potentials from a stranded neonate, which suggest that neonatal sperm whales respond to sounds from 2.5 kHz to 60 kHz. Sperm whales vocalize in high- and mid-frequency ranges; most of the energy of sperm whales clicks is concentrated at 2 kHz to 4 kHz and 10 kHz to 16 kHz. Other studies indicate sperm whales' wide-band clicks contain energy between 0.1 kHz and 20 kHz (Goold and Jones 1995; Weilgart and Whitehead 1993b). Ridgway and Carder (Ridgway and Carder 2001) measured low-frequency, high amplitude clicks with peak frequencies at 500 Hz to 3 kHz from a neonate sperm whale.The full range of functional hearing for the sperm whale is estimated to occur between approximately 150 Hz and 160 kHz, placing them among the group of cetaceans that can hear mid-frequency sounds (Southall et al. 2007b). Therefore, TTS associated with mid-frequency sonar could conceivably interfere with an animal's ability to hear vocalizations or most other biologically important sounds.

2. Degree of the shift (i.e., how many dB is the sensitivity of the hearing reduced by)—Generally, both the degree of TTS and the duration of TTS will be greater if the marine mammal is exposed to a higher level of energy (which would occur when the peak dB level is higher or the duration is longer). The threshold for the onset of TTS was discussed previously in this document. An animal would have to approach closer to the source or remain in the vicinity of the sound source appreciably longer to increase the received SEL, which would be difficult considering the lookouts, the sightability of sperm whales, and the nominal speed of an active sonar vessel (10 to 15 knots). In the TTS studies, some using exposures of almost an hour in duration or up to 217 SEL, most of the TTS induced was 15 dB or less, though Finneran et al. (2007) induced 43 dB of TTS with a 64-second exposure to a 20 kHz source. However, mid-frequency active sonar emits a nominal ping every 50 seconds, and incurring those levels of TTS is highly unlikely.

3. Duration of TTS (recovery time)—In the TTS laboratory studies, some using exposures of almost an hour in duration or up to 217 SEL, almost all individuals recovered within 1

> day (or less, often in minutes), though in one study (Finneran et al. 2007), recovery took 4 days. Based on the range of degree and duration of TTS reportedly induced by exposures to non-pulse sounds of energy higher than that to which frees wimming marine mammals in the field are likely to be exposed during mid-frequency/high-frequency active sonar training exercises in the Action Area, it is unlikely that sperm whale or other listed cetaceans would ever sustain a TTS from MFAS that alters their sensitivity by more than 20 dB for more than a few days (and any incident of TTS would likely be far less severe due to the short duration of the majority of the exercises and the speed of a typical vessel). Also, because of the short distance within which animals would need to approach the sound source, it is unlikely that animals would be exposed to the levels necessary to induce TTS in subsequent time periods such that their recovery is impeded.

Therefore, for sperm whales and other ESA-listed marine mammals analyzed in this Opinion, even though the modeled TTS estimates may change from year to year over baseline conditions including potential increases of exposure, NMFS does not anticipate TTS of a long duration or severe degree to occur as a result of exposure to mid- or high-frequency active sonar utilized in the MITT Action Area.

Behavioral Responses - The Navy's acoustic analysis indicates that exposures of sperm whales to sound levels are likely to result in behavioral harassment from sonar or other active acoustic stressors during training and testing activities. These exposure instances are anticipated to be in the form of behavioral harassment and no injurious takes of sperm whales from sonar, other active acoustic stressors, or explosives are anticipated. Sperm whales have shown resilience to acoustic and human disturbance, although they may react to sound sources and activities within a few kilometers. Sperm whales that are exposed to activities that involve the use of sonar and other active acoustic sources may alert, ignore the stimulus, avoid the area by swimming away or diving, or display aggressive behavior. Some (but not all) sperm whale vocalizations might overlap with the mid-frequency active sonar or high frequency active sonar frequency ranges, which could temporarily decrease an animal's sensitivity to the calls of conspecifics or returning echolocation signals. However, we do not anticipate TTS of a long duration or severe degree to occur as a result of exposure to these sonar sources. The majority of exposure instances are expected to be in the form of mild responses.

Vocal changes in response to anthropogenic noise can occur across the range of sound production modes used by marine mammals, such as whistling, echolocation click production, calling, and singing. Changes may result in response to a need to compete with an increase in background noise or may reflect an increased vigilance or startle response. Odontocetes such as killer whales off the northwestern coast of the U.S. have been observed to increase the duration of primary calls once a threshold in observing vessel density (e.g., whale watching) was reached, which has been suggested as a response to increased masking noise produced by the vessels (Foote et al. 2004). In contrast, both sperm and pilot whales potentially ceased sound production during the Heard Island feasibility test (Bowles et al. 1994), although it cannot be absolutely determined whether the inability to acoustically detect the animals was due to the cessation of sound production or the displacement of animals from the area.

There is some evidence of disruptions of clicking and behavior from sonars (Goold 1999a; Watkins 1985), pingers (Watkins and Schevill 1975a), the Heard Island Feasibility Test (Bowles et al. 1994), and the Acoustic Thermometry of Ocean Climate (Costa et al. 1998). Sperm whales have been observed to frequently stop echolocating in the presence of underwater pulses made by echosounders (Watkins and Schevill 1975a). Goold (1999a) reported six sperm whales that were driven through a narrow channel using ship noise, echosounder, and fish finder emissions from a flotilla of 10 vessels. Watkins and Schevill (1975a) showed that sperm whales interrupted click production in response to pinger (6 to 13 kHz) sounds. They also stopped vocalizing for brief periods when codas were being produced by other individuals, perhaps because they can hear better when not vocalizing themselves (Goold and Jones 1995).

Sperm whales stop vocalizing for brief periods when codas are being produced by other individuals, perhaps because they can hear better when not vocalizing themselves (Goold and Jones 1995). Results of experimental playbacks of killer whale sounds to five individual male sperm whales in the Norwegian Sea showed that, rather than diving away from the perceived predator, sperm whales responded by interrupting their foraging or resting dives and returning to the surface, changing their vocal production, and initiating a surprising degree of social behavior (Cure et al. 2013).

Other studies identify instances in which sperm whales did not respond to anthropogenic sounds. Sperm whales did not alter their vocal activity when exposed to levels of 173 dB re 1 µPa from impulsive sounds produced by 1 g TNT detonators (Madsen and Mohl 2000). Richardson et al. (1995c) citing a personal communication with J. Gordon suggested that sperm whales in the Mediterranean Sea continued calling when exposed to frequent and strong military sonar signals. When Andre et al. (1997) exposed sperm whales to a variety of sounds to determine what sounds may be used to scare whales out of the path of vessels, sperm whales were observed to have startle reactions to 10 kHz pulses (180 dB re 1 µPa at the source), but not to the other sources played to them.

Published reports identify instances in which sperm whales have responded to an acoustic source and other instances in which they did not appear to respond behaviorally when exposed to seismic surveys. Mate et al. (1994) reported an opportunistic observation of the number of sperm whales to have decreased in an area after the start of airgun seismic testing. However, Davis et al. (2000b) noted that sighting frequency did not differ significantly among the different acoustic levels examined in the northern Gulf of Mexico, contrary to what Mate et al. (1994) reported. Sperm whales may also have responded to seismic airgun sounds by ceasing to call during some (but not all) times when seismic pulses were received from an airgun array >300 km away (Bowles et al. 1994).

A study offshore of northern Norway indicated that sperm whales continued to call when exposed to pulses from a distant seismic vessel. Received levels of the seismic pulses were up to 146 dB re 1 µPa peak-to-peak (Madsen et al. 2002). Similarly, a study conducted off Nova Scotia that analyzed recordings of sperm whale sounds at various distances from an active seismic program did not detect any obvious changes in the distribution or behavior of sperm whales (McCall-Howard 1999). Data from vessel-based monitoring programs in United Kingdom waters suggest that sperm whales in that area may have exhibited some changes in

behavior in the presence of operating seismic vessels (Stone 1997; Stone 1998; Stone 2000; Stone 2001; Stone 2003). However, the compilation and analysis of the data led the author to conclude that seismic surveys did not result in observable effects to sperm whales (Stone 2003). The results from these waters seem to show that some sperm whales tolerate seismic surveys.

Sperm whales have been observed to frequently stop echolocating in the presence of underwater pulses produced by echosounders and submarine sonar (Watkins 1985; Watkins and Schevill 1975a). They also stop vocalizing for brief periods when codas are being produced by other individuals, perhaps because they can hear better when not vocalizing themselves (Goold and Jones 1995). Because they spend large amounts of time at depth and use low frequency sound sperm whales are likely to be susceptible to low frequency sound in the ocean (Croll et al. 2001b). Furthermore, because of their apparent role as important predators of mesopelagic squid and fish, changes in their abundance could affect the distribution and abundance of other marine species.

Disruption of feeding behavior can be difficult to correlate with anthropogenic sound exposure. Responses may vary depending on the behavioral state of the individual or group of animals. For example, sperm whales engaged in foraging dives did not abandon dives when exposed to distant signatures of seismic airguns (Madsen et al. 2006). Conversely, preliminary results of controlled playback of sonar may indicate feeding/foraging disruption of killer whales and sperm whales (Miller et al. 2011).

Richardson et al. (1995c) noted that avoidance (temporary displacement of an individual from an area) reactions are the most obvious manifestations of disturbance in marine mammals. It is qualitatively different from the startle or flight response, but also differs in the magnitude of the response (i.e., directed movement, rate of travel, etc.). Oftentimes avoidance is temporary, and animals return to the area once the noise has ceased. In the Caribbean, sperm whales avoided exposure to mid-frequency submarine sonar pulses, in the range of 1000 Hz to 10,000 Hz (IWC 2005).

These studies suggest that the behavioral responses of sperm whales to anthropogenic sounds are highly variable, but do not appear to result in the death or injury of individual whales or result in reductions in the fitness of individuals involved. Responses of sperm whales to anthropogenic sounds probably depend on the age and sex of animals being exposed, as well as other factors. There is evidence that many individuals respond to certain sound sources, provided the received level is high enough to evoke a response, while other individuals do not.

The TTS and behavioral response estimates may change from year to year over baseline conditions, which could mean an increase in the number of individual animals exposed per year or an increase in the number of times per year some animals are exposed. However, the severity of individual responses, and the consequences of those responses on the fitiness of affected individuals, is not expected to change.

Non-Impulsive acoustic stressors from Navy training exercises and testing activities conducted during the five-year period of the proposed MMPA Rule and into the reasonably foreseeable future are not likely to significantly interact (exposure and response) with a sufficient number of

sperm whales to reduce the viability of these populations or their ability to recovery. We anticipate behavioral responses, but do not anticipate any injury or mortality from acoustic stressors. Therefore, we do not anticipate those behavioral responses to result in substantial changes in reproduction, numbers, or distribution of these populations.

6.8.4 Effects of Non-Impulsive Acoustic Stressors - Sea Turtles

For this consultation, we considered exposure estimates from the Navy Acoustic Effects Model at several output points for sea turtles.

6.8.4.1 Unprocessed Exposures to Non-Impulsive Acoustic Stressors During Training Activities

Sea turtles that reside in the Action Area may be exposed several times throughout the year to sound from sonar and other active acoustic sources. Exposures to sonar and other active acoustic sources in open water areas would be intermittent and geographically variable. The Navy model output indicates that green, hawksbill, loggerhead, and leatherback sea turtles would be exposed to sonar at levels that may rise to the level of behaviroral take and TTS.

Navy model output estimates of sea turtes that will be exposed to sonar and other non-impulsive acoustic stressors associated with training activities throughout the year are summarized in Table 56 and discussed below.

Table 56. Model-Predicted Exposures of Sea Turtles to Non-Impulsive Sound During Training Activities

Species	Number of Model-Predicted Exposures >120 dB Per Year
Green Turtle	12,564
Hawksbill Turtle	383
Leatherback Turtle	99
Loggerhead Turtle	94

Green sea turtle. The NAEMO provided an unprocessed estimate of 12,564 green sea turtle exposure events annually to non-impulsive sounds associated with annual training at levels greater than 120 dB SPL. Eighty-two (82) percent of the estimated 12,564 green sea turtle exposures will result from Marine Air Ground Task Force Exercise (Amphibious) while 11 percent will result from TRACKEX/TORPEX – Surface.

Hawksbill sea turtle. The NAEMO provided an unprocessed estimate of 383 hawksbill sea turtle exposure events annually to non-impulsive sounds associated with annual training at levels greater than 120 dB SPL. Forty-seven (47) percent of the estimated 383 hawksbill sea turtle exposures will result from Marine Air Ground Task Force Exercise (Amphibious) while 19 percent will result from TRACKEX/TORPEX – Surface, 17 percent from Joint Multi-Strike Group Exercises and 12 percent from Joint Expeditionary Exercises .

Leatherback sea turtle. The NAEMO provided an unprocessed estimate of 99 leatherback sea turtle exposure events annually to non-impulsive sounds associated with annual training at levels greater than 120 dB SPL. Thirty (30) percent of the estimated 99 leatherback sea turtle exposures

will result from Joint Multi-Strike Group Exercises while 28 percent will result from Joint Expeditionary Exercises, 20 percent from TRACKEX/TORPEX – Surface and 15 percent from Marine Air Ground Task Force Exercise (Amphibious).

Loggerhead sea turtle. The NAEMO provided an unprocessed estimate of 94 loggerhead sea turtle exposure events annually to non-impulsive sounds associated with annual training at levels greater than 120 dB SPL. Twenty-six (26) percent of the estimated 94 loggerhead sea turtle exposures will result from Joint Multi-Strike Group Exercises while 26 percent will result from Joint Expeditionary Exercises, 22 percent from TRACKEX/TORPEX – Surface and 19 percent from Marine Air Ground Task Force Exercise (Amphibious).

6.8.4.2 Unprocessed Exposures to Non-impulsive Acoustic Stressors During Testing Activities

Navy model output estimates of sea turtes that will be exposed to sonar and other non-impulsive acoustic stressors associated with training activities throughout the year are summarized in Table 57 and discussed below.

Table 57. Model-Predicted Exposures of Sea Turtles to Non-Impulsive Sound During Testing Activities

Species	Number of Model-Predicted Exposures >120 dB Per Year
Green Turtle	20,848
Hawksbill Turtle	800
Leatherback Turtle	144
Loggerhead Turtle	131

Green sea turtle. The NAEMO provided an unprocessed estimate of 20,848 green sea turtle exposure events annually to non-impulsive sounds associated with annual testing activities at levels greater than 120 dB SPL. Eighty-five (85) percent of the estimated 20,848 green sea turtle exposures will result from ASW Mission Package Testing while 7 percent will result from At-Sea Sonar Testing.

Hawksbill sea turtle. The NAEMO provided an unprocessed estimate of 800 hawksbill sea turtle exposure events annually to non-impulsive sounds associated with annual testing activities at levels greater than 120 dB SPL. Sixty-nine (69) percent of the estimated 800 hawksbill sea turtle exposures will result from ASW Mission Package Testing while 10 percent will result from At-Sea Sonar Testing and 15 percent from Anti-Submarine Warfare Tracking Test – Maritime Patrol Aircraft.

Leatherback sea turtle. The NAEMO provided an unprocessed estimate of 144 leatherback sea turtle exposure events annually to non-impulsive sounds associated with annual testing activities at levels greater than 120 dB SPL. Fifty-five (55) percent of the estimated 144 leatherback sea turtle exposures will result from ASW Mission Package Testing while 39 percent will result from Anti-Submarine Warfare Tracking Test – Maritime Patrol Aircraft.

Loggerhead sea turtle. The NAEMO provided an unprocessed estimate of 131 loggerhead sea turtle exposure events annually to non-impulsive sounds associated with annual testing activities

at levels greater than 120 dB SPL. Sixty (60) percent of the estimated 131 loggerhead sea turtle exposures will result from ASW Mission Package Testing while 34 percent will result from Anti-Submarine Warfare Tracking Test – Maritime Patrol Aircraft.

6.8.4.3 Processed Exposures to Non-Impulsive Acoustic Stressors During Training and Testing Activities

In the previous sections we assessed, that the Navy model output indicates approximately 33,412 unprocessed instances of green sea turtle exposures, 1,182 unprocessed instances of hawksbill sea turtle exposures, 243 unprocessed instances of leatherback sea turtle exposures, and 224 unprocessed instances of loggerhead sea turtle exposures each year resulting from non-impulsive sound (sonar) from training and testing activities at levels equal to or greater than 120 dB which is the level at which we would expect an onset of more significant behavioral responses.

Processed exposures of sea turtles to acoustic stressors from training and testing activities predicted by the NAEMO are shown below in Table 58. The exposure estimates for each alternative represent the total number of exposures and not necessarily the number of individuals exposed, as a single individual may be exposed multiple times over the course of a year. The predicted acoustic impacts do not take into account avoidance behavior or mitigation measures, such as establishing shut-down zones for certain sonar systems. Again, since TTS and PTS criteria for sea turtles is 17 dB below what it is supposed to be, the estimates provided are overestimates (See Section 6.3.8).

Table 58. Annual Total Model-Predicted Impacts on Sea Turtles from Training and Testing Activities Using Sonar and Other Active Acoustic Sources

Sea Turtle Species	Temporary Threshold Shift	Permanent Threshold Shift
Green sea turtle	251	0
Hawksbill sea turtle	17	0
Leatherback sea turtle	12	0
Loggerhead sea turtle	15	0

The Navy model may over-predict acoustic impacts because it does not consider avoidance and the criteria to predict impacts. The TTS exposures could temporarily affect perception of sound within a limited frequency range.

6.8.4.4 Response of Sea Turtles to Non-impulsive Acoustic Stressors During Training and Testing Activities

Little is known about how sea turtles use sound in their environment. Based on knowledge of their sensory biology (Moein Bartol and Ketten 2006) (Moein Bartol and Musick 2003), sea turtles may be able to detect objects within the water column (e.g., vessels, prey, predators) via some combination of auditory and visual cues. However, research examining the ability of sea turtles to avoid collisions with vessels shows they may rely more on their vision than auditory cues (Hazel et al. 2007). Similarly, while sea turtles may rely on acoustic cues to identify nesting beaches, they appear to rely on other non-acoustic cues for navigation, such as magnetic fields (Lohmann and Lohmann 1996a) (Lohmann and Lohmann 1996b) and light (Avens and Lohmann 2003). Additionally, they are not known to produce sounds underwater for communication.

Further, although the information on the hearing capabilities of sea turtles is limited, the information available suggests that the auditory capabilities of sea turtles are centered in the low-frequency range (<2 kHz) (Bartol et al. 1999b; Dow Piniak et al. 2012; Lenhardt et al. 1983; Lenhardt et al. 1994a; Martin et al. 2012; O'Hara and Wilcox 1990; Ridgway et al. 1969), with greatest sensitivity below 1 kHz. A more recent review on sea turtle hearing and sound exposure indicated that sea turtles detect sounds at less than 1000Hz and therefore would not be affected by mid or high-frequency active sonar (Popper et al. 2014).

Similarly, a study on the effects of airguns on sea turtle behavior also suggests that sea turtles are most likely to respond to low-frequency sounds. McCauley et al. (2000) reported that green and loggerhead turtles will avoid air-gun arrays at 2 km and at 1 km with received levels of 166 dB re 1 μPa and 175 db re 1 μPa, respectively. The sea turtles responded consistently: above a level of approximately 166 dB re 1 μPa the turtles noticeably increased their swimming activity compared to non-airgun operation periods. Above 175 dB re 1 μPa mean squared pressure their behavior became more erratic possibly indicating the turtles were in an agitated state. A study conducted in the Mediterranean Sea found that of 164 loggerhead turtles observed, 57 percent responded to the firing of an air gun array (source level 252 dB re 1 μPa [peak]) by diving at or before their closest point of approach to the airguns, with dive probability decreasing with increasing distance from the airgun array (DeRuiter and Larbi Doukara 2012).

Acoustic stressors associated with the Navy's activities in the MITT Action Area have the ability to cause behavioral responses in sea turtles. The response of a sea turtle to an anthropogenic sound will depend on the frequency, duration, temporal pattern, and amplitude of the sound, as well as the animal's prior experience with the sound and the context in which the sound is encountered (i.e., what the animal is doing at the time of the exposure). Distance from the sound source and whether it is perceived as approaching or moving away could also affect the way a sea turtle responds. Potential behavioral responses to anthropogenic sound could include startle reactions, disruption of feeding, disruption of migration, changes in respiration, alteration of swim speed, alteration of swim direction, and area avoidance. Any disruptions are expected to be temporary in nature, with the animal resuming normal behaviors shortly after the exposure. To result in significant fitness consequences we would have to assume that an individual turtle detects and responds to the acoustic source, and that it could not compensate for the energy expended during evasion and any potential lost feeding opportunities by either immediately feeding at another location, by feeding shortly after cessation of acoustic exposure, or by feeding at a later time. Similarly, to result in significant fitness consequences we would have to assume that an individual turtle detects and responds to the acoustic source, and that it could not compensate for the energy expended during evasion rather than would have been incurred during normal migration, respiration, swimming speed, and swimming direction. There is no indication this is the case, particularly since foraging habitat would still be available in the environment following the cessation of acoustic exposure. Therefore, behavioral responses of sea turtles to acoustic stressors is unlikely to lead to fitness consequences and long-term implications for the population.

Although we assume that sea turtles in the vicinity of sonar might experience a TTS, it is not certain at what energy levels and received levels are necessary to induce threshold shifts. The

few studies completed on the auditory capabilities of sea turtles (adult green, loggerhead, and Kemp's ridley turtles) suggest that they could be capable of hearing low frequency sounds (Lenhardt 1994a; Moein et al. 1993; Ridgway et al. 1969). Ridgway et al. (Ridgway et al. 1969) reported maximal sensitivity for green turtles occurred at 300 to 400 Hz, with a rapid decline in sensitivity for lower and higher tones. Similarly, Moein et al. (Moein et al. 1993) reported a hearing range of about 250 to 1,000 Hz for loggerhead turtles, and Lenhardt (Lenhardt 1994a) stated that maximal sensitivity in sea turtles generally occurs in the range from 100 to 800 Hz. Calculated in-water hearing thresholds within the useful range appear to be high (e.g., about 160 to 200 dB re 1 µPa) (Lenhardt 1994a). Piniak et al. reported maximum sensitivity between 100 and 400 Hz in water (84 dB re: 1 µPa at 300 Hz) and 50 and 400 Hz in air (62 dB re: 20 µPa at 300 Hz) for leatherback sea turtle hatchlings (Piniak et al. 2012). In the absence of more specific information that could be used to determine the acoustic harassment range for sea turtles, the U.S. Navy assumed that frequencies >100 Hz (which are the acoustical harassment ranges predicted for odontocetes) would be conservative for sea turtles. Given that sea turtles do not rely on acoustic cues for most important life functions, it is anticipated that TTS will not result in fitness consequences to individuals or the populations to which they belong.

Non-impulsive acoustic stressors from Navy training and testing activities conducted during five-year period of the proposed MMPA rule and into the reasonably foreseeable future are likely to cause TTS to sea turtles in the MITT Action Area. However, there is no evidence that TTS results in energetic effects to individual sea turtles or would be likely to significantly reduce the viability of the population these individuals represent. Additionally, based on the analysis presented above, we do not anticipate any PTS, injury or mortality of sea turtles from non-impulsive acoustic stressors.

6.8.5 Effects of Non-Impulsive Acoustic Stressors - Scalloped Hammerhead Shark – Indo-Pacific DPS

This section discusses the effects of non-impulsive acoustic stressors on scalloped hammerhead sharks. Exposure of scalloped hammerhead sharks to acoustic stressors could not be quantitatively assessed due to limited information on species distribution and density in the Action Area. Scalloped hammerhead sharks are likely only capable of detecting sounds between 20 Hz and 1 kHz with the highest sensitivity in the lower end of this spectrum (Casper et al. 2003; Casper and Mann 2006; Myrberg Jr. 2001). As such, this species is only anticipated to detect and potentially be exposed to non-impulsive acoustic stressors below 1 kHZ, which the Navy defines as low-frequency sources. No low frequency sources will be used during training activities as part of the proposed action. As part of training activities, in port maintenance of sonar systems would occur within Inner Apra Harbor where anecdotal evidence suggests a scalloped hammerhead nursery may be present. However, the in-port and at-sea maintenance of surface ship sonar systems training are mid-frequency hull-mounted sonar systems. The in-port and at-sea maintenance of submarine sonar systems are mid- and high-frequency sonar systems. Therefore, these activities are unlikely to be detected by scalloped hammerhead sharks.

A combined total of 174 hours of low-frequency acoustic sources will be used per year during testing activities. Low-frequency sonar use may be part of the following testing activities: at-sea sonar testing, pierside integrated swimmer defense testing, and anti-submarine warfare mission package testing. Of these activities, the pierside integrated swimmer defense testing will occur in

Inner Apra Harbor, where exposure to scalloped hammerhead sharks is most likely. Pierside integrated swimmer defense testing includes non-impulsive acoustic energy from 180 to 200 dB at frequencies less than 1 kHz, suggesting that if juvenile or adult scalloped hammerhead sharks are present within Inner Apra Harbor, they could be exposed to non-impulsive acoustic energy at frequencies they can detect. Pierside integrated swimmer defense testing will occur for 28 days per year with intermittent periods of use of low-frequency sound.

The duration and intensity of low-frequency non-impulsive acoustic stressors and the lack of a swim bladder will likely minimize the effect this stressor has on scalloped hammerhead sharks. In studies of rainbow trout, low-frequency active sonar at 193 dB re 1 μPa^2 for up to 648 seconds did not cause mortality although up to a 25 dB threshold shift was observed when trout received a 400 Hz exposure (Popper et al. 2007). The threshold shift lasted at least 48 hours post-exposure. Exposure at this level also caused a rapid swimming behavioral response at the beginning of treatment. Although a threshold shift was observed it is noteworthy no noticeable morphological effects were observed to ear structures and fish appeared healthy and active throughout the end of the experimental period (1 week) (Popper et al. 2007).

Several shark species, including the oceanic silky shark (*Carcharhinus falciformis*) and coastal lemon shark (*Negaprion brevirostris*), have been observed withdrawing from pulsed low-frequency sounds played from an underwater speaker (Klimley and Myrberg 1979; Myrberg et al. 1978). Lemon sharks exhibited withdrawal responses to pulsed low to mid-frequency sounds (500 to 4,000 Hz) raised 18 dB at an onset rate of 96 dB/sec to a peak amplitude of 123 dB RL from a continuous level, just masking broadband ambient noise (Klimley and Myrberg 1979). In their study, lemon sharks withdrew from artificial sounds which included 10 pulses/second (continuous), 10 pulses/second (intermittent, and 15 to 7.5 decreasing pulses/second (intermittent).

Some sharks are attracted to pulsing LF sounds. Myrberg (2001) stated that sharks have demonstrated highest sensitivity to LF sound (40 to 800 Hz). Free-ranging sharks are attracted to sounds possessing specific characteristics including irregular pulsed, broadband frequencies below 80 Hz and transmitted suddenly without an increase in intensity thus resembling a struggling fish.

These signals, some "pulsed," are substantially different from the LFA sonar signals. Myrberg et al. (1978) reported that a silky shark withdrew 10 m (33 ft) from a speaker broadcasting a 150 to 600 Hz sound with a sudden onset and a peak SL of 154 dB. These sharks avoided a pulsed LF attractive sound when its sound level was abruptly increased by more than 20 dB. Other factors enhancing withdrawal were sudden changes in the spectral or temporal qualities of the transmitted sound. These results do not rule out that such sounds may have been harmful to them after habituation; the tests were not designed to examine that point. Klimley (unpublished data) also noted the increase in tolerance of lemon sharks during successive sound playback tests. The pelagic whitetip (*Carcharhinus longimanus*) also showed a withdrawal response during limited tests (Myrberg et al. 1978).

The precise expected response of scalloped hammerhead sharks to low-frequency acoustic energy is not completely understood due to a lack of sufficient experimental and observational

data for this species. However, given the signal type and level of exposure to the low frequency signals used in pierside swimmer defense testing activities and the lack of swim bladders in scalloped hammerhead sharks as discussed above, we do not expect significant responses (including TTS, PTS, injury or mortality) to low-frequency acoustic energy from pierside integrated swimmer defense testing. The most likely response of scalloped hammerhead sharks exposed to low-frequency sonar are minor temporary changes in their behavior including increased swimming rate, avoidance of the sound source, attraction to the sound source, or changes in orientation to the sound source, not rising to the level of take. Therefore, these behavioral responses will not have long term impacts to the individual, the population, or the DPS.

6.8.6 Effects of Non-Impulsive Acoustic Stressors – *Acropora globiceps*

Corals are not biologically capable of detecting noise except as vibrations of water particles caused by low frequency sounds. Non-impulsive acoustic stressor sources (sonar) are typically intiated from offshore activities where *Acropora globiceps* is not expected to occur. Non-impulsive acoustic stressors are of short duration and intermittent and even if detectable by corals, would not increase the likelihood of injury from significant disruption of breeding, feeding, or sheltering. Therefore, effects to ESA-listed corals from non-impulsive acoustic stressors are not reasonably expected to occur or will be insignificant.

6.8.7 Effects of Impulsive Acoustic Stressors – Cetaceans

As mentioned above, we considered exposure estimates from the Navy Acoustic Effects Model at two output points for marine mammals. First, the total number of ESA-listed species (animats) that would be exposed to acoustic sources greater than 120 dB prior to the application of a dose-response curve or criteria. We term these the "unprocessed" estimates. This estimate is the number of times individual animats or animals are likely to be exposed to the acoustic environment that is a result of training exercises and testing activities, regardless of whether they are "taken" as a result of that exposure. In most cases, the number of animals "taken" by an action would be a subset of the number of animals that are exposed to the action because (1) in some circumstances, animals might not respond to an exposure and (2) some responses may be negative for an individual animal without constituting a form of "take" (for example, some physiological stress responses only have fitness consequences when they are sustained and would only constitute a "take" as a result of cumulative exposure).

The second set of exposure estimates ("processed") of listed species were generated and processed using dose-response curves and criteria for temporary and permanent threshold shift developed by the Navy and NMFS' Permits Division for the purpose of identifying harassment pursuant to the MMPA and account for any mitigation and avoidance behaviors that may reduce instances of exposure at levels that might result in injury including PTS. The unprocessed impulsive sound exposure estimates do not consider standard mitigation actions that NMFS' Permits Division would require under the MMPA rule to avoid marine mammals or that the Navy proposes for marine mammals, nor did the unprocessed estimates consider any avoidance responses that might be taken by individual animals once they sense the presence of Navy vessels or aircraft.

The exposure and response analysis presented in this Opinion considers these exposure estimates on an annual basis, cumulatively over the five-year period, and cumulatively for the reasonably foreseeable future to derive a final estimate of anticipate levels of take by training activity and species.

Approximately 12,500 explosives would be used during training and testing activities per year and would occur in areas designated for use of explosives within the Action Area. Approximately 10,000 (or 80 percent) of the explosives used in the Action Area are in source class E1 (0.1 to 0.25 lb. NEW). Other than those on FDM, most detonations would typically occur beyond approximately 12 nm from shore, minimizing impacts near nesting beaches or coastal habitats for sea turtles. A small number of near-shore (within 3 nm) training activities could occur, potentially exposing some sea turtles approaching nesting beaches to impulse sounds over a short duration if the training occurred during nesting season or close to sea turtles nearshore habitats. However, the terrain of FDM does not provide any nesting beaches, therefore, effects are not expected. In water training and testing activities using lower NEW explosives (up to 10 lb. NEW) will occur at UNDET sites within Apra Harbor and the Piti Mine Neutralization Site and higher NEW explosives (up to 20 lb. NEW) at the Agat Bay Mine Neutralization Site.

The remaining activities utilizing explosive detonations would be restricted to portions of the Action Area that are farther than 12 nm from the shore.

6.8.7.1 Unprocessed Exposure to Impulsive Acoustic Stressors During Training Activities

Navy model output estimates of cetaceans that will be exposed to impulsive acoustic stressors associated with training activities throughout the year are summarized in Table 59 and discussed below.

Table 59. Model-Predicted, Unprocessed Exposures of Cetaceans to Impulsive Sound During Training Activities

Species	Number of Model-Predicted Exposures >120 dB Per Year
blue whale	112
fin whale	76
humpback whale	1,704
sei whale	562
sperm whale	1,747

Blue whale. The model output estimates that blue whales will be exposed to impulsive acoustic stressors from explosions associated with training activities throughout the year. The NAEMO provided an unprocessed estimate of 112 blue whale exposure events annually to impulsive sounds associated with annual training at levels above 120 dB SPL. Ninety-six (96) percent of the estimated 112 unprocessed exposures to blue whales during training activities will result from BOMBEX [A-S].

Fin whale. The model output estimates that fin whales will be exposed to impulsive acoustic stressors from explosions associated with testing activities throughout the year. The NAEMO provided an unprocessed estimate of 76 fin whale exposure events annually to impulsive sounds associated with annual training at levels above 120 dB SPL. Eighty-eight (88) percent of the estimated 76 unprocessed exposures to fin whales during training activities will result from BOMBEX [A-S].

Humpback whale. The model output estimates that humpback whales will be exposed to impulsive acoustic stressors from explosions associated with testing activities throughout the year. The NAEMO provided an unprocessed estimate of 1,704 humpback whale exposure events annually to impulsive sounds associated with annual training at levels above 120 dB SPL. Eighty-two (82) percent of the estimated 1,704 unprocessed exposures to humpback whales during training activities will result from BOMBEX [A-S].

Sei whale. The model output estimates that sei whales will be exposed to impulsive acoustic stressors from explosions associated with testing activities throughout the year. The NAEMO provided an unprocessed estimate of 562 sei whale exposure events annually to impulsive sounds associated with annual training at levels above 120 dB. Seventy-nine (79) percent of the estimated 562 unprocessed exposures to sei whales during training activities will result from BOMBEX [A-S]. Approximately 12 percent of exposures will result from GUNEX [S-S] Ship – Medium Caliber.

Sperm whale. The model output estimates that sperm whales will be exposed to impulsive acoustic stressors from explosions associated with testing activities throughout the year. The NAEMO provided an unprocessed estimate of sperm 1,747 whale exposure events annually to impulsive sounds associated with annual training at levels above 120 dB. Fifty-two (52) percent of the estimated 1,747 unprocessed exposures to sperm whales during training activities will result from BOMBEX [A-S]. Approximately 21 percent of exposures will result from GUNEX [A-S] - Medium Caliber and 10 percent from GUNEX [S-S] Ship – Medium Caliber.

6.8.7.2 Processed Exposure to Impulsive Acoustic Stressors during Training Activities

There are limitations to the data used in the NAEMO, and the results must be interpreted with consideration for these known limitations. Output (Table 59 and Table 60) from the NAEMO relies heavily on the quality of both the input parameters and impact thresholds and criteria. When there was a lack of definitive data to support an aspect of the modeling (such as lack of well described diving behavior for all marine species), conservative assumptions believed to overestimate the number of exposures have been chosen:

- Marine mammals (virtual animals called “animats” in the model) are modeled as being underwater, facing the source and therefore always predicted to receive the maximum sound level at their position within the water column (e.g., the model does not account for conditions such as body shading, porpoising out of the water, or an animal raising its head above water). Some odontocetes have been shown to have directional hearing, with best hearing sensitivity facing a sound source and higher hearing thresholds for sounds propagating toward the rear or side of an animal (Kastelein et al. 2005; Mooney et al. 2008; Popov and Supin 2009).

- Animats do not move horizontally (but change their position vertically within the water column), which may overestimate physiological effects such as hearing loss, especially for slow moving or stationary sound sources in the model.
- Animats are stationary horizontally and therefore do not avoid the sound source, unlike in the wild where animals would most often avoid exposures at higher sound levels, especially those exposures that may result in PTS.
- Animats are assumed to receive the full impulse of the initial positive pressure wave due to an explosion, although the impulse-based thresholds (onset mortality and onset slight lung injury) assume an impulse delivery time adjusted for animal size and depth. Therefore, these impacts are overestimated at farther distances and increased depths.
- Multiple exposures within any 24-hour period are considered one continuous exposure for the purposes of calculating the temporary or permanent hearing loss, because there are not sufficient data to estimate a hearing recovery function for the time between exposures.
- Mitigation measures which are implemented during many training and testing activities were not considered in the model. In reality, sound-producing activities would be reduced, stopped, or delayed if marine mammals are detected within the mitigation zones around sound sources.

Observation of marine mammals prior to or during a detonation (explosion) would stop or delay the event until the area was cleared as described the Navy's Standard Operating Procedures, Mitigation, and Monitoring. This delay of the sound-producing activity (explosion) would reduce actual marine mammal sound exposures to zero at the level that rises to take pursuant to the ESA. Exposure to sound at lower levels may result in minor behavioral responses.

While there are model-predicted unprocessed exposures (Table 59 and Table 60) of cetaceans to impulsive sound sources (explosions), Navy post-calculations of these exposures reduced exposures to impulsive sources to zero. Therefore, any potential effects from impulsive sound sources on cetaceans are considered discountable.

6.8.7.3 Unprocessed Exposure to Impulsive Acoustic Stressors During Testing Activities

Navy model output estimates of cetaceans that will be exposed to impulsive acoustic stressors associated with testing activities throughout the year are summarized in Table 60 and discussed below.

Table 60. Model-Predicted, Unprocessed Exposures of Cetaceans to Impulsive Sound During Testing Activities

Species	Number of Model-Predicted Exposures >120 dB Per Year
blue whale	6
fin whale	7
humpback whale	213
sei whale	71
sperm whale	284

Blue whale. The model output estimates that blue whales will be exposed to impulsive acoustic stressors from explosions associated with testing activities throughout the year. The NAEMO provided an unprocessed estimate of six blue whale exposure events annually to impulsive sounds associated with annual testing at levels above 120 dB. Sixty-nine (69) percent of the estimated 6 exposures to blue whales during testing activities will result from Anti-Submarine Warfare Tracking Test - Maritime Patrol Aircraft while 19 percent will result from Torpedo (Explosive) Testing and 11 percent from ASUW Mission Package Testing.

Fin whale. The model output estimates that fin whales will be exposed to impulsive acoustic stressors from explosions associated with testing activities throughout the year. The NAEMO provided an unprocessed estimate of seven fin whale exposure events annually to impulsive sounds associated with annual testing at levels above 120 dB. Forty-five (45) percent of the estimated 7 exposures to fin whales during testing activities will result from Anti-Submarine Warfare Tracking Test - Maritime Patrol Aircraft while 31 percent will result from Torpedo (Explosive) Testing and 17 percent from ASUW Mission Package Testing.

Humpback whale. The model output estimates that humpback whales will be exposed to impulsive acoustic stressors from explosions associated with testing activities throughout the year. The NAEMO provided an unprocessed estimate of 213 humpback whale exposure events annually to impulsive sounds associated with annual testing at levels above 120 dB. Seventy-one (71) percent of the estimated 213 exposures to humpback whales during testing activities will result from Anti-Submarine Warfare Tracking Test - Maritime Patrol Aircraft while 16 percent will result from Torpedo (Explosive) Testing and 6 percent from ASUW Mission Package Testing.

Sei whale. The model output estimates that sei whales will be exposed to impulsive acoustic stressors from explosions associated with testing activities throughout the year. The NAEMO provided an unprocessed estimate of 71 sei whale exposure events annually to impulsive sounds associated with annual testing at levels above 120 Db SPL. Seventy-seven (77) percent of the estimated 71 exposures to sei whales during testing activities will result from Anti-Submarine Warfare Tracking Test - Maritime Patrol Aircraft while 13 percent will result from Torpedo (Explosive) Testing and 8 percent from ASUW Mission Package Testing.

Sperm whale. The model output estimates that sperm whales will be exposed to impulsive acoustic stressors from explosions associated with testing activities throughout the year. The NAEMO provided an unprocessed estimate of sperm 284 whale exposure events annually to impulsive sounds associated with annual testing at levels above 120 dB SPL. Eighty-one (81) percent of the estimated 284 exposures to sperm whales during testing activities will result from Anti-Submarine Warfare Tracking Test - Maritime Patrol Aircraft while 7 percent will result from Torpedo (Explosive) Testing, 5 percent from MCM Mission Package Testing, and 4 percent from ASUW Mission Package Testing.

6.8.7.4 Processed Exposure to Impulsive Acoustic Stressors during Testing Activities

As discussed above for training activities, while there are model-predicted unprocessed exposures (Table 59 and Table 60) of cetaceans to impulsive sound sources (explosions), Navy

post-calculations of these exposures reduced exposures to impulsive sources to zero. Therefore, any potential effects from impulsive sound sources on cetaceans are considered discountable.

6.8.7.5 Response of Cetaceans to Impulsive Acoustic Stressors During Training and Testing

Since we do not anticipate exposures of cetaceans to impulsive acoustic stressors, we also do not anticipate any responses rising to the level of take. Therefore, we conclude that the potential for effects to cetaceans resulting from impulsive acoustic stressors is sufficiently low to be discountable and therefore is not discussed further in this Opinion.

6.8.8 Effects of Impulsive Acoustic Stressors - Sea Turtles

For this consultation, we considered exposure estimates from the Navy Acoustic Effects Model at several output points for sea turtles.

6.8.8.1 Unprocessed Exposures to Impulsive Acoustic Stressors During Training Activities

Unlike large cetaceans, observation of sea turtles prior to or during a detonation (explosion) is less effective and likely would not stop or delay the event until the area was cleared. Therefore, model-predicted exposures are used to derive potential levels of take for sea turtles although these takes will likely not be detected during training or testing. Navy model output estimates of sea turtles that will be exposed to impulsive acoustic stressors associated with training activities throughout the year are summarized in Table 61 and discussed below.

Table 61. Model-Predicted Unprocessed Exposures of Sea Turtles to Impulsive Sound During Training Activities

Species	Number of Model-Predicted Exposures >120 dB Per Year
Green Turtle	2,630
Hawksbill Turtle	210
Leatherback Turtle	67
Loggerhead Turtle	121

Green sea turtle. The NAEMO provided an unprocessed estimate of 2,360 green sea turtle exposure events annually to impulsive sounds associated with annual training activities at levels greater than 120 dB SPL. Thirty-two (32) percent of the estimated 2,630 green sea turtle exposures will result from BOMBEX [A-S] while 26 percent will result from Underwater Demolition Qualification / Certification, 17 percent from Mine Neutralization – EOD and 11 percent Maritime Security Operations.

Hawksbill sea turtle. The NAEMO provided an unprocessed estimate of 210 hawksbill sea turtle exposure events annually to impulsive sounds associated with annual training activities at levels greater than 120 dB SPL. Forty-five (45) percent of the estimated 210 hawksbill sea turtle exposures will result from BOMBEX [A-S] while 19 percent will result from Underwater Demolition Qualification / Certification, 13 percent from Mine Neutralization – EOD.

Leatherback sea turtle. The NAEMO provided an unprocessed estimate of 67 leatherback sea turtle exposure events annually to impulsive sounds associated with annual training activities at

levels greater than 120 dB SPL. Eighty-five (85) percent of the estimated 67 leatherback sea turtle exposures will result from BOMBEX [A-S] while 7 percent will result from GUNEX [S-S] Ship – Medium Caliber.

Loggerhead sea turtle. The NAEMO provided an unprocessed estimate of 121 loggerhead sea turtle exposure events annually to impulsive sounds associated with annual training activities at levels greater than 120 dB SPL. Fifty-six (56) percent of the estimated 121 loggerhead sea turtle exposures will result from BOMBEX [A-S] while 28 percent will result from GUNEX [S-S] Ship – Medium Caliber.

6.8.8.2 Unprocessed Exposures to Impulsive Acoustic Stressors During Testing Activities

Navy model output estimates of sea turtes that will be exposed to impulsive acoustic stressors associated with testing activities throughout the year are summarized in Table 62 and discussed below.

Table 62. Model-Predicted Exposures of Sea Turtles to Impulsive Sound During Testing Activities

Species	Number of Model-Predicted Exposures >120 dB Per Year
Green Turtle	489
Hawksbill Turtle	52
Leatherback Turtle	29
Loggerhead Turtle	32

6.8.8.3 Processed Exposures to Impulsive Acoustic Stressors During Training and Testing

Navy modeling (Table 63) results indicate 14 TTS-level exposures, 1 PTS-level exposure, 4 exposures resulting in slight lung injury, and 2 exposures resulting in mortality combined for green and hawksbill turtles. No TTS, PTS, injury or mortality was predicted by the NAEMO modeling for loggerheads, or leatherback turtles.

Table 63. Annual Model-Predicted Impacts on Sea Turtles from Explosives Used During Training and Testing Activities

Sea Turtle Species	TTS	PTS	GI Tract Injury	Slight Lung Injury	Mortality
Green sea turtle	**11**	**1**	0	**3**	**1**
Hawksbill sea turtle	**3**	0	0	**1**	**1**
Loggerhead sea turtle	0	0	0	0	0
Leatherback sea turtle	0	0	0	0	0

6.8.8.4 Estimated Instances of Behavioral Harrassment of Sea Turtles from Impulsive Acoustic Stressors

In addition to Navy-modeled estimates for TTS, PTS, Slight Lung Injury, and Mortality from impulsive acoustic stressors, we calculated the number of modeled (unprocessed) instances of behavioral harassment of sea turtle species. To do this, we summed the number of modeled

exposures greater than 175dB (See Section 6.3.6) and subtracted instances of estimated TTS, PTS, slight lung injury, and mortality to provide an estimate (balance of exposures greater than 175dB) of exposures that may result in more than minor behavioral responses potentially rising to the level of "take" pursuant to the ESA. These unprocessed estimates do not take into account U.S. Navy standard operating procedures and mitigation activities that might reduce actual instances of harassment. We also acknowledge that individuals experiencing TTS, PTS, or slight lung injury likely also experience some form of behavioral response associated with these responses; however, we do not double count these instances to remain consistent with our analysis of TTS, PTS, injury where only the highest level response is counted towards take.

Table 64. Annual Estimated Behavioral Harrassment of Sea Turtles from Training and Testing Activities Using Impulsive Acoustic Sources

Sea Turtle Species	Behavioral Harrassment
Green sea turtle	1,837
Hawksbill sea turtle	129
Leatherback sea turtle	49
Loggerhead sea turtle	54

6.8.8.5 Response of Sea Turtles to Impulsive Acoustic Stressors During Training and Testing

Most detonations would typically occur beyond approximately 12 nm from shore, which minimizes the impacts near nesting beaches or coastal habitats for sea turtles. Any injured sea turtles could suffer reduced fitness and long-term survival. As also discussed in Section 6.8.4.4, sea turtles that experience PTS would have permanently reduced perception of sound within a limited frequency range. It is uncertain whether some permanent hearing loss over a part of a sea turtle's hearing range would have long-term consequences for that individual, as the sea turtle hearing range is already limited. A long-term consequence could be an impact on an individual turtle's ability to sense biologically important sounds, such as predators or prey, reducing that animal's fitness. PTS and TTS threshold criteria for sea turtles are conservatively based on criteria developed for mid-frequency marine mammals, so actual PTS and TTS impacts may be less than the predicted quantities.

Some sea turtles beyond the ranges of the TTS or PTS-level effects may behaviorally react if they hear a detonation. If a sea turtle hears multiple detonations in a short period, such as during gunnery, firing, or sonobuoy exercises, it may react by temporarily avoiding the area. Any significant behavioral reactions could lead to a sea turtle expending energy and missing opportunities to feed, nest or rest. However, because most activities would consist of a limited number of detonations and exposures would not occur over long durations, there would be an opportunity to recover from an incurred energetic cost.

Most impacts would be short-term, potential impacts are not expected to result in substantial changes to behavior, growth, survival, annual reproductive success, lifetime reproductive success (fitness), or species recruitment. Although a few individuals may experience long-term impacts and potential mortality, population-level impacts are not expected.

Although we assume that sea turtles in the vicinity of an in-water detonation might experience a TTS or PTS, it is not certain at what energy levels and received levels are necessary to induce threshold shifts. The few studies completed on the auditory capabilities of sea turtles (adult green, loggerhead, and Kemp's ridley turtles) suggest that they could be capable of hearing low frequency sounds (Lenhardt 1994a; Moein et al. 1993; Ridgway et al. 1969). Ridgway et al. (Ridgway et al. 1969) reported maximal sensitivity for green turtles occurred at 300 to 400 Hz, with a rapid decline in sensitivity for lower and higher tones. Similarly, Moein et al. (Moein et al. 1993) reported a hearing range of about 250 to 1,000 Hz for loggerhead turtles, and Lenhardt (Lenhardt 1994a) stated that maximal sensitivity in sea turtles generally occurs in the range from 100 to 800 Hz. Calculated in-water hearing thresholds within the useful range appear to be high (e.g., about 160 to 200 dB re 1 μPa) (Lenhardt 1994a). Piniak et al. reported maximum sensitivity between 100 and 400 Hz in water (84 dB re: 1 μPa at 300 Hz) and 50 and 400 Hz in air (62 dB re: 20 μPa at 300 Hz) for leatherback sea turtle hatchlings (Piniak et al. 2012). In the absence of more specific information that could be used to determine the acoustic harassment range for sea turtles, the U.S. Navy assumed that frequencies >100 Hz (which are the acoustical harassment ranges predicted for odontocetes) would be conservative for sea turtles. Given that sea turtles do not rely on acoustic cues for most important life functions, it is anticipated that TTS and PTS will not result in fitness consequences to individuals or the populations to which they belong.

Acoustic stressors associated with the Navy's activities in the MITT Action Area have the ability to cause slight lung injury. Slight lung injury is defined as having a zero percent mortality rate and being completely recoverable. Although slight lung injuries could temporarily affect the fitness of affected individuals by reducing their respiration rate, these effects are expected to stop once the injury has healed. Because sea turtles are long-lived animals, a temporary disruption of behaviors or fitness levels resulting from slight lung injury is not expected to substantially impair an individual turtle when considering its overall lifetime fitness. Because we do not expect fitness consequences to any individuals, we do not expect population-level consequences.

Impulsive acoustic stressors from Navy training and testing activities conducted annually and continuing into the reasonably foreseeable future are likely to cause behavioral responses, and instances of TTS, PTS, slight lung injury, and mortality to sea turtles in the MITT Action Area. There is no evidence that behavioral responses, TTS, or PTS result in energetic effects to individual sea turtles or would be likely to significantly reduce the viability of the population these individuals represent. While we anticipate small numbers (See Table Table 63) of injury and mortality of green and hawksbill sea turtles from impulsive acoustic stressors in the MITT Action Area that would have fitness consequences on individual sea turtles, we do not anticipate those levels of injury and mortality to result in substantial changes in reproduction, numbers, or distribution of green or hawksbill sea turtle populations.

6.8.9 Effects of Impulsive Acoustic Stressors - Scalloped Hammerhead Shark – Indo-West Pacific DPS

The following section discusses the effects of impulsive acoustic stressors on scalloped hammerhead sharks.

6.8.9.1 Exposure to Impulsive Acoustic Stressors During Training

Agat Bay Mine Neutralization Site and Outer Apra Harbor UNDET (Figure 5) will support activities using explosives up to 20 lb. and 10 lb. NEW devices, respectively. Explosives used at the Piti Floating Mine Neutralization Site are also limited to 10 lb. NEW. In total, approximately 260 explosives would be used annually in shallow water and coastal areas (e.g., Apra Harbor, Agat Bay, Piti Point) per year (Figure 5). The scalloped hammerhead shark is primarily a shallow water, coastal species. Underwater detonations will primarily occur during the day when this species is more likely to be closer to shore. Additionally, Navy divers involved with underwater detonation in the at these sites will visually observe to the best extent practicable for hammerhead sharks prior to initiating detonation as part of the diver's normal underwater training procedures. If hammerhead sharks are observed within the immediate area, then detonation will be delayed until the shark is no longer observed in the immediate area.

The density of scalloped hammerhead sharks in the shallow, nearshore waters of the Action Area are not well understood but anecdotal evidence suggests inner Apra Harbor may serve as nursery habitat for this species (Miller et al. 2014). If Apra Harbor acts as a nursery for this species, juveniles may seasonally occur in substantial densities and it can also be reasonably expected adult males and females would frequently move between Apra Harbor and nearshore areas outside the harbor. One of the underwater detonations sites is within Apra Harbor itself, Agat Bay is south of Apra Harbor, and the Piti site is immediately north of Apra Harbor.

Although sound thresholds capable of inducing behavioral responses and injury in scalloped hammerhead sharks have not been determined, it is expected they will be less susceptible than marine mammals and fish species with swim bladders. Using the formula Young (1991) for effects of underwater detonations to fish without a swim bladder, it is estimated 90 percent of scalloped hammerhead sharks would likely survive at a range of 2.2 meters (7.3 feet) or further from a 10 lb. NEW explosive underwater detonation and 2.8 meters (9.2 feet) or further from a 20 lb. NEW underwater detonation. Therefore, the mortality zone for a 10 lb. NEW charge would be approximately 15.21 m^2 (167.42 ft^2) and approximately 24.63 m^2 (267 ft^2) for a 20 lb. NEW charge. Navy divers observe the underwater detonation site prior to detonation, which should minimize the likelihood of detonating explosives while scalloped hammerhead sharks (or other ESA-listed species) are within the immediate vicinity, thereby minimizing injury or mortality. Since scalloped hammerhead sharks may occur at all three sites, and we do not have the breakdown of planned detonations at the three sites by NEW, we will assume a worst case scenario with all 260 planned detonations using 20 lb. NEW. We assume that mitigation measures including detection of scalloped hammerhead sharks (or any shark species) within the underwater detonation site exclusion zones prior to detonation and subsequent delay of detonation until the area is clear would effectively eliminate the potential for direct injury or mortality resulting from exposure of scalloped hammerhead sharks within 2.8 meters (9.2 feet) of a 20 lb. charge detonation.

While we do not expect detonations to result in any instances of shark mortality, sub-lethal effects (temporary hearing loss, behavioral response) could occur. Due to a lack of shark density information and hearing/behavioral threshold data, it is not feasible to estimate the number of scalloped hammerhead sharks exposed to sublethal effects from impulsive acoustic stressors associated with underwater detonations. Since estimating the number of individual exposed

scalloped hammerhead sharks is not feasible, we use the amount of affected habitat as a surrogate to analyze the effects of impulsive acoustic stressors on the Indo-West Pacific DPS of scalloped hammerhead shark.

In the absence of information on range to significant behavioral effects to scalloped hammerhead sharks from underwater detonations and lack of data on the efficacy of Navy mitigation including the ability to detect scalloped hammerhead sharks during routine underwater detonation activities, we doubled the estimated mortality zones for 20 lb. NEW detonations to derive an area (displacement zone) where scalloped hammerhead sharks might experience behavioral responses, TTS, temporary disruption of feeding, breeding, or sheltering activities, or the reduced availability of preferred habitat. We determined that the affected habitat area for a 20 lb. NEW charge would be 99 m2 (1,064 ft^2) per detonation (based on a radius of impact of 5.6m). While we did not exclude the estimated mortality zone from this larger displacement area, we still assume the injury and mortality is not likely. We anticipate that up to 260 charges would be detonated annually at underwater detonation sites where scalloped hammerhead sharks may be present. In this scenario, any scalloped hammerhead sharks within the 99 m^2 area would be behaviorally-harassed, or up to 99 m^2 of their habitat would be temporarily displaced during each detonation. We expect the 260 underwater detonations and subsequent effects to be distributed across the Piti Point, Outer Apra Harbor, and Agat Bay sites throughout a given year, and we anticipate the number of charges that are routinely detonated in a day (no more than five) or week (no more than 20) would result in temporary effects that would not lead to a significant reduction in feeding, breeding, or sheltering opportunities. That is, we expect normal behavioral activities of scalloped hammerhead sharks and the availability of this habitat to sharks to resume soon after each of the 260 disturbances events have concluded.

Based on the ETOPO1 Global Relief Model Bathymetry data available from NOAA's National Geophysical Data Center there are approximately 19,462,434 km^2 of ocean with depths less than 1,000 m (where scalloped hammerhead sharks are most likely to occur) occurring within listed DPS segments. The Indo-West Pacific DPS contains 13,510,249 km^2 of ocean with depths less than 1,000 m (Figure 26).

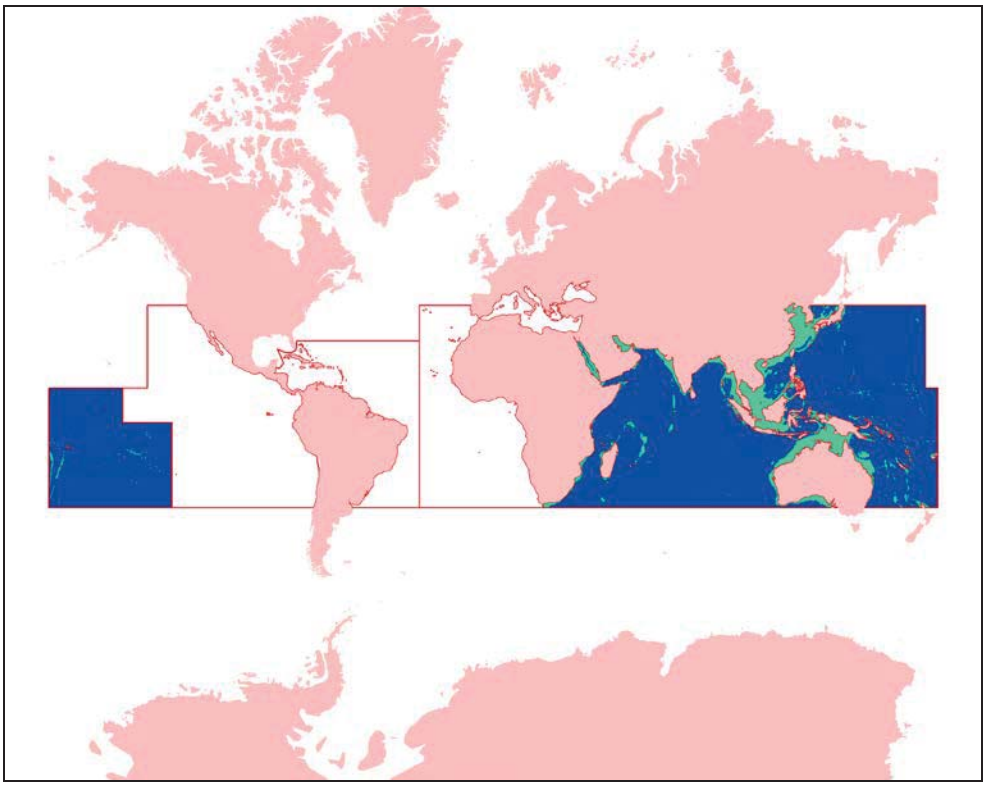

Figure 26. The Indo-West Pacifc DPS of scalloped hammerhead sharks. Dark blue areas are waters with depths greater than 1,000 m while light blue areas are waters with depths less than 1,000 m. The total area of water with depths less than 1,000 m is 13,510,249 km^2.

6.8.9.2 Exposure to Impulsive Acoustic Stressors During Testing

No MITT testing activities include underwater detonations at the Apra Harbor, Agat Bay, or Piti Point sites. The use of impulsive airguns for pierside integrated swimmer defense testing activities occurring in Inner Apra Harbor will occur infrequently (no more than 11 activities totaling 308 hours per year) and will occur in a high-use area with high ambient noise levels. The small airguns used in pierside testing activities lack the strong shockwave and pressure increases associated with underwater detonations. These airguns produce 185 to 195 dB re 1 µPa^2 SEL at 1 m. The small ensonified area capable of eliciting an injury or behavioral response of scalloped hammerhead sharks and the limited duration of impulsive acoustic energy from swimmer defense airguns indicate the likelihood of exposure of scalloped hammerhead sharks to impulsive acoustic energy resulting in take from pierside integrated swimmer defense testing activities to be so low as to be discountable. Therefore, no exposure of scalloped hammerhead sharks to impulsive acoustic stressors during testing is anticipated.

6.8.9.3 Response to Impulsive Acoustic Stressors During Training and Testing

Given the short distance from the detonation source that a shark would need to be for injury or mortality to occur and the mitigation procedures for underwater detonations, it is unlikely that scalloped hammerhead sharks would be injured or killed during underwater detonations. However, scalloped hammerhead sharks may experience hearing loss if within an unknown

distance to the underwater detonation. Hearing loss would be temporary because unlike marine mammals, fish are capable of regenerating sensory hair cells and no permanent hearing loss has ever been reported in fish (Lombarte et al. 1993) (Smith et al. 2006b).

Additionally, the potential for behavioral harassment remains. As discussed above, we were unable to quantify the number of individual scalloped hammerhead sharks that could experience behavioral harassment. Instead, we estimated the area of affected habitat as a surrogate to define take. Because scalloped hammerheads are long-lived, highly mobile animals and alternate habitat is available outside of the habitat area expected to be effected during each underwater detonation event, sharks that are temporarily displaced from their preferred habitat would likely select adjacent habitat where forage, breeding habitat and refugia is available. Also, instances of temporary hearing loss are not expected to substantially impair individual scalloped hammerheads when considering overall lifetime fitness. We do not anticipate any responses of scalloped hammerhead sharks to integrated swimmer defense testing activities that would rise to the level of take. Because we do not expect fitness consequences to any individuals resulting from temporary displacement of habitat or TTS, we do not expect population-level consequences.

6.8.10 Effects of Impulsive Acoustic Stressors and Military Expended Materials

The effects of impulsive acoustic stressors on marine mammals, sea turtles, and scalloped hammerhead sharks are discussed in sections 6.8.7, 6.8.8, and 6.8.9, respectively. The effects of military expended materials on these species are discussed below in Section 6.8.10.1. In Section 6.8.10.2, we combined the discussion of the effects of impulsive acoustic stressors and military expended materials on *Acropora globiceps* because both stressors are related to the use of ordnance.

6.8.10.1 Marine mammals, sea turtles, and scalloped hammerhead sharks

Military expended materials include all sizes of non-explosive practice munitions, fragments from explosive munitions, and expended materials such as sonobuoys, ship hulks, and targets. The expected density of ESA-listed marine mammals, sea turtles, and scalloped hammerhead sharks in areas receiving a majority of munition, and ordnance testing that could potentially strike these species is very low. The impact site for munitions, dropped ordnance, and other expended materials have very small footprints. The density of marine mammals, sea turtles, and scalloped hammerhead sharks; the small footprint of expended materials; and the Navy's strike modeling efforts suggest direct strikes to these species from expended materials is so unlikely as to be discountable. According to the Navy's BE, there are no records of military expended materials striking marine mammals, sea turtles, or scalloped hammer head sharks further supporting this conclusion.

6.8.10.2 Acropora globiceps

The following sections discuss the effects of impulsive acoustic stressors on colonies of *Acropora globiceps*. The available information regarding the distribution of *Acropora retusa* and *Seriatopora aculeata*, does not suggest these species are likely to occur near underwater detonation sites or at-sea target sites. Therefore, we only analyze effects to *Acropora globiceps* in this section.

Little is known about the long-term ecosystem effects of blast impacts or the dynamics of recovery of corals from underwater or surface detonations within close proximity of corals. With regard to the use of military ordnance at FDM, we would expect areas to receive periodic disturbance from military expended materials impacting reefs and sporadic detonations near the surface in relatively shallow waters. In fewer instances, ordnance may impact at or near the bottom or directly on coral reefs.

Direct trauma and mortality may occur due to the rapid pressure changes associated with an explosion. Though most invertebrates lack air cavities that would respond to pressure waves, which typically causes the most damage in fish or marine mammals, a blast in the vicinity of hard corals (i.e., *Acropora globiceps*) could cause direct impact to coral polyps, or fragmentation and siltation of the corals. A blast near the bottom could also disturb hard substrate suitable for colonization.

The effects of dynamite or "blast" fishing may help provide some insight to the potential effects of detonation of live military ordnance in and around coral colonies. However, it is worth noting that blast fishing detonations typically occur at depth (i.e., near or on the substrate) (Fox and Caldwell 2006), whereas the military detonations that may occur near FDM would be expected to occur at the surface of the water. The shock waves from blast fishing explosions break the coral's calcium carbonate skeleton into small pieces. Once broken, the coral/algal symbiotic relationship is disrupted and the coral begins to lose nourishment and starts to die.

Coral reef survival and recovery may be affected by acute single blasts as well as chronic blasting over greater spatial and temporal scales. Fox and Caldwell (2006) examined coral reef recovery following acute single blasts and following chronic blasting. Rubble resulting from single blasts slowly stabilized, and craters filled in with surrounding coral and new colonies. After five years, coral cover within craters formed by single blasts no longer differed significantly from control plots. In contrast, extensively bombed areas showed no significant recovery over the six years of the study, despite adequate supply of coral larvae. After extensive blasting, resulting coral rubble may shift in ocean currents, abrading or burying new coral larvae, thereby slowing reef recovery (Fox and Caldwell 2006). McManus (1997) suggested that blastfishing in Bolinao, Philippines may reduce the growth capacity of scleractinian coral on the reef slope by approximately one third.

A study at a former U.S. Navy range at Vieques Island (Puerto Rico, United States), which is now the largest national wildlife refuge in the Caribbean, investigated the geomorphology and benthic assemblage structure to understand the status of the coral reefs. In that study (Reigl et al. 2008), investigators found no differences in living benthic coral reef cover or composition of coral assemblages inside and outside the bombing range or in comparison to reefs investigated on St. Croix. Reigl et al. (2008) concluded that this may indicate not that zero impacts occurred but rather that natural disturbances appear to have altered the coral communities drastically, thus obscuring military impacts. Effects of natural disturbances were severe at Vieques, outweighing impacts of past military activity which were present but not quantitatively discernible at the scale of sampling. Disease and storms, rather than military expended ordnance, were seen to have taken the worst toll on corals at both Vieques and St. Croix (Reigl et al. 2008).

The US Navy conducted annual nearshore marine resource surveys around FDM from 1999 through 2012 (except 2011). A 2013 report presented the findings of the calender year 2012 survey and compares findings from those of the previous 12 surveys (Smith et al. 2013). The report indicates that despite ongoing use by the Department of Defense as a live and inert range, no significant impacts to the physical or biological environment were detected between 1999 and 2012. Direct ordnance impacts upon the submerged physical environment, which were clearly attributable to training activities, were detected in 2007, 2008, 2010, and 2012. Indirect impacts, such as ordnance that skipped or eroded off the island and rock and ordnance fragments blasted off the island were detected every year. The report indicated that very few areas of disturbance were detected, the size of any disturbed areas were generally less than 2 m^2, and substantial or complete recovery of these disturbed areas occurred within one year. Additionally, large numbers of one and two year old stony coral recruits were consistently observed, suggesting that coral recruitment is not a limiting factor around the island. The report also indicated that restricted access to FDM (because it is a DoD live and inert range) may have a conservation benefit to the reef ecosystem around the island, with marine resources at FDM comparable to or superior to those of any of the other islands within the Mariana Archipelago (Smith et al. 2013).

6.8.10.2.1 Exposure of Corals to Impulsive Acoustic Stressors Around Guam

The vast majority of training and testing activities around Guam that use explosives occur in areas greater than 12 nm from shore and thus not considered further in this Opinion. The Agat Bay Mine Neutralization Site is located beyond 3 nm of Guam and is capable of supporting activities using explosives up to 20 lbs. NEW, but this site is located in water depths deeper than eight meters (maximum known depth of *Acropora globiceps*). Explosives used at the Piti Point Mine Neutralization site and Outer Apra Harbor UNDET sites are limited to 10 lbs. NEW. Of these sites, the Outer Apra Harbor UNDET site and Piti Point Mine Neutralization site are within less than one kilometer of existing reef structures known to support coral growth (Figure 27).

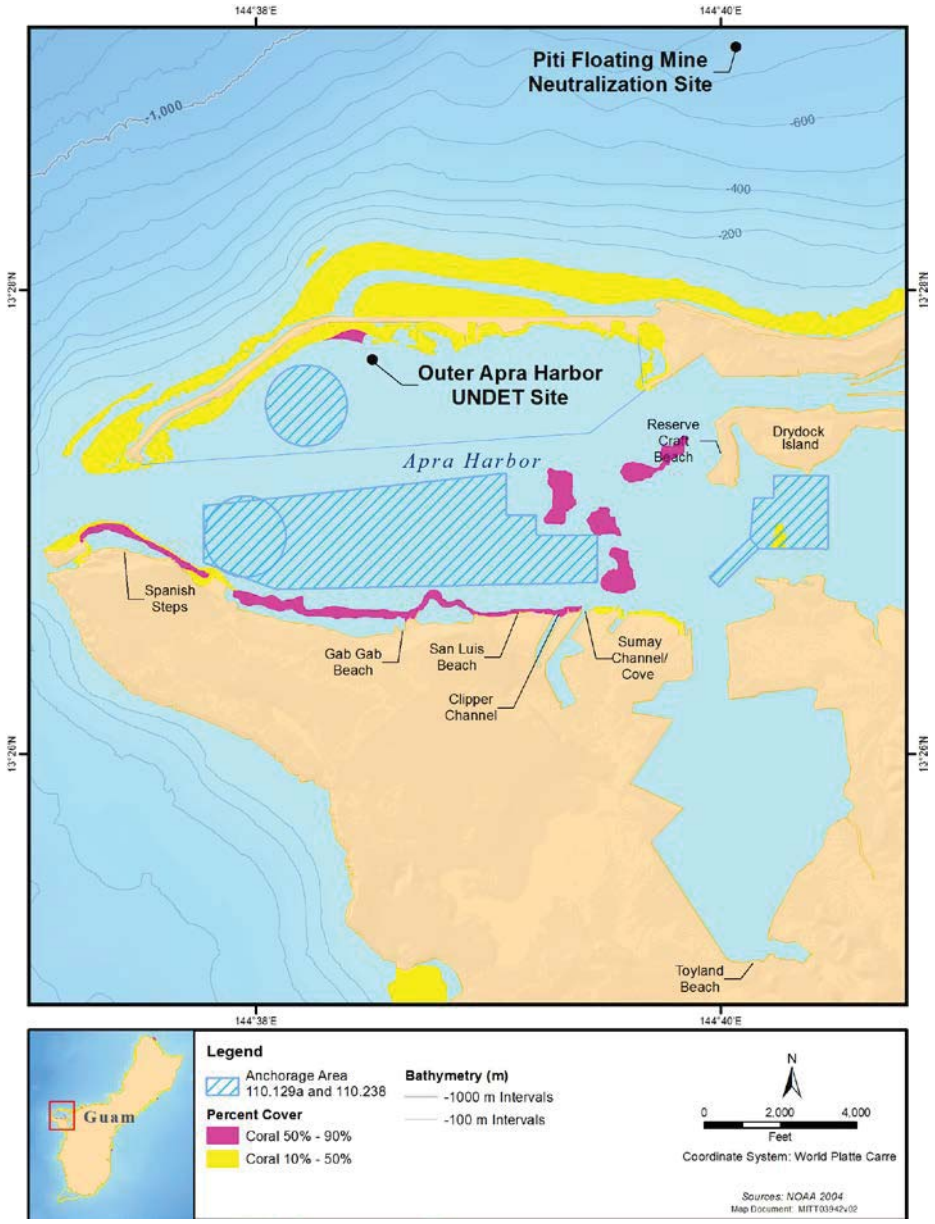

Figure 27. Underwater Detonation and Mine Neutralizaton Sites in and around Apra Harbor, Guam

Effects from explosions at these locations are not reasonably expected to affect ESA-listed coral colonies due to the distance between UNDET and mine neutralization sites, and known locations of *Acropora globiceps,* as well as precautions taken by the Navy during mine neutralization activities. Several surveys have been conducted within Apra Harbor (e.g., (Smith et al. 2009), (Starmer 2008)) and in only two instances (Schils et al. 2011), TetraTech 2015), was *Acropora globiceps* observed. However, the species was observed near Kilo Wharf and Spanish Steps, located across Apra Harbor from the UNDET site. The species has not been documented within a close enough to the Outer Apra Harbor UNDET site to be adversely effected by Navy activities at this site. It is possible that *Acropora globiceps* is present at the Piti Point UNDET site, most

likely very close to shore. However, no more than a 10 lb NEW detonation will be used at this site, resulting in a percussive effect of about 10 feet. All UNDET locations are monitored for presence of corals and the Navy maintains a distance of 350 feet from hard bottom structures (e.g., coral reefs) during detonations, indicating that coral reefs (including those that may contain *Acropora globiceps*) are not expected to be affected. For these reasons, *Acropora globiceps* adult colonies are not expected to be affected by detonations around Guam.

6.8.10.2.2 Exposure of Corals to Impulsive Acoustic Stressors Around Farallon de Medinilla

In 2004, 81 species of corals, including *Acropora globiceps,* were observed on reefs at FDM (DoN 2005b) where training or testing activities using explosives would occur. *Acropora retusa* and *Seriatopora aculeata* have also been documented in either Guam or CNMI, respectively. However, the available information does not suggest these species are likely to occur in the reefs around the island (D. Fenner, personal communication, May 13, 2015). Therefore, *Acropora globiceps* could be impacted by explosion of live ordnance that miss or skip off intended onshore targets at FDM and land in the adjacent nearshore environment and either detonate upon impact with the water at or near the surface or do not detonate and sink to the bottom either impacting substrate or potentially coral colonies in the area. FDM has a relatively wide insular shelf (400 to 1,800 m wide) that supports limited coral cover along all sides except portions of the western side of the island (Figure 28).

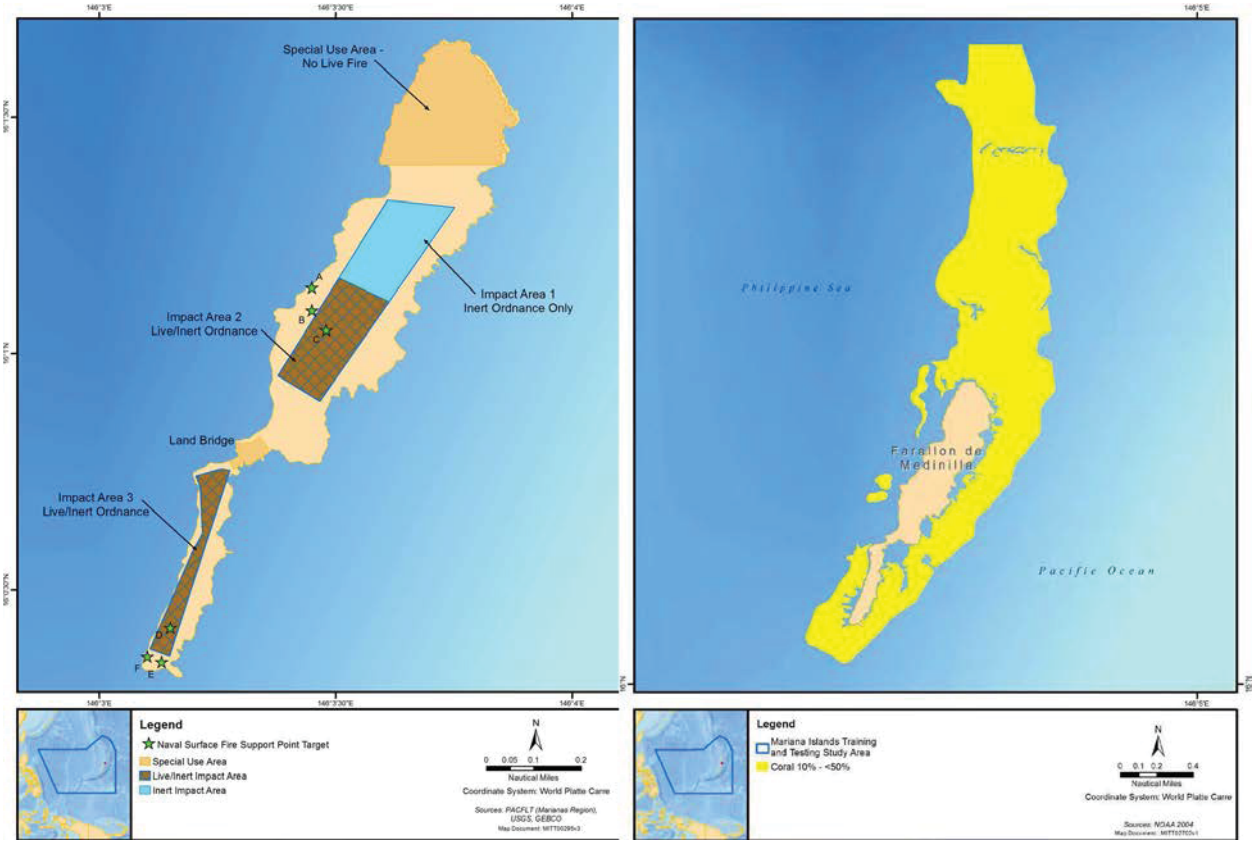

Figure 28. Coral reef structures (right picture highlighted in yellow) in relation to impact areas on Farallon de Medinilla. Reef structures within approximately 0.5 km of the shoreline cover an area of approximately 1.7 km^2.

Near the cliff edge on the reef terrace of the eastern side of FDM, there is estimated to be less than 5 percent coral cover (DoN 2005b). Further offshore, there is estimated to be 10 to 20 percent coral cover composed of encrusting *Porites* and head coral forming *Pocillopora*. Coral cover on the boulders is estimated to be 25 to 30 percent and comprised primarily of *Pocillopora*, *Porites*, *Montipora*, and *Millepora*. Coral cover on the ridges of the spur-and-groove system off the island isthmus on the windward side ranges is estimated to be from 15 to 25 percent, and is composed of *Porites* and *Pocillopora*.

As described above in Section 0, FDM has been a target site for live-fire military exercises (ship-to-shore gunfire, aerial gunnery and bombing) since 1971 (Smith et al. 2013). While the majority of live and inert ordnance strikes the island and does not impact the nearshore marine environment, there are known instances where bombs have missed the island or rolled down into the water after impact.

In order to estimate the incidences of injury or mortality to ESA-listed corals around FDM that result from direct strike of ordnance, in-water explosions of ordnance, and direct strike of corals from fragments of exploded or inert ordnance richocheting from land-based targets, we performed the following analysis:

Step One. Determine Relative Abundance of *Acropora globiceps*

Survey data (DoN 2005b) indicate that *Acropora globiceps* is the only ESA-listed coral that is likely to inhabit waters around FDM. We assumed that all of the coral reefs round FDM would be populated with patchy but fairly uniform distributions of coral colonies including *Acropora globiceps.* Near the cliff edge on the reef terrace of the eastern side of FDM, there is estimated to be less than 5 percent coral cover (DoN 2005b). Further offshore, there is estimated to be 10 to 20 percent coral cover. Coral cover on the boulders is estimated to be 25 to 30 percent. Coral cover on the ridges of the spur-and-groove system off the island isthmus on the windward side ranges is estimated to be from 15 to 25 percent (DoN 2005b). Based on these values, we estimate an average coral coverage of approximately 18.6 percent around FDM.

Survey data from FDM indicate that the relative abundance of *Acropora globiceps* compared to the other 80 species identified in the area is rare (DoN 2005b). We compared 260 records of observed species from six different survey transects and attributed a number of colonies to each based on the relative abundance of each record (abundant = 25 colonies, common = 20 colonies, occasional = 10 colonies, and rare = 5 colonies; as defined in the DoN (2005) report (Table 65). For example, in survey D1, three species were identified as abundant, meaning the surveyors observed 25 or more colonies of each of those species. Surveyors identified 14 rare species in transect D1, meaning that these 14 species were observed five or fewer times on the survey. *Acropora globiceps* was observed during two of the surveys, and was not observed more than five times during those surveys. Therefore, for the purpose of calculating the relative abundance

of *Acropora globiceps*, we assumed a maximum of 10 total colonies were observed during six transects. The six survey transects resulted in the estimation of 2,270 colonies of all 81 species around FDM. Therefore, the proportion of *A globiceps* to all coral species observed around FDM is 0.0044 (10 *Acropora globiceps* colonies/2,270 total coral colonies = 0.0044).

Table 65. Survey data used to calculate the relative abundance of *Acropora globiceps* in coral habitat around FDM. Survey data was from (DoN 2005b).

Relative Abundance	Transect						Total Records	Colonies per Record	Total Colonies
	D1	D2	D3	D4	D5	D6			
Abundant	3	3	5	3	1	1	16	25	400
Common	4	3	5	3	1	5	21	20	420
Occasional	16	11	12	7	10	11	67	10	670
Rare	14	25	33	22	24	38	156	5	780
Total	37	42	55	35	36	55	260	-	2270

Step Two. Determine *Acropora globiceps* colony size in reference to reef area surrogate

The Final Rule regarding Incidental Take Statements (80 FR 26832) allows the use of surrogates in determining the level of expempted take for ESA-listed species when take of individual listed species is not readily observable. However, to understand the observed or estimated incremental effects of an action on a surrogate, we must understand the causal link between the surrogate and the take of the species (section 6.5 describes how we delineate an individual coral). *Acropora globiceps* in the CNMI have been observed to be roughly 10 to 20 cm in diameter (D. Fenner, personal communication, May 14, 2015). Using an average of 15 cm diameter, **the average colony area is 0.01767 m^2**.

Step Three. Estimate the number of live and inert munitions that impact coral habitat

FDM supports a full suite of munitions use, from the delivery of heavyweight explosive bombs dropped from fighter aircraft to small arms fire from helicopters. Up to 6,242 explosive bombs and 2,670 non-explosive bombs would be expended annually at FDM (8,912 total). Bombs range in size from 25 pounds to 2,000 pounds. Up to 42,000 small-caliber projectiles would be expended annually at FDM. Small-caliber projectiles are those projectiles that are 50 caliber and below. Small caliber projectiles will lose most of their energy upon contact with the water surface and are not expected to impact *Acropora globiceps* with enough force to cause a measurable effect. Up to 17,350 explosive and 94,150 non-explosive projectiles would be expended annually. Medium caliber projectiles are those projectiles that are greater than 50 caliber, but less than 57mm. Up to 1,200 explosive, large-caliber projectiles and up to 1,800 non-explosive large-caliber projectiles would be expended annually. Large caliber includes 5 inch ship fired projectiles as well as mortars fired into the impact areas from the northern end of FDM. Up to 85 explosive missiles would be expended and up to 2,000 explosive rockets would be expended annually at FDM. Table 66 provides estimates of the annually-expended ordnance that is anticipated to miss or richochet off of the on-land target impact areas and land in

nearshore waters. Further detail regarding the estimation of total reef area impacted by munitions at FDM is available in a memo to the file (Environmental Readiness Division (N465) 2015). This memo includes information on how the Navy estimated the percent of items that fall in the water and the percent of those items that are assumed to impact coral habitat.

Table 66. Estimated Area of Coral Habitat Impacted by Ordnance at Farrallon de Medinilla

Ordnance Items per the Proposed Action (FEIS/OEIS)	Number of Items Expended Annually	Percent of Items That Fall in Water	Number of Items That Fall in Water	Percent of Items Assumed to Impact Reefs	Number of Items Assumed to Impact Reefs	Impact Area Per Item (m2)	Total Coral Habitat Area (m2)
Bombs (HE)[1]	6,242	1	62.42	100	62.42	132.73	**8,285.0066**
Bombs (NEPM)	2,670	2	53.4	100	53.4	3.0044	160.43496
Bomb debris (end plates)	6,242	50	3,121	17	530.57	0.072929	38.693879
Bomb Debris (ejecta)	6,242	50	3,121	17	530.57	0.072929	38.693879
Small-caliber projectiles	42,000	5	2,100	17	357	0.0056	1.9992
Medium-caliber projectiles (HE)	17,350	5	867.5	0	0	0.0104	0
Medium-caliber projectiles (NEPM)	94,150	5	4,707.5	17	800.275	0.0104	8.32286
Large-caliber projectiles (HE)	1,200	5	60	0	0	0.1876	0
Large-caliber projectiles (NEPM)	1,800	20	360	17	61.2	0.1876	11.48112
Missiles	85	0	0	100	0	6.943	0
Rockets	2,000	5	100	17	17	0.1484	2.5228
						Total Habitat Area Affected	**8,547.1552**

[1] Bombs (HE) is the only ordnance anticipated to result in mortality of coral colonies

For bombs with high explosives (HE) that may have greater impacts (see footnote in table), we also assessed the potential mortality and injury zones from a documented Navy observation of an underwater impact crater.

Step Four. Determine the Range to Effects for Injury and Mortality from Detonations of Bombs (HE)

During a 2010 survey, a fresh shallow crater was observed for the first time since 1999. It was located in the southern portion of Z3W. The crater pit was 5 m across in its maximum dimension and the cratered portion of the seafloor was a maximum of 50 cm deeper than the surrounding sea floor. Water depth at the site was 12 m. Explosive Ordnance Disposal (EOD) Detachment "MARI" personnel judged that a bomb had detonated at the water surface to produce the disturbance. This event occurred in an area that was dominated by relatively barren bedrock. No

corals or any other sessile benthic invertebrates or the remains thereof were observed in the crater/blast pit or within a distance of approximately 4 m from the edge of the crater. Past the 4 m perimeter, (approximately 9 m from the center of the impact site) sea floor cover by corals was estimated to be less than 5 percent. The bedrock segments of the sea floor with less than 5 percent coral cover are 'natural' around much of FDM at depths of 14 m or less. Note, this low percentage of sea floor cover by coral was uniform for most of Z3W, except on the tops of some large cliff blocks and boulders where coral cover ranged up to 50 percent and the SW portion of Z3W where extensive coral development occurs with coverage > 50 percent (Navy, pers. comm., memorandum to the record, May 8, 2015).

This observation suggests that any coral within a circular area with a diameter of 13 meters (5m + 4m + 4m) could have been impacted, as coral beyond this range appear to be similar to undisturbed background locations. From this observation, we established a mortality zone extending 6.5 meters from the center of the crater, equating to an area of 132.73 m^2. To estimate potential injuries outside of the mortality zone, and in the absence of any available information on distance to effects for explosions and corals, we assumed that recoverable injuries (e.g., breakage) might occur within a zone extending another 6.5 meters past the mortality zone (i.e., an additional distance equal to the radius of the mortality zone; see Figure 29). This equates to an injury zone of 398.2 m^2. Again, the mortality zone is based on a single observation of a surface detonation in 12 m of water with approximately 5 percent coral cover. We recognize that the range to effects for mortality and injury will likely increase with a decrease in water depth (less than 12 meters) and will likely decrease as water depth increases (greater than 12 meters). We also recognize the explosive weight of the bomb that created the crater was not known. However, we assume it was a relatively large bomb to create a crater of that size 12 meters below the water's surface. As such, smaller bombs would be expected to create a smaller blast-impact area. Also, the magnitude of effects may vary depending on bottom type and bottom features (boulders, shelfs, etc.). For example the percent of hard bottom versus soft bottom environments might influence the amount of refraction of sound pressure waves. Nevertheless, we consider these zones of effect to be representative of a typical scenario at FDM with an average depth and bottom type similar to the 12 meter depth observation.

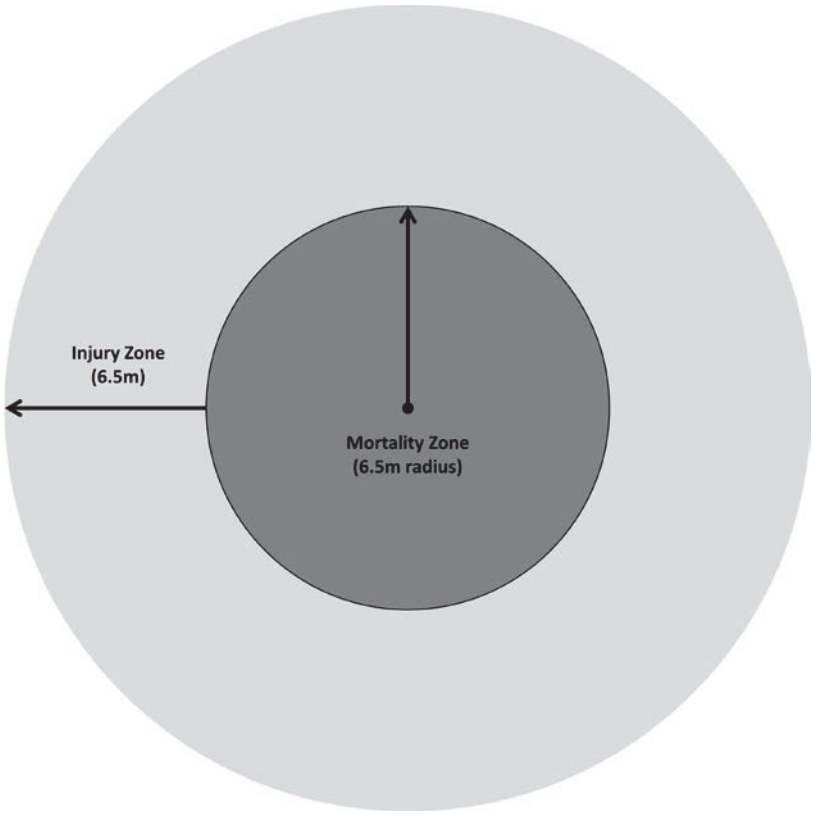

Figure 29. Estimated Injury and Mortality Zones for Coral Colonies Based on a HE Bomb Detonating at the Water's Surface in 12 m of Water

Step Five. Estimate impacts to *Acropora globiceps* from HE Bombs

Next, we used the mortality and injury zones estimated for HE bombs (as determined in Step Four) to estimate the area (m^2) and number of colonies of *Acropora globiceps* impacted. We assumed 18.6 percent live coral coverage (as described in Step One) and patchy, yet uniform distribution of corals. We used our calculated relative proportion of *Acropora globiceps* (also from Step One) to other FDM reef-building corals of 0.0044 and assumed an average colony size of 0.01767 m^2. We first multiplied the estimated total reef area impacted (from Table 66) by the percent live coral coverage to determine the total area of mortality of live coral cover (8,285m^2 x .186 = 1,541m^2). We then multiplied this total area by the relative proportion of *Acropora globiceps* to other FDM reef-building corals to determine the area of impacted *Acropora globiceps* (1,541m^2 x 0.0044 = 6.78 m^2). We then divided this area by the assumed average colony size to estimate the number of annual *Acropora globiceps* colony mortalities (6.78 m^2 ÷ 0.01767 m^2 = 383.7 colonies). Table 67 provides these results.

Table 67. Estimated Annual Mortality From In-Water Explosions of High-explosive Bombs at FDM

Total reef impact area (m^2)	Mortality Zone (Assuming 18.6% Coral Coverage)(m^2)	Apportioned Area for *A globiceps* (m^2); habitat area surrogate	Estimated *Acropora globiceps* Colony Mortalities (Assuming an Average Colony Size of 0.01767 m^2)
8,285.00	1541.01	6.78	383.7 (384[1])

[1]**This number is rounded up to the nearest whole number to provide the total number of individuals killed.**

We performed the same series of calculations to determine the area and number of colonies of *Acropora globiceps* injured from HE bombs. These injuries are expected to be recoverable. The total reef area impacted was estimated by multiplying the number of HE bombs expected to impact reefs (from Table 66) by the area of injury from each bomb, as determined in Step Four (62.42 x 398.2m^2 = 24,855.64 m^2). We then multiplied this area by the percent live coral coverage to determine the total area of injury to live coral (24,855.64m^2 x .186 = 4,623.14m^2). We then multiplied this total area by the relative proportion of *Acropora globiceps* to other FDM reef-building corals to determine the area of injured *Acropora globiceps* (4,623.14m^2 x 0.0044 = 20.34 m^2). Finally, we divided this area by the assumed average colony size to estimate the number of annual *Acropora globiceps* colony mortalities (20.34 m^2 ÷ 0.01767 m^2 = 1,151 colonies). Table 68 provides the results of these calculations.

Table 68. Estimated Recoverable Injury From Direct Strike of Ordnance and Expended Materials at FDM

Total reef impact area (m^2)	Injury Zone (Assuming 18.6% coral coverage) (m^2)	Apportioned Area for *A globiceps* (m^2)	Estimated *Acropora globiceps* Colony Recoverable Injuries (Assuming an Average Colony Size of 0.01767 m^2)
24,855.64	4,623.14	20.34	1,151.2 (1,152[1])

[1]**This number is rounded up to the nearest whole number to provide the total number of individuals injured.**

Step Six. Estimate Instances of Injury of Coral Colonies from Ordnance other than HE Bombs

Next we estimated the number of reasonably expected injuries to *Acropora globiceps* from strikes of inert practice bombs, projectiles and missiles, and military expended materials (bomb, missile, shell fragments). Injuries from live ordnance were estimated in the previous step. Most small caliber projectiles will lose most of their energy upon contact with the water surface and are not expected to impact *Acropora globiceps* with enough force to cause a measurable effect. Table 66 indicates 1,993 strikes to reefs from ordnance other than small-caliber projectiles and HE-bombs are expected to occur annually. To determine how many of these strikes are likely to

impact *Acropora globiceps*, we first multiplied this number of strikes by the average percent of live coral cover (1,993 strikes x 0.186 = 370.7 strikes of live coral). We then multiplied this number by the relative proportion of *Acropora globiceps* to other FDM reef-building corals to determine the number of *Acropora globiceps* colonies struck by ordnance other than HE bombs (370.7 strikes x 0.0044 = 1.6 strikes). Rounding up, this results in an estimate of two *Acropora globiceps* strikes per year from ordnance other than HE-bombs and small caliber projectiles.

Step Seven. Estimate the population size of *Acropora globiceps* around FDM

The contiguous coral reef around FDM covers an estimated 7,725,226 m^2 based on GIS analysis of data from the National Oceanic Service (2004). Given an estimated 18.6 percent coral cover of reefs around FDM and an *Acropora globiceps* abundance proportion of 0.0044 to other coral species this equates to an estimated 6,322.3 m^2 of *Acropora globiceps* live coral area (7,725,226 m^2 x 0.186 = 6,322.3 m^2). Assuming an average colony size of 0.01767 m^2, this area could be inhabited by as many as 357,800 *Acropora globiceps* colonies (6,322.3 m^2 ÷ 0.01767 m^2 = 357,800 colonies).

Step Eight. Compare Mortality and Injury Estimates to FDM Population Estimates and Rangewide Population Estimates

We compared the take estimates calculated in steps five and six to the area and colony estimates from step seven and from the rangewide population estimate for *Acropora globiceps*.

While the above methods can be used to generate rough estimates of the number of *Acropora globiceps* colonies affected by the proposed action, it is not practical to express the amount or extent of anticipated take of individual *Acropora globiceps* colonies, or to monitor take-related impacts in terms of individuals of this species. There are many reasons for this, but the primary ones are species identification uncertainty, and natural spatial and temporal variability in the occurrence and density of listed coral colonies, as described below.

As noted in the final listing rule, Indo-Pacific reef-building coral species are generally difficult to identify, even by experts, because of: (1) The high biodiversity of reef-building corals; (2) the high morphological plasticity in many reef-building coral species; and (3) the different methods used for species identification (NMFS 2014, 79 FR 53852). For example, 13 of the 15 ESA-listed Indo-Pacific coral species, including the three species confirmed in the MITT Action Area, have a moderate or high level of species identification difficulty (Fenner 2014). Thus, even if experts can be hired to survey and monitor Action Area sites, the species-level data is likely to be confounded by species identification uncertainty.

In addition, coral reef communities are highly dynamic whether humans are present or not, with species presence/absence, colony density, colony size and morphology, and other factors varying over small spatial scales (e.g., a few meters separate forereef and backreef habitats, which can have radically different coral communities) and small temporal scales (e.g., seasonal and annual cycles of natural disturbance, like storms and predation events, can wipe out a species or community in a particular area, followed by species recovery). The spatial and temporal variability in coral habitat and species abundance is described in detail in the final rule's Corals

and Coral Reefs section (NMFS 2014, 79 FR 53852). Thus, even if reliable species-level data can be produced for a given Action Area site over time, any changes in species abundance caused by the proposed action are likely to be confounded by natural variability.

Thus, for the proposed action, it is not practical to express the amount or extent of anticipated take of *Acropora globiceps*, or to monitor take-related impacts in terms of individuals of these species. Therefore, the incidental take of *Acropora globiceps* is expressed as a habitat area surrogate for mortality and in instances of injury to this area of habitat assumed to be occupied by *Acropora globiceps* in the Incidental Take Statement, as prescribed by the new NMFS-FWS ITS rule (May 11, 2015; 80 FR 26832).

6.8.10.2.3 Effects of detonations on coral eggs, sperm, and larvae

Acropora globiceps broadcast spawn where fertilization and early embryonic development occurs (See Section 4.2.11.3). The eggs, sperm, and larval stage of *Acropora globiceps* could remain in the water column for extended periods. Each individual polyp of an *Acropora* coral can produce 16 eggs and concentrations of sperm can be as high as 1 million per milliliter of seawater during spawning. Fertilized eggs develop into planula larvae within 5 days in *Acropora* species but these larvae can also remain in the water column over 200 days before settling. It is reasonable to assume in-water detonations occurring around FDM, at the Piti Point Floating Mine Neutralization site, the Agat Bay Mine Neutralization site, and the Outer Apra Harbor UNDET site could affect eggs, sperm, or planula larvae of *Acropora globiceps* (or other ESA-listed coral species) if their presence coincided with an explosion. Life stages subjected to the shearing forces of turbulent shockwaves from underwater detonations could be deformed, die, or experience a decreased likelihood of fertilization. Shock waves in the waters around explosions may reflect off of hard surfaces and the surface of the water, magnifying the exposure of nearby reefs. However, as described above, the reproductive biology of *Acropora globiceps*, and other coral species, results in prolific larval production and high natural mortality from a combination of factors including predation and dispersal to areas within the ocean without appropriate settlement habitat (e.g., deeper or colder water, unsuitable substrate). Any anthropogenic mortality from the Navy's actions is likely to be infinitesimally small by comparison (L. Smith, personal communication, May 6, 2015) and biologically insignificant to reproduction of corals. Additionally, of the 19 threats to coral identified in the 2011 status review report of the 82 candidate coral species petitioned under the U.S. Endangered Species Act (Brainard et al. 2011a) and the top 9 threats to coral analyzed in the final rule (79 FR 53851), none include mortality of larvae by physical contact such as cavitation or explosives, or acoustic effects. While detonations may result in the mortality of the developmental stages of *Acropora globiceps* (and other ESA-listed coral species), it likely would have an insignificant effect on the reproductive potential for an individual colony of the species or recruitment at the population level of this species. Since this level effect is not expected to be signficant and detectable at the individual level (i.e., colony) we would not consider this effect to be a reduction in fitness of any colony of *Acropora globiceps* and thus we do not anticipate any population-level effects.

6.8.10.2.4 Exposure of Corals to Impulsive Acoustic Stressors During Testing

No MITT testing activities will occur at the Outer Apra Harbor UNDET site or on FDM; therefore no exposure of corals to impulsive acoustic stressors during testing is anticipated.

6.8.10.2.5 Response of Corals to Impulsive Acoustic Stressors During Training and Testing

Impacts from explosive ordnance accidentally impacting reefs around FDM will vary with explosive weight but it can be expected local colonies and collections of colonies forming a reefscape would be negatively affected and likely die from such an event. Colonies closest to the blast would likely be killed. The calcium carbonate structure of the reef could also be broken and pulverized by such an event. The resulting changes in coral community structure may reduce ecosystem function in the immediate area of the detonation. However, if not chronically disturbed from subsequent impacts of munitions or natural causes (e.g., storms), coral community structure and ecosystem function would likely return with time. Additionally, the breaking of reefs could also create new habitat for future coral recruitment (Chabanet et al. 2005).

Based on GIS analysis of data from the National Oceanic Service (2004) regarding coral cover around FDM and previous coral reef surveys conducted by the Navy (DoN 2005b), we estimated the area of live *Acropora globiceps* cover around FDM to total 6,322.3 m^2. We also estimated mortality of up to 6.78 m^2 of habitat occupied by live *Acropora globiceps* from Navy explosive ordnance activities around FDM each year. Therefore, we estimate that Navy activities will kill up to 0.11 percent (6.78m^2) of *Acropora globiceps* colonies around the island each year.

In addition to the assessed mortality, our analysis estimated 20.34 m^2 of habitat assumed to be occupied by *Acropora globiceps* will be injured (recoverable injury to approximately 1,152 colonies) from Navy explosive ordnance activities around FDM each year. We also estimated two instances of recoverable injury to habitat assumed to be occupied by *Acropora globiceps* around FDM from ordnance other than high-explosive bombs will occur on an annual basis. Injuries could include varying degrees of abrasion, breakage, and/or pieces of debris settling upon portions of the coral colony. However, because only a portion of the coral colony polyps would be affected, we do not expect injuries to result in coral colony mortality. Uninjured coral polyps within the colony affected would be able to sustain the "individual" as defined in Section 6.5. The tissue thickness of *Acropora* species is 1 to 2 mm thick, considerably thinner than many coral species, which allows them to grow quicker than many other species (Loya et al. 2001). Therefore, injured *Acropora globiceps* colonies would likely be able to bud and develop new polyps to replace those lost in the injury. Fragmentation may also occur where pieces of the coral colony break off, separating a single colony into two or more individuals. Fragmentation may lead to a large number of asexually-produced, genetically identical colonies, commonly resulting in a population made up of more asexually-produced colonies than sexually-produced colonies (Hughes 1984).

These assumptions are supported by Navy coral reef surveys, which indicate military-caused reef damage around FDM is short term and recovery occurs within two to three years. Although individual colonies and clusters of colonies forming a smallscale reefscape may be negatively impacted by impulsive explosions, Navy surveys of FDM reefs suggest no significant population level impacts are likely to occur, and colony repair or successful recruitment will likely occur within two to three years following disturbance.

6.9 Cumulative Effects

Cumulative effects include the effects of future State, tribal, local, or private actions that are reasonably certain to occur in the Action Area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA.

During this consultation, NMFS searched for information on future State, tribal, local, or private actions that were reasonably certain to occur in the Action Area. Most of the Action Area includes federal military reserves or is outside of territorial waters of the United States of America, which would preclude the possibility of future state, tribal, or local action that would not require some form of federal funding or authorization. NMFS conducted electronic searches of business journals, trade journals, and newspapers using *First Search*, Google, and other electronic search engines. Those searches produced no evidence of future private action in the Action Area that would not require federal authorization or funding and is reasonably certain to occur. As a result, NMFS is not aware of any actions of this kind that are likely to occur in the Action Area during the reasonably foreseeable future.

7 Integration and Synthesis Of Effects

Our effects analyses identified the probable risks the DoD and USCG training and testing activities and issuance of an MMPA rule and LOA to authorize take of marine mammals would pose to ESA-listed individuals that will be exposed to these actions. We measure risks to individuals of endangered or threatened species using changes in the individuals' "fitness" or the individual's growth, survival, annual reproductive success, and lifetime reproductive success. When we do not expect listed animals exposed to an action's effects to experience reductions in fitness, we would not expect the action to have adverse consequences on the viability of the populations those individuals represent or the species those populations comprise. As a result, if we conclude that listed animals are not likely to experience reductions in their fitness, we would conclude our assessment. If, however, we conclude that listed animals are likely to experience reductions in their fitness, we would assess the consequences of those fitness reductions for the population or populations the individuals in an *Action Area* represent.

The activities the DoD and USCG conducts in the MITT Action Area will continue to introduce a suite of stressors into the marine and coastal ecosystems of the Mariana Islands and the transit lanes to and from the Hawaii Action Area. The stressors include: low, mid, and high-frequency active sonar from surface vessels, torpedoes, and dipping sonar; shock waves and sound fields associated with underwater detonations, acoustic and visual cues from surface vessels as they move through the ocean's surface, and sounds transferred into the water column from fixed-wing aircraft and helicopters. Repeatedly exposing endangered and threatened marine animals to each of these individual stressors could pose additional risks as the exposures accumulate over time. Repeated exposures are discussed in more detail in section 6.2.11 and 6.3.7. Also, exposing endangered and threatened marine animals to this suite of stressors could pose additional risks as the stressors interact with one another or with other stressors that already occur in those areas. More importantly, endangered and threatened marine animals that occur in the MITT Action Area would be exposed to combinations of stressors produced by DoD and USCG activities at

the same time they are exposed to stressors from other human activities and natural phenomena. We recognize these interactions might have effects on endangered and threatened species that we have not considered; however, the data available do not allow us to do more than acknowledge the possibility.

For the purposes of this Opinion, we assume that all of these activities in the MITT Action Area and associated impacts will continue into the reasonably foreseeable future at the levels set forth in the Final EIS/OEIS and MMPA rule. To address the likelihood of long-term additive or accumulative effects, we first considered (1) stressors that accumulate in the environment, and (2) effects that represent either the response of individuals, populations, or species to that accumulation of stressors.

Sound does not permanently accumulate in the environment; therefore, an accumulative effects analysis on this stressor is not warranted. However, repeated exposure of individuals to acoustic stress can cause auditory fatigue and hearing loss. We expect ESA-listed species will not receive repeated exposures at a rate at which recovery between exposures would not occur because of the intermittent nature and duration of Navy acoustic sources. Navy activities on the MITT Action Area involving active sonar or underwater detonations are infrequent, short-term, and generally unit level. Unit level events occur over a small spatial scale (one to a few 10s of square miles) and with few participants (usually one or two). Single-unit unit level training would typically involve a few hours of sonar use, with a typical nominal ping of every 50 seconds (duty cycle). Even though an animal's exposure to active sonar may be more than one time, the intermittent nature of the sonar signal, its low duty cycle, and the fact that both the vessel and animal are moving provide a very small chance that exposure to active sonar for individual animals and stocks would be repeated over extended periods of time. Consequently, the DoD and USCG's MITT activities do not create conditions of chronic, continuous underwater noise and are unlikely to lead to habitat abandonment or long-term hormonal or physiological stress responses in marine mammals.

Although Goldbogen et al. (2013) speculates that "frequent exposures to mid-frequency anthropogenic sounds may pose significant risk to the recovery rates of endangered blue whale populations," the authors acknowlege that the actual responses of individual blue whales to simulated mid-frequency sonar documented in the study "typically involves temporary avoidance responses that appear to abate quickly after sound exposure." Moreover, the most significant response documented in the study occurred not as a result of exposure to simulated mid-frequency sonar but as a result of exposure to pseudo-random noise. Therefore, the overall weight of scientific evidence indicates that substantive behavioral responses by mysticetes, if any, from exposure to mid-frequency active sonar and other active acoustic sources evaluated in this Opinion are likely to be temporary and are unlikely to have any long-term adverse impact on individual animals or affected populations. Even if sound exposure were to be concentrated in a relatively small geographic area over a long period of time (e.g., days or weeks during major training exercises), we would expect that some individual whales would avoid areas where exposures to acoustic stressors are at higher levels (e.g., greater than 120 dB). For example, Goldbogen et al. (2013) indicated some horizontal displacement of deep foraging blue whales in response to simulated MFA sonar. Given these animal's mobility and large ranges, we would expect these individuals to temporaily select alternative foraging sites nearby until the exposure

levels in their initially selected foraging area have decreased. Therefore, even temporary displacement from initially selected foraging habitat is not expected to impact the fitness of any individual animals because we would expect equivalent foraging habitat to be available in close proximity. Because we do not expect any fitness consequences from any individual animals, we do not expect any population level effects from these behavioral responses.

Further, establishing a causal link between anthropogenic noise, animal communication, and individual impacts as well as population viability is difficult to quantify and assess (McGregor 2013) (Read et al. 2014). The difficulty in assessing the effects of sounds individually and cumulatively on marine species is the confounding nature of indirect effects, age class, prior experience, behavioral state at the time of exposure, and that responses may be influenced by other non-sound related factors (Ellison et al. 2011; Goldbogen et al. 2013; Kight and Swaddle 2011; McGregor 2013; Williams et al. 2014) (Read et al. 2014).

Our assessment that the continuation of the Navy activities into the reasonably foreseeable future is unlikely to have any adverse additive or long-term impacts on the affected threatened or endangered species (assuming current levels of activity and no significant changes in the status of species or to the *Environmental Baseline*) is also consistent with the absence of any documented population-level or adverse aggregate impacts resulting from DoD and USCG activities to date, despite decades of training in the MITT Action Area using many of the same systems. Most of the training activities the DoD and USCG conducts in the MITT Action Area are similar, if not identical, to activities that have been occurring in the same locations for decades.

Our regulations require us to consider, using the best available scientific data, effects of the action that are "likely" and "reasonably certain" to occur rather than effects that are speculative or uncertain. See 50 C.F.R. § 402.02 (defining to "jeopardize the continued existence of" and "effects of the action"). Our analysis and conclusions in this Opinion are based on estimates of exposures and take assuming that the DoD and USCG conduct the maximum number of authorized training and testing activities for the maximum number of authorized hours. The effects of the action in relation to the *Status of Listed Resources* and the *Environmental Baseline* are presented by each species below.

7.1.1 Blue Whale

In determining whether U.S. Navy training and testing activities in the MITT Action Area are likely to jeopardize the survival and recovery of blue whales, we assessed effects of the action against the aggregate effects of everything in the *Environmental Baseline* that has led to the current *Status of Listed Resources* and, those effects of future non-Federal activities that are reasonably certain to occur within the Action Area in the reasonably foreseeable future. Many U.S. Navy training exercises and testing activities in the MITT Action Area over a five-year period and continuing into the reasonably foreseeable future will occur without any blue whales being exposed to U.S. Navy vessels, sound fields associated with active sonar pings, or shock waves associated with underwater detonations. Those individuals that are exposed would only be so periodically or episodically.

As described in the *Status of Listed Resources* and *Environmental Baseline* sections of this Opinion, some of the primary anthropogenic threats to the survival and recovery of blue whales have been whaling and ship strikes. The threat of whaling has been eliminated. The current abundance trend for blue whales rangewide including the MITT Action Area is not well understood. However, recent evidence indicates that some blue whale populations in the North Pacific may be increasing (Monnahan et al. 2014).

Assuming that the Navy conducts the maximum number of authorized training and testing activities for the maximum number of authorized hours, we estimated that in any given year during the five-year period (August 2015 through August 2020), blue whales could potentially experience up to 28 instances of take in the form of behavioral harassment and TTS resulting from non-impulsive acoustic stressors. Of those 28 instances of behavioral harassment, we anticipate no more than of 3 takes per year in the form of TTS. We do not anticipate any take in the form of injury from PTS or other injuries such as GI tract or lung injury during annual training or testing activities. We do not anticipate any mortality of blue whales from MITT stressors. The estimates of exposures to training and testing exercises that would result in behavioral responses (including instances of TTS) annually would not be expected to appreciably reduce the likelihood of the survival of blue whales in the wild by reducing the reproduction, numbers, or distribution of that species for the reasons discussed herein.

While we recognize that animal hearing evolved separately from animal vocalizations and, as a result, it may be inappropriate to make inferences about an animal's hearing sensitivity from their vocalizations, we have no data on blue whale hearing so we assume that blue whale vocalizations are partially representative of their hearing sensitivities. Blue whales are not likely to respond to high-frequency sound sources associated with the proposed training exercises and testing activities because of their hearing sensitivities. Despite previous assumptions based on vocalizations and anatomy that blue whales predominantly hear low-frequency sounds below 400 Hz (Croll et al. 2001b) (Oleson et al., 2007; Stafford and Moore, 2005), recent research has indicated blue whales not only hear mid-frequency active sonar transmissions, in some cases they respond to those transmissions (Southall et al. 2011a).

Blue whales may hear some sounds in the mid-frequency range and exhibit behavioral responses to sounds in this range depending on received level and context (Goldbogen et al. 2013 and Melcon et al. 2012). However, both Goldbogen et al (2013) and Melcon et al. (2012) indicated that behavioral responses to simulated or operational MFA sonar were temporary, with whales resuming normal behavior quickly after the cessation of sound exposure. Further, responses were discernible for whales in certain behavioral states (i.e., deep feeding), but not in others (i.e., surface feeding). As stated in Goldbogen et al. (2013) when summarizing the response of blue whales to simulated MFA sonar, "We emphasize that elicitation of the response is complex, dependent on a suite of contextual (e.g., behavioral state) and sound exposure factors (e.g., maximum received level), and typically involves temporary avoidance responses that appear to abate quickly after sound exposure." Goldbogen et al. (2013) also speculated that if this temporary behavioral response interrupted feeding behavior, this could have impacts on individual fitness and eventually, population health. However, for this to be true, we would have to assume that an individual whale could not compensate for this lost feeding opportunity by either immediately feeding at another location, by feeding shortly after cessation of acoustic

exposure, or by feeding at a later time. Additionally, in instances of TTS, individuals would likely fully recover within 24 hours of exposure and resume normal behavioral activities. There is no indication, particularly since unconsumed prey would still be available in the environment following the cessation of acoustic exposure and resumption of normal behaviors following instances of behavioral response including responses associated with TTS.

During the Controlled Exposure Experiments (CEEs) used in Goldbogen et al. (2013), sound sources were deployed from a stationary source vessel positioned approximately 1,000 m from the focal animals, with one transmission onset every 25 seconds (Southall et al. 2012). In contrast, most Navy sonar systems are deployed from highly mobile vessels or in-water devices which do not directly target marine mammals. Further, the typical duty cycle with most tactical anit-submarine warefare is lower than used in the CEEs described above, transmitting about once per minute (DoN 2015). For example, a typical Navy vessel with hull mounted MFA sonar would travel over 0.3 kilometers between pings (based on a speed of 10 knots/hr and transmission rate of 1 ping/min). Based on this distance traveled and potential avoidance behavior of acoustically exposed animals, we expect repeat acoustic exposures capable of eliciting a behavioral response to an individual over a brief period of time to be rare. In the event an individual is exposed to multiple sound sources that elicit a behavioral response (e.g., disruption of feeding) in a short amount of time, including instances of TTS, we do not expect these exposures to have fitness consequences as individuals will resume feeding upon cessation of the sound exposure and unconsumed prey will still be available in the environment.

Even if sound exposure were to be concentrated in a relatively small geographic area over a long period of time (e.g., days or weeks during major training exercises), we would expect that some individual whales would avoid areas where exposures to acoustic stressors are at higher levels (e.g., greater than 120 dB). For example, Goldbogen et al. (2013) indicated some horizontal displacement of deep foraging blue whales in response to simulated MFA sonar. Given these animal's mobility and large ranges, we would expect these individuals to temporaily select alternative foraging sites nearby until the exposure levels in their initially selected foraging area have decreased. Therefore, even temporary displacement from initially selected foraging habitat is not expected to impact the fitness of any individual animals because we would expect equivalent foraging to be available in close proximity. Because we do not expect any fitness consequences from any individual animals, we do not expect any population level effects from these behavioral responses.

Most of the blue whales that are exposed to acoustic stressors would be exposed periodically or episodically over certain months or seasons from military activities in the MITT Action Area. Given the nature of testing and training as described above, these periodic or episodic exposure and behavioral response scenarios, including TTS, most often allow sufficient time to return to baseline conditions and resumption of normal behavioral activities such as feeding and breeding. As described previously, including in Sections 6.2.11 and 6.8.3.2.1 of this Opinion, the available scientific information does not provide evidence that exposure to acoustic stressors from Navy training and testing activities will impact the fitness of any individuals of this species. Therefore exposure to acoustic stressors will not have population or species level impacts.

Further, recent evidence indicates that the Eastern North Pacific blue whale population, has likely reached carrying capacity (Monnahan et al. 2014). Navy training and testing activities, including the use of MFA sonar, have been ongoing in this area for decades. Therefore, any potential temporary behavioral impacts on blue whales from the use of MFA during Navy training and testing activities do not appear to have inhibited population growth of the Eastern North Pacific blue whale population in that area. We would expect similar effects to exist in the MITT Action Area.

The 1998 blue whale recovery plan does not outline downlisting or delisting criteria. The recovery plan does list several stressors potentially affecting the status of blue whales in the North Pacific Ocean that are relevant to MITT activities including: vessel strike, vessel disturbance, and military operations (including sonar). At the time the recovery plan was published, the effects of these stressors on blue whales in the Pacific Ocean were not well documented, their impact on recovery was not understood, and no attempt was made to prioritize the importance of these stressors on recovery. As described previously, anthropogenic noise associated with MITT activities is not expected to impact the fitness of any individuals of this species. No mortality of blue whales is expected to occur from MITT activities.

Based on the evidence available, including the *Environmental Baseline* and *Cumulative Effects*, stressors resulting from training and testing activities the DoD and USCG will conduct in the MITT Action Area on an annual basis, cumulatively over the five year period from August 2015 through August 2020, or cumulatively for the reasonably foreseeable future (assuming there are no significant changes to the *Status of Listed Resources* or *Environmental Baseline*), would not be expected to appreciably reduce the likelihood of the survival of blue whales in the wild by reducing the reproduction, numbers, or distribution of that species. We also conclude that effects from ongoing Navy training and testing activities continuing into the reasonably foreseeable future would not be expected, directly or indirectly, to appreciably reduce the likelihood of recovery of blue whales in the wild by reducing the reproduction, numbers, or distribution of that species. MITT stressors will not affect the population dynamics, behavioral ecology, and social dynamics of individual blue whales in ways or to a degree that would reduce their fitness. We anticipate temporary behavioral responses, but do not anticipate any injury or mortality from acoustic stressors. We do not anticipate those behavioral responses to result in fitness consequences to any individuals and therefore, we do not expect acoustic stressors to result in substantial changes in reproduction, numbers, or distribution of these populations. An action that is not likely to reduce the fitness of individual whales would not be likely to reduce the viability of the populations those individual whales compose (that is, we would not expect reductions in the reproduction, numbers, or distribution of those populations). We do not anticipate any reductions in survival rate or trajectory of recovery of the species as listed pursuant to the ESA that would be sufficient to be readily perceived or estimated.

7.1.2 Fin Whale

In determining whether U.S. Navy training and testing activities in the MITT Action Area are likely to jeopardize the survival and recovery of fin whales, we assessed effects of the action against the aggregate effects of everything in the *Environmental Baseline* that has led to the current *Status of Listed Resources* and, those effects of future non-Federal activities that are reasonably certain to occur within the Action Area in the reasonably foreseeable future. Many

U.S. Navy training exercises and testing activities in the MITT Action Area over a five-year period and continuing into the reasonably foreseeable future will occur without any fin whales being exposed to U.S. Navy vessels, sound fields associated with active sonar pings, or shock waves associated with underwater detonations. Those individuals that are exposed would only be so periodically or episodically.

Assuming that the Navy conducts the maximum number of authorized training and testing activities for the maximum number of authorized hours, we estimated that in any given year during the five-year period (August 2015 through August 2020), fin whales could potentially experience up to 28 instances of take in the form of behavioral harassment and TTS resulting from non-impulsive acoustic stressors. Of those 28 instances of behavioral harassment, we anticipate no more than 4 takes per year in the form of TTS resulting from non-impulsive sound stressors. We anticipate zero take by injury in the form of permanent threshold shift (PTS) or other injuries such as GI tract or lung injury from annual training and testing activities. We do not anticipate any mortality of fin whales from MITT stressors. The estimates of exposures to training and testing exercises that would result in behavioral responses (including instances of TTS) annually would not be expected to appreciably reduce the likelihood of the survival of fin whales in the wild by reducing the reproduction, numbers, or distribution of that species for the reasons discussed herein.

Frequencies associated with mid-frequency sonar have generally been considered above the hearing range of fin whales. However, recent observations of blue whale responses to the mid-frequency sonar sounds support the possibility that this ecologically, physiologically, and taxonomically similar species may be capable of detecting and responding to them. Additional data are necessary to determine the potential impact that mid-frequency sonar may or may not have on fin whales. Considering information presented in this opinion, we consider fin whales to be able to hear and respond to mid-frequency sonar as blue whales appear to.

Most of the fin whales that are exposed to acoustic stressors would be exposed periodically or episodically over certain months or seasons from military activities in the MITT Action Area. Given the nature of testing and training as described above, these periodic or episodic exposure and behavioral response scenarios, including responses to TTS, most often allow sufficient time to return to baseline conditions and resumption of normal behavioral activities such as feeding and breeding. Individuals exposed to acoustic stressors at levels resulting in TTS will likely fully recover within 24 hours of the exposure and resume normal behaviors including feeding. As described previously, including in Sections 6.2.11 and 6.8.3.2.1 of this Opinion, the available scientific information does not provide evidence that exposure to acoustic stressors from Navy training and testing activities will impact the fitness of any individuals of this species. Therefore exposure to acoustic stressors will not have population or species level impacts.

The 2010 fin whale recovery plan defines three recovery populations by ocean basin (the North Atlantic, North Pacific, and Southern Hemisphere) and sets criteria for the downlisting and delisting of this species. Both downlisting and delisting requirements include abatement of threats associated with fisheries, climate change, direct harvest, anthropogenic noise, and ship collision. Of these, anthropogenic noise and ship collision are relevant to MITT activities. As discussed previously, anthropogenic noise associated with MITT activities will not impact the

fitness of any individuals of this species. Downlisting criteria for fin whales includes the maintenance of at least 250 mature females and 250 mature males in each recovery population, which is already exceeded in the North Pacific. To qualify for downlisting, each recovery population must also have no more than a 1 percent chance of extinction in 100 years. To qualify for delisting, each recovery population must also have no more than a 10 percent chance of becoming endangered in 20 years. To our knowledge a population viability analysis has not been conducted on fin whale recovery populations.

Based on the evidence available, including the *Environmental Baseline* and *Cumulative Effects*, stressors resulting from training and testing activities the DoD and USCG will conduct in the MITT Action Area on an annual basis, cumulatively over the five year period from August 2015 through August 2020, or cumulatively for the reasonably foreseeable future (assuming there are no significant changes to the *Status of Listed Resources* or *Environmental Baseline*), would not be expected to appreciably reduce the likelihood of the survival of fin whales in the wild by reducing the reproduction, numbers, or distribution of that species. We also conclude that effects from ongoing DoD and USCG training and testing activities continuing into the reasonably foreseeable future would not be expected, directly or indirectly, to appreciably reduce the likelihood of recovery of fin whales in the wild by reducing the reproduction, numbers, or distribution of that species. MITT stressors will not affect the population dynamics, behavioral ecology, and social dynamics of individual fin whales in ways or to a degree that would reduce their fitness. An action that is not likely to reduce the fitness of individual whales would not be likely to reduce the viability of the populations those individual whales represent (that is, we would not expect reductions in the reproduction, numbers, or distribution of those populations). We do not anticipate any reductions in survival rate or trajectory of recovery of the species as listed pursuant to the ESA that would be sufficient to be readily perceived or estimated.

7.1.3 Humpback Whale

In determining whether U.S. Navy training and testing activities in the MITT Action Area are likely to jeopardize the survival and recovery of humpback whales, we assessed effects of the action against the aggregate effects of everything in the *Environmental Baseline* that has led to the current *Status of Listed Resources* and, those effects of future non-Federal activities that are reasonably certain to occur within the Action Area in the reasonably foreseeable future. Many U.S. Navy training exercises and testing activities in the MITT Action Area over a five-year period and continuing into the reasonably foreseeable future will occur without any humpback whales being exposed to U.S. Navy vessels, sound fields associated with active sonar pings, or shock waves associated with underwater detonations. Those individuals that are exposed would only be so periodically or episodically.

Assuming that the Navy conducts the maximum number of authorized training and testing activities for the maximum number of authorized hours, we estimated that in any given year during the five year period (August 2015 through August 2020), humpback whales could potentially experience up to 860 instances of behavioral harassment and TTS resulting from non-impulsive acoustic stressors. Of those 860 instances, we anticipate no more than 679 instances per year of harassment in the form of TTS resulting from non-impulsive sound stressors. We anticipate zero instances of injury in the form of PTS or other injuries such as GI tract or lung injury from annual training and testing activities. We do not anticipate any mortality of

humpback whales from MITT stressors. The estimates of exposures to training exercises and exposures to testing exercises that would result in behavioral responses (including instances of TTS) annually would not be expected to appreciably reduce the likelihood of the survival of humpback whales in the wild by reducing the reproduction, numbers, or distribution of that species for the reasons discussed herein.

Frequencies associated with mid-frequency sonar have generally been considered above the hearing range of humpback whales. However, recent observations of blue whale responses to the mid-frequency sonar sounds support the possibility that this ecologically, physiologically, and taxonomically similar species may be capable of detecting and responding to them. Additional data are necessary to determine the potential impact that mid-frequency sonar may or may not have on humpback whales. Considering information presented in this opinion, we consider humpback whales to be able to hear and respond to mid-frequency sonar similar to blue whales.

Most of the humpback whales that are exposed to acoustic stressors would be exposed periodically or episodically over certain months or seasons from military activities in the MITT Action Area. Given the nature of testing and training as described above, these periodic or episodic exposure and behavioral response scenarios, including responses to TTS, most often allow sufficient time to return to baseline conditions and resumption of normal behavioral activities such as feeding and breeding. As described previously, including in Sections 6.2.11 and 6.8.3.2.1 of this Opinion, the available scientific information does not provide evidence that exposure to acoustic stressors from Navy training and testing activities will impact the fitness of any individuals of this species. Therefore exposure to acoustic stressors will not have population or species level impacts.

The general increase in the number of humpback whales range-wide suggests that the stress regime these whales are exposed to including activities in the MITT Action Area have not prevented these whales from increasing their numbers. Humpback whales have been exposed to U.S. Navy training exercises in the MITT Action Area, including vessel traffic, aircraft traffic, active sonar, and underwater detonations, for more than a generation. Although the U.S. Navy proposes to increase the frequency of some of these activities, we do not believe those increases are likely to affect the rate at which humpback whale counts are increasing.

The 1991 humpback whale recovery plan does not outline specific downlisting and delisting criteria. The recovery plan does list several threats known or suspected of impacting humpback whale recovery including subsistence hunting, commercial fishing stressors, habitat degradation, loss of prey species, ship collision, and acoustic disturbance. Of these, ship collision and acoustic disturbance are relevant to MITT activities. As described previously, anthropogenic noise associated with MITT activities will not impact the fitness of any individuals of this species.

Based on the evidence available, including the *Environmental Baseline* and *Cumulative Effects*, stressors resulting from training and testing activities the DoD and USCG will conduct in the MITT Action Area on an annual basis, cumulatively over the five year period from August 2015 through August 2020, or cumulatively for the reasonably foreseeable future (assuming there are no significant changes to the *Status of Listed Resources* or *Environmental Baseline*), would not be expected to appreciably reduce the likelihood of the survival of humpback whales in the wild

by reducing the reproduction, numbers, or distribution of that species. We also conclude that effects from ongoing U.S. Navy training and testing activities continuing into the reasonably foreseeable future would not be expected, directly or indirectly, to appreciably reduce the likelihood of recovery of humpback whales in the wild by reducing the reproduction, numbers, or distribution of that species. MITT stressors will not affect the population dynamics, behavioral ecology, and social dynamics of individual humpback whales in ways or to a degree that would reduce their fitness. An action that is not likely to reduce the fitness of individual whales would not be likely to reduce the viability of the populations those individual whales represent (that is, we would not expect reductions in the reproduction, numbers, or distribution of those populations). We do not anticipate any reductions in survival rate or trajectory of recovery of the species as listed pursuant to the ESA that would be sufficient to be readily perceived or estimated. Due to a lack of fitness consequences to individuals and the populations they represent, we also do not anticipate any reductions in survival rate or trajectory of recovery of the Western North Pacific DPS as currently proposed.

7.1.4 Sei Whale

In determining whether U.S. Navy training and testing activities in the MITT Action Area are likely to jeopardize the survival and recovery of sei whales, we assessed effects of the action against the aggregate effects of everything in the *Environmental Baseline* that has led to the current *Status of Listed Resources* and, those effects of future non-Federal activities that are reasonably certain to occur within the Action Area in the reasonably foreseeable future. Many U.S. Navy training exercises and testing activities in the MITT Action Area over a five-year period and continuing into the reasonably foreseeable future will occur without any sei whales being exposed to U.S. Navy vessels, sound fields associated with active sonar pings, or shock waves associated with underwater detonations. Those individuals that are exposed would only be so periodically or episodically.

Assuming that the Navy conducts the maximum number of authorized training and testing activities for the maximum number of authorized hours, we estimated that in any given year during the five year period (August 2015 through August 2020), sei whales could potentially experience up to 319 instances of behavioral harassment and TTS resulting from non-impulsive acoustic stressors. Of those 319 instances of behavioral harassment, we anticipate no more than 258 instances per year of harassment in the form of TTS resulting from non-impulsive sound stressors. We anticipate zero instances of injury in the form of PTS resulting from non-impulsive acoustic stressors or other injuries such as GI tract or lung injury from annual training and testing activities. We do not anticipate any mortality of sei whales from MITT stressors. The estimates of exposures to training exercises and exposures to testing exercises that would result in behavioral responses (including instances of TTS) annually would not be expected to appreciably reduce the likelihood of the survival of sei whales in the wild by reducing the reproduction, numbers, or distribution of that species for the reasons discussed herein.

Frequencies associated with mid-frequency sonar have generally been considered above the hearing range of sei whales. However, recent observations of blue whale responses to the mid-frequency sonar sounds support the possibility that this ecologically, physiologically, and taxonomically similar species may be capable of detecting and responding to them. Additional data are necessary to determine the potential impact that mid-frequency sonar may or may not

have on sei whales. Considering information presented in this opinion, we consider sei whales to be able to hear and respond to mid-frequency sonar similar to blue whales.

Most of the sei whales that are exposed to acoustic stressors would be exposed periodically or episodically over certain months or seasons from military activities in the MITT Action Area. Given the nature of testing and training as described above, these periodic or episodic exposure and behavioral response scenarios, including responses to TTS, most often allow sufficient time to return to baseline conditions and resumption of normal behavioral activities such as feeding and breeding. Individuals experiencing TTS are likely to fully recover within 24 hours of exposure and return to normal behaviors. As described previously, including in Sections 6.2.11 and 6.8.3.2.1 of this Opinion, the available scientific information does not provide evidence that exposure to acoustic stressors from Navy training and testing activities will impact the fitness of any individuals of this species. Therefore exposure to acoustic stressors will not have population or species level impacts.

The 2011 sei whale recovery plan defines three recovery populations by ocean basin (the North Atlantic, North Pacific, and Southern Hemisphere) and sets criteria for the downlisting and delisting of this species. Both downlisting and delisting requirements include abatement of threats associated with fisheries, climate change, direct harvest, anthropogenic noise, and ship collision. Of these, anthropogenic noise and ship collision are relevant to MITT activities. As described previously, anthropogenic noise associated with MITT activities will not impact the fitness of any individuals of this species. Downlisting criteria for fin whales includes the maintenance of 1,500 mature, reproductive individuals with at least 250 mature females and 250 mature males in each recovery population, which is already exceeded in the North Pacific. To qualify for downlisting, each recovery population must also have no more than a 1 percent chance of extinction in 100 years. To qualify for delisting, each recovery population must also have no more than a 10 percent chance of becoming endangered in 20 years. To our knowledge a population viability analysis has not been conducted on sei whale recovery populations.

Based on the evidence available, including the *Environmental Baseline* and *Cumulative Effects*, stressors resulting from training and testing activities the DoD and USCG will conduct in the MITT Action Area on an annual basis, cumulatively over the five year period from August 2015 through August 2020, or cumulatively for the reasonably foreseeable future (assuming there are no significant changes to the *Status of Listed Resources* or *Environmental Baseline*), would not be expected to appreciably reduce the likelihood of the survival of sei whales in the wild by reducing the reproduction, numbers, or distribution of that species. We also conclude that effects from ongoing DoD and USCG training and testing activities continuing into the reasonably foreseeable future would not be expected, directly or indirectly, to appreciably reduce the likelihood of recovery of sei whales in the wild by reducing the reproduction, numbers, or distribution of that species. MITT stressors will not affect the population dynamics, behavioral ecology, and social dynamics of individual sei whales in ways or to a degree that would reduce their fitness. An action that is not likely to reduce the fitness of individual whales would not be likely to reduce the viability of the populations those individual whales represent (that is, we would not expect reductions in the reproduction, numbers, or distribution of those populations). We do not anticipate any reductions in survival rate or trajectory of recovery of the species as listed pursuant to the ESA that would be sufficient to be readily perceived or estimated.

7.1.5 Sperm Whale

In determining whether U.S. Navy training and testing activities in the MITT Action Area are likely to jeopardize the survival and recovery of sperm whales, we assessed effects of the action against the aggregate effects of everything in the *Environmental Baseline* that has led to the current *Status of Listed Resources* and, those effects of future non-Federal activities that are reasonably certain to occur within the Action Area in the reasonably foreseeable future. Many U.S. Navy training exercises and testing activities in the MITT Action Area over a five-year period and continuing into the reasonably foreseeable future will occur without any sperm whales being exposed to U.S. Navy vessels, sound fields associated with active sonar pings, or shock waves associated with underwater detonations. Those individuals that are exposed would only be so periodically or episodically.

Assuming that the Navy conducts the maximum number of authorized training and testing activities for the maximum number of authorized hours, we estimated that in any given year during the five-year period (August 2015 through August 2020), sperm whales could potentially experience up to 506 instances of take in the form of behavioral harassment and TTS resulting from non-impulsive acoustic stressors. Of these 506 instances of behavioral harassment, we anticipate no more than 54 takes per year in the form of TTS resulting from non-impulsive sound stressors. We do not anticipate any take in the form of injury from PTS or other injuries such as GI tract or lung injury during annual training and testing activities. We do not anticipate any mortality of sperm whales from stressors associated with MITT activities. The estimates of exposures to training exercises and exposures to testing exercises that would result in behavioral responses (including instances of TTS) annually would not be expected to appreciably reduce the likelihood of the survival of sperm whales in the wild by reducing the reproduction, numbers, or distribution of that species for the reasons discussed herein.

Most of the sperm whales that are exposed to acoustic stressors would be exposed periodically or episodically over certain months or seasons from military activities in the MITT Action Area. Given the nature of testing and training as described above, these periodic or episodic exposure and behavioral response scenarios, including responses to TTS, most often allow sufficient time to return to baseline conditions and resumption of normal behavioral activities such as feeding and breeding. Indivudals experiencing TTS will likely fully recover within 24 hours and resume normal behaviors. As described previously, including in Sections 6.2.11 and 6.8.3.2.5 of this Opinion, the available scientific information does not provide evidence that exposure to acoustic stressors from Navy training and testing activities will impact the fitness of any individuals of this species. Therefore exposure to acoustic stressors will not have population or species level impacts.

The 2010 sperm whale recovery plan defines three recovery populations by ocean basin (the Atlantic Ocean/Mediterranean Sea, Pacific Ocean, and Indian Ocean) and sets criteria for the downlisting and delisting of this species. Both downlisting and delisting requirements include abatement of threats associated with fisheries, climate change, direct harvest, oil spills, anthropogenic noise, and ship collision. Of these, anthropogenic noise and ship collision are relevant to MITT activities. As discussed previously, anthropogenic noise associated with MITT activities will not impact the fitness of any individuals of this species. Downlisting criteria for sperm whales includes the maintenance of 1,500 mature, reproductive individuals with at least

250 mature females and 250 mature males in each recovery population, which is already exceeded in the North Pacific. To qualify for downlisting, each recovery population must also have no more than a 1 percent chance of extinction in 100 years. To qualify for delisting, each recovery population must also have no more than a 10 percent chance of becoming endangered in 20 years. To our knowledge a population viability analysis has not been conducted on spern whale recovery populations.

Based on the evidence available, including the environmental baseline and cumulative effects, we conclude that impulsive and non-impulsive acoustic stressors resulting from training exercises and testing activities the DoD and USCG plans to conduct in the MITT Action Area on an annual basis, or cumulatively over the five year period from August 2015 through August 2020, or cumulatively for the reasonably foreseeable future (assuming there are no significant changes to the status of the species or *Environmental Baseline*), would not be expected to appreciably reduce the likelihood of the survival of sei whales in the wild by reducing the reproduction, numbers, or distribution of that species. We also conclude that effects from ongoing DoD and USCG training and testing activities continuing into the reasonably foreseeable future would not be expected, directly or indirectly, to appreciably reduce the likelihood of recovery of sperm whales in the wild by reducing the reproduction, numbers, or distribution of that species. MITT stressors will not affect the population dynamics, behavioral ecology, and social dynamics of individual sperm whales in ways or to a degree that would reduce their fitness. An action that is not likely to reduce the fitness of individual whales would not be likely to reduce the viability of the populations those individual whales represent (that is, we would not expect reductions in the reproduction, numbers, or distribution of those populations). We do not anticipate any reductions in survival rate or trajectory of recovery of the species as listed pursuant to the ESA that would be sufficient to be readily perceived or estimated.

7.1.6 Sea Turtles

In determining whether U.S. Navy training and testing activities in the HSTT Action Area are likely to jeopardize the survival and recovery of sea turtles, we assessed effects of the action against the aggregate effects of everything in the *Environmental Baseline* that has led to the current *Status of Listed Resources,* and those effects of future non-Federal activities that are reasonably certain to occur within the Action Area in the reasonably foreseeable future. Many U.S. Navy training exercises and testing activities in the MITT Action Area over a five-year period and continuing into the reasonably foreseeable future will occur without any sea turtles being exposed to U.S. Navy vessels, sound fields associated with active sonar pings, or shock waves associated with underwater detonations. Those individuals that are exposed would only be so periodically or episodically.

As described in the *Status of Listed Resources* and *Environmental Baseline* sections of this Opinion, the primary anthropogenic threats to the survival and recovery of sea turtles are overharvest (directed harvest of both eggs and adults), incidental capture in commercial fisheries, and human development of coastlines. Harvest of sea turtles has been greatly reduced in some locations, though it still occurs in other parts of the world, including areas in the Pacific Ocean. Further, efforts have been made in some areas to reduce incidental capture in fisheries, but the problem persists. For some sea turtles (i.e., leatherbacks and loggerheads), available information

indicates that population abundances in the North Pacific Ocean are low enough to experience the dynamics of small population sizes. However, the degree to which this, versus other exogenous threats, contributes to the decline, or inhibits recovery, of these species is unknown.

The predicted acoustic impacts on sea turtles from training and testing activities are shown in Table 58 and Table 63. The exposure estimates represent the total number of exposures and not necessarily the number of individuals exposed, as a single individual may be exposed multiple times over the course of a year. The predicted acoustic impacts do not take into account avoidance behavior or mitigation measures, such as establishing shut-down zones for certain sonar systems.

Approximately 12,500 explosives would be used during training and testing activities per year and would occur in areas designated for use of explosives within the Action Area. Approximately 10,000 (or 80 percent) of the explosives used in the Action Area are in source class E1 (0.1 to 0.25 lb. NEW). Other than those on FDM, most detonations would occur beyond approximately 12 nm from shore, minimizing impacts near nesting beaches or coastal habitats for sea turtles. A small number of near-shore (within 3 nm) training activities could occur, potentially exposing some sea turtles approaching nesting beaches to impulse sounds over a short duration if the training occurred during nesting season or close to sea turtles nearshore habitats. The terrain of FDM does not provide any nesting beaches so effects are not expected at this location to nesting turtles.

Little is known about how sea turtles use sound in their environment. Based on knowledge of their sensory biology (Moein Bartol and Ketten 2006; Bartol and Musick 2003), sea turtles may be able to detect objects within the water column (e.g., vessels, prey, predators) via some combination of auditory and visual cues. However, research examining the ability of sea turtles to avoid collisions with vessels shows they may rely more on their vision than auditory cues (Hazel et al. 2007). Similarly, while sea turtles may rely on acoustic cues to identify nesting beaches, they appear to rely on other non-acoustic cues for navigation, such as magnetic fields (Lohmann and Lohmann 1996a, b) and light (Avens and Lohmann 2003). Additionally, they are not known to produce sounds underwater for communication.

Further, although the information on the hearing capabilities of sea turtles is limited, the information available suggests that the auditory capabilities of sea turtles are centered in the low-frequency range (<2 kHz) (Bartol et al. 1999b; Dow Piniak et al. 2012; Lenhardt et al. 1983; Lenhardt et al. 1994a; Martin et al. 2012; O'Hara and Wilcox 1990; Ridgway et al. 1969), with greatest sensitivity below 1 kHz.

As described in sections 6.3.6, potential behavioral responses of sea turtles to anthropogenic sound could include startle reactions, disruption of feeding, disruption of migration, changes in respiration, alteration of swim speed, alteration of swim direction, and area avoidance. Any disruptions are expected to be temporary in nature, with the animal resuming normal behaviors shortly after the exposure. To result in significant fitness consequences we would have to assume that an individual turtle detects and responds to the acoustic source, and that it could not compensate for lost feeding opportunities by either immediately feeding at another location, by feeding shortly after cessation of acoustic exposure, or by feeding at a later time. There is no

indication this is the case, particularly since foraging habitat would still be available in the environment following the cessation of acoustic exposure. Similarly, we expect temporary disruptions of migration and swim speed or direction to be inconsequential because they can resume these behaviors almost immediately following the cessation of the sound exposure. Further, these sorts of behavioral disruptions may be similar to natural disruptions such those resulting from predator avoidance, or fluctuations in oceanographic conditions. Therefore, behavioral responses of sea turtles to acoustic stressors are unlikely to lead to fitness consequences and long-term implications for the population.

We assume that acoustic stressors from Navy training and testing activities conducted during the five-year MMPA rule and into the reasonably foreseeable future are likely to cause TTS and PTS in ESA-listed sea turtles in the MITT Action Area at the levels described above. However, as described previously in sections 6.3.3 and 6.8.4.4, there is no evidence that TTS or PTS results in energetic effects to individual sea turtles or would be likely to significantly reduce the viability of the population these individuals represent. Given that sea turtles do not rely on acoustic cues for most important life functions, it is anticipated that TTS and PTS will not result in fitness consequences to individuals or the populations to which they belong.

Acoustic stressors associated with the Navy's activities in the MITT Action Area also have the ability to cause slight lung injury in ESA-listed sea turtles in the MITT Action Area. As described previously in section 6.8.4.4, although slight lung injuries could temporarily affect the fitness of affected individuals by reducing their respiration rate, these effects are expected to stop once the injury has healed. Therefore, a temporary disruption of behaviors or fitness levels resulting from slight lung injury is not expected to substantially impact individual turtles when considering their overall lifetime fitness. Because we do not expect fitness consequences to individual turtles, we do not expect impacts to populations composed of those individual turtles.

Most of the sea turtles that are exposed to acoustic stressors would be exposed periodically or episodically over certain months or seasons when the Navy is training and testing in the Action Area. These periodic or episodic exposure and response scenarios most often allow sufficient time for the affected individuals to return to baseline conditions and resumption of normal behavioral activities. As described previously in Section 6.3.7, available scientific information does not provide evidence that exposure of sea turtles to acoustic stressors leading to sub-lethal effects from Navy training and testing activities will reduce the fitness of any individuals of this species. The potential for population level impacts resulting from lethal exposure of sea turtles to acoustic stressors is considered in the sections below, along with lethal vessel strike.

7.1.6.1 Green Sea Turtle

Based on our risk analysis on annual training and testing activities, we conclude that in any given year during the five-year period (August 2015 through August 2020), green sea turtles could potentially experience take in the form of behavioral harassment resulting from non-impulsive and impulsive acoustic stressors. As described in sections 6.3.6, 6.8.4.4, and 6.8.8.5, potential behavioral responses of sea turtles to anthropogenic sound could include startle reactions, disruption of feeding, disruption of migration, changes in respiration, alteration of swim speed, alteration of swim direction, and area avoidance. Any disruptions are expected to be temporary in nature, with the animal resuming normal behaviors shortly after the exposure. To result in

significant fitness consequences we would have to assume that an individual turtle detects and responds to the acoustic source, and that it could not compensate for lost feeding opportunities by either immediately feeding at another location, by feeding shortly after cessation of acoustic exposure, or by feeding at a later time. There is no indication this is the case, particularly since foraging habitat would still be available in the environment following the cessation of acoustic exposure. Similarly, we expect temporary disruptions of migration and swim speed or direction to be inconsequential because they can resume these behaviors almost immediately following the cessation of the sound exposure. Further, these sorts of behavioral disruptions may be similar to natural disruptions such those resulting from predator avoidance, or fluctuations in oceanographic conditions. Therefore, behavioral responses of sea turtles to acoustic stressors are unlikely to lead to fitness consequences and long-term implications for the population.

We anticipate approximately 1,837 instances of exposure to impulsive acoustic stressors that may result in behavioral harassment. We do not anticipate any additional exposures to non-impulsive acoustic stressors that might result in purely behavioral responses that were not also assessed as part of the instances of TTS, PTS, or injury. Additionally, we expect no more than 262 takes per year in the form of TTS resulting from impulsive (11 instances) and non-impulsive (251 instances) sound stressors. We anticipate one take each year during the five-year period in the form of PTS from impulsive sound sources. We also estimate approximately three (3) injuries in the form of slight lung injury and one (1) mortality from acoustic stressors that could occur in a given year. We also aniticipate the mortality of one green sea turtle from vessel strikes in a given year.

Death of an individual sea turtle would have a direct fitness consequence to the individual leading to lost reproductive potential that the individual might contribute to the population or sub-population. This lost reproductive potential will vary depending on the sex (male or female) and maturity of the individual. The death of a male would have less of an effect on the population than the loss of a female. Loss of a sexually mature female will have immediate effects on recruitment while lost reproductive potential from mortality of a juvenile female might not be realized for several years.

As stated previously in Section 4.2.6.9, the threatened green sea turtle population (the population that includes turtles in the MITT Action Area) is estimated to lay approximately 109,000 nests annually. On average green turtles nest every 2, 3 or 4 years, and lay 3.3 nests each year they breed (USFWS 2012a). Conservatively assuming that most turtles nest every 2 years, this equates to a likely total population size of approximately 66,000 females (if we assume the turtles nest every 4 years, the total population size is approximately 132,000 females). Removing 2 females from this population in one year would reduce the reproductive potential of this population by 0.002 percent. We do not consider this an appreciable reduction in the numbers of female green turtles or the reproductive rate of the population, either on an annual basis or continuing into the reasonably foreseeable future. Because we do not expect this level of mortality to result in an appreciable reduction in the numbers or reproductive rate of the threatened population of green sea turtles, we do not expect this level of mortality to impact the survival or recovery of this population.

The proposed Central West Pacific DPS of green sea turtles has an estimated 6,500 nesting females. Removing two females from this population in one year would reduce the reproductive potential of this population by 0.03 percent. We do not consider this an appreciable reduction in the numbers of female green turtles or the reproductive rate of this proposed DPS, either on an annual basis or continuing into the reasonably foreseeable future. Because we do not expect this level of mortality to result in an appreciable reduction in the numbers or reproductive rate of the proposed endangered Central West Pacific DPS of green sea turtles, we do not expect this level of mortality to impact the survival or recovery of this population.

The 1998 recovery plan for the threatened U.S. Pacific population of green sea turtles identifies directed take (poaching), coastal construction, and increased human presence as major threats occurring within the Action Area, and sets criteria for the delisting of this entity. These stressors are not associated with MITT activities analyzed in this Opinion. Neither vessel collision or acoustic stressors were identified as stressors affecting recovery in Guam or the CNMI. Delisting requires identifying regional stocks to source beaches, maintenance of stocks above 5,000 nesting females annually, nesting populations at source beaches are stable or increasing for 25 years, maintenance of healthy foraging areas, increases of foraging populations, completion of all priority one tasks, and the finalization of management plans and international agreements. However, we do not have sufficient information to assign sea turtles killed by DoD and USCG activities to individual nesting populations. Because of this, we considered the entirety of the listed entity, and concluded the removal of two green sea turtles annually from acoustic stressors and vessel strike and continuing at this rate into the reasonably foreseeable future is not an appreciable reduction in the numbers or the reproductive capability of the species. As a proposed DPS, the Central West Pacific population does not have a recovery plan.

Based on our analysis in this Opinion, we conclude that effects from ongoing DoD and USCG training and testing activities continuing into the reasonably foreseeable future would not be expected, directly or indirectly, to appreciably reduce the likelihood of the survival of green sea turtles in the wild by reducing the reproduction, numbers, or distribution of that species. We also conclude that effects from ongoing DoD and USCG training and testing activities continuing into the reasonably foreseeable future would not be expected, directly or indirectly, to appreciably reduce the likelihood of recovery of green sea turtles in the wild by reducing the reproduction, numbers, or distribution of that species. That is, acoustic stressors will not have fitness consequences and vessel strike will not result in an appreciable reduction in reproductive capability at the population or range-wide level. Therefore, we do not anticipate any measurable or detectable reductions in survival rate or trajectory of recovery of the proposed Central West Pacific DPS or to the species as currently listed pursuant to the ESA.

7.1.6.2 Hawksbill sea turtle

Based on our risk analysis on annual training and testing activities, we conclude that in any given year during the five-year period (August 2015 through August 2020), hawksbill sea turtles could potentially experience take in the form of behavioral harassment resulting from non-impulsive and impulsive acoustic stressors. As described in sections 6.3.6, 6.8.4.4, and 6.8.8.5, potential behavioral responses of sea turtles to anthropogenic sound could include startle reactions, disruption of feeding, disruption of migration, changes in respiration, alteration of swim speed, alteration of swim direction, and area avoidance. Any disruptions are expected to be temporary

in nature, with the animal resuming normal behaviors shortly after the exposure. To result in significant fitness consequences we would have to assume that an individual turtle detects and responds to the acoustic source, and that it could not compensate for lost feeding opportunities by either immediately feeding at another location, by feeding shortly after cessation of acoustic exposure, or by feeding at a later time. There is no indication this is the case, particularly since foraging habitat would still be available in the environment following the cessation of acoustic exposure. Similarly, we expect temporary disruptions of migration and swim speed or direction to be inconsequential because they can resume these behaviors almost immediately following the cessation of the sound exposure. Further, these sorts of behavioral disruptions may be similar to natural disruptions such those resulting from predator avoidance, or fluctuations in oceanographic conditions. Therefore, behavioral responses of sea turtles to acoustic stressors are unlikely to lead to fitness consequences and long-term implications for the population.

We anticipate approximately 129 instances of exposure to impulsive acoustic stressors that may result in behavioral harassment. We do not anticipate any additional exposures to non-impulsive acoustic stressors that might result in purely behavioral responses that were not counted as TTS, PTS, or injury. Additionally, we anticipate no more than 20 takes per year in the form of harassment from TTS resulting from impulsive (3 instances) and non-impulsive (17 instances) sound stressors. We anticipate zero takes each year during the five-year period in the form of PTS from impulsive sound sources. We estimate that approximately one slight lung injury and one mortality from acoustic stressors could occur in a given year.

We do not anticipate any mortality of this species from vessel strikes.

Death of an individual sea turtle would have a direct fitness consequence to the individual leading to lost reproductive potential that the individual might contribute to the population or sub-population. This lost reproductive potential will vary depending on the sex (male or female) and maturity of the individual. The death of a male would have less of an effect on the population than the loss of a female. Loss of a sexually mature female will have immediate effects on recruitment while lost reproductive potential from mortality of a juvenile female might not be realized for several years.

As stated previously, an average of between 11,000 and 12,700 hawksbill nests are estimated to occur each year in the Pacific. On average hawksbill turtles nest every 2 or 3 years, and lay 4.5 nests each year they (USFWS 2012b). Conservatively assuming that most turtles nest every 2 years and assuming the lower estimate of the number of nests annually, this equates to a likely total population size of approximately 4,889 females (if we assume the turtles nest every 3 years, the total population size is approximately 9,778 females). Removing 1 female from this population in a given year would reduce the reproductive potential of this population by 0.02 percent. We do not consider this to be an appreciable reduction in the numbers of female hawksbill turtles or the reproductive rate of the population, either on an annual basis or continuing into the reasonably foreseeable future. Because we do not expect this level of mortality to result in an appreciable reduction in the numbers or reproductive rate of this population of hawksbill sea turtles, we do not expect this level of mortality to impact the survival or recovery of this population.

The 1998 recovery plan for the U.S. Pacific populations of hawksbill sea turtles identifies increased human presence (primarily thorugh impacts to nesting beaches) and nest predation as the only major threats occurring in Hawaii and sets criteria for the delisting the species. MITT activities are not expected to exacerbate these threats. Delisting requires identifying regional stocks to source beaches; maintenance of stocks above 1,000 nesting females annually; nesting populations at source beaches are stable or increasing for 25 years; maintenance of healthy foraging areas; increases of foraging populations; completion of all priority one tasks; and the finalization of management plans; formal cooperative relationships with revional sea turtle management programs; and international agreements. However, we do not have sufficient information to assign sea turtles killed by Navy activities to individual nesting populations. Because of this, we considered the entire Pacific Ocean population (which is a component of the rangewide, circumglobal, listed entity), and concluded the removal of 1 hawksbill sea turtle in a given year, from acoustic stressors, continuing into the reasonably foreseeable future, is not an appreciable reduction in its numbers or its reproductive capability.

Based on our analysis in this Opinion, we conclude that effects from ongoing DoD and USCG training and testing activities continuing into the reasonably foreseeable future would not be expected, directly or indirectly, to appreciably reduce the likelihood of the survival of hawksbill sea turtles in the wild by reducing the reproduction, numbers, or distribution of that species. We also conclude that effects from ongoing DoD and USCG training and testing activities continuing into the reasonably foreseeable future would not be expected, directly or indirectly, to appreciably reduce the likelihood of recovery of hawksbill sea turtles in the wild by reducing the reproduction, numbers, or distribution of that species. That is, acoustic stressors will not have fitness consequences or will not result in an appreciable reduction in reproductive capability at the population or range-wide level. Therefore, we do not anticipate any measurable or detectable reductions in survival rate or trajectory of recovery of the species as listed pursuant to the ESA.

7.1.6.3 Leatherback Sea Turtle

Based on our risk analysis on annual training and testing activities, we conclude that in any given year during the five-year period (August 2015 through August 2020), hawksbill sea turtles could potentially experience take in the form of behavioral harassment resulting from non-impulsive and impulsive acoustic stressors. As described in sections 6.3.6, 6.8.4.4, and 6.8.8.5, potential behavioral responses of sea turtles to anthropogenic sound could include startle reactions, disruption of feeding, disruption of migration, changes in respiration, alteration of swim speed, alteration of swim direction, and area avoidance. Any disruptions are expected to be temporary in nature, with the animal resuming normal behaviors shortly after the exposure. To result in significant fitness consequences we would have to assume that an individual turtle detects and responds to the acoustic source, and that it could not compensate for lost feeding opportunities by either immediately feeding at another location, by feeding shortly after cessation of acoustic exposure, or by feeding at a later time. There is no indication this is the case, particularly since foraging habitat would still be available in the environment following the cessation of acoustic exposure. Similarly, we expect temporary disruptions of migration and swim speed or direction to be inconsequential because they can resume these behaviors almost immediately following the cessation of the sound exposure. Further, these sorts of behavioral disruptions may be similar to natural disruptions such those resulting from predator avoidance, or fluctuations in

oceanographic conditions. Therefore, behavioral responses of sea turtles to acoustic stressors are unlikely to lead to fitness consequences and long-term implications for the population.

We anticipate approximately 49 instances of exposure to impulsive acoustic stressors that may result in behavioral harassment. We do not anticipate any additional exposures to non-impulsive acoustic stressors that might result in purely behavioral responses that were not counted as TTS, PTS, or injury. Assuming that the Navy conducts the maximum number of authorized training and testing activities for the maximum number of authorized hours, we estimated 12 takes per year in the form of harassment from TTS resulting from non-impulsive sound stressors. We anticipate zero takes each year during the five-year period in the form of PTS from impulsive sound sources or other forms of injury including GI tract, slight lung injury or mortality from acoustic stressors.

The 1998 recovery plan for the U.S. Pacific populations of leatherback sea turtles does not identify any major threats occurring in the Action Area, but sets criteria for the delisting the species. Delisting requires identifying regional stocks to source beaches, stability in the number of nesting females over 25 years, maintenance of at least 5,000 females in each stock over 6 years, maintenance of healthy foraging habitat, increases of foraging populations, completion of all priority one tasks, and the finalization of management plans. We do not have sufficient information to assign leatherback a specific number of takes from Navy acoustic stressors; however, any leatherbacks affected are not expected to experience fitness consequences because this species does not rely heavily on auditory cues from their environment for breeding, feeding, or sheltering. Because of a lack of fitness consequences and that acoustic stressors are not identified as a threat to leatherback recovery, we do not expect sub-lethal leatherback sea turtle take to impede recovery of this species.

Based on the evidence available, including the *Environmental Baseline* and *Cumulative Effects*, stressors resulting from training and testing activities the DoD and USCG will conduct in the MITT Action Area on an annual basis, cumulatively over the five year period from August 2015 through August 2020, or cumulatively for the reasonably foreseeable future (assuming there are no significant changes to the *Status of Listed Resources* or *Environmental Baseline*), would not be expected to appreciably reduce the likelihood of the survival of leatherback sea turtles in the wild by reducing the reproduction, numbers, or distribution of that species. We also conclude that effects from ongoing DoD and USCG training and testing activities continuing into the reasonably foreseeable future would not be expected, directly or indirectly, to appreciably reduce the likelihood of recovery of leatherback sea turtles in the wild by reducing the reproduction, numbers, or distribution of that species. Therefore, we do not anticipate any measurable or detectable reductions in survival rate or trajectory of recovery of sub-populations in the North Pacific or to these species as listed pursuant to the ESA.

7.1.6.4 Loggerhead Sea Turtle

Based on our risk analysis on annual training and testing activities, we conclude that in any given year during the five-year period (August 2015 through August 2020), hawksbill sea turtles could potentially experience take in the form of behavioral harassment resulting from non-impulsive and impulsive acoustic stressors. As described in sections 6.3.6, 6.8.4.4, and 6.8.8.5, potential behavioral responses of sea turtles to anthropogenic sound could include startle reactions,

disruption of feeding, disruption of migration, changes in respiration, alteration of swim speed, alteration of swim direction, and area avoidance. Any disruptions are expected to be temporary in nature, with the animal resuming normal behaviors shortly after the exposure. To result in significant fitness consequences we would have to assume that an individual turtle detects and responds to the acoustic source, and that it could not compensate for lost feeding opportunities by either immediately feeding at another location, by feeding shortly after cessation of acoustic exposure, or by feeding at a later time. There is no indication this is the case, particularly since foraging habitat would still be available in the environment following the cessation of acoustic exposure. Similarly, we expect temporary disruptions of migration and swim speed or direction to be inconsequential because they can resume these behaviors almost immediately following the cessation of the sound exposure. Further, these sorts of behavioral disruptions may be similar to natural disruptions such those resulting from predator avoidance, or fluctuations in oceanographic conditions. Therefore, behavioral responses of sea turtles to acoustic stressors are unlikely to lead to fitness consequences and long-term implications for the population.

We anticipate approximately 54 instances of exposure to impulsive acoustic stressors that may result in behavioral harassment. We do not anticipate any additional exposures to non-impulsive acoustic stressors that might result in purely behavioral responses that were not counted as TTS, PTS, or injury. Assuming that the Navy conducts the maximum number of authorized training and testing activities for the maximum number of authorized hours, we estimated 15 takes per year in the form of harassment from TTS resulting from non-impulsive sound stressors. We anticipate zero takes each year during the five-year period in the form of PTS from impulsive sound sources or other forms of injury including GI tract, slight lung injury or mortality from acoustic stressors.

The North Pacific DPS of loggerhead sea turtles does not have a recovery plan; therefore no recovery criteria have been established, nor have major threats and their remedies specific to loggerhead recovery been established. Any loggerheads affected are not expected to experience fitness consequences because this species does not rely heavily on auditory cues from their environment for breeding, feeding, or sheltering. Because of a lack of fitness consequences and supporting information from a recovery plan suggesting temporary effects from acoustic stressors would impede loggerhead recovery, we do not expect sub-lethal loggerehead sea turtle take to impede recovery of this species.

Based on the evidence available, including the *Environmental Baseline* and *Cumulative Effects*, stressors resulting from training and testing activities the DoD and USCG will conduct in the MITT Action Area on an annual basis, cumulatively over the five year period from August 2015 through August 2020, or cumulatively for the reasonably foreseeable future (assuming there are no significant changes to the *Status of Listed Resources* or *Environmental Baseline*), would not be expected to appreciably reduce the likelihood of the survival or the recovery of loggerhead sea turtles in the wild by reducing the reproduction, numbers, or distribution of that species. We also conclude that effects from ongoing DoD and USCG training and testing activities continuing into the reasonably foreseeable future would not be expected, directly or indirectly, to appreciably reduce the likelihood of recovery of loggerhead sea turtles in the wild by reducing the reproduction, numbers, or distribution of that species. That is, non-impulsive acoustic stressors will not have fitness consequences at the individual level. Therefore, we do not

anticipate any measurable or detectable reductions in survival rate or trajectory of recovery of sub-populations in the North Pacific or to these species as listed pursuant to the ESA.

7.1.7 Scalloped Hammerhead Shark – Indo-West Pacific DPS

In determining whether U.S. Navy training and testing activities in the MITT Action Area are likely to jeopardize the survival and recovery of the Indo-West Pacific DPS of scalloped hammerhead sharks, we assessed effects of the action against the aggregate effects of everything in the *Environmental Baseline* that has led to the current *Status of Listed Resources* and, those effects of future non-Federal activities that are reasonably certain to occur within the Action Area in the reasonably foreseeable future. Many U.S. Navy training exercises and testing activities in the MITT Action Area over a five-year period and continuing into the reasonably foreseeable future will occur without any scalloped hammerhead sharks being exposed to shock waves associated with underwater detonations. Those individuals that are exposed to UNDETs in and around Apra Harbor, Guam would only be so periodically or episodically over certain months or seasons.

In section 6.8, we analyzed the effects of acoustic stressors on scalloped hammerhead sharks. There is no evidence of juvenile or adult injury or mortality resulting from underwater detonations or other impulsive acoustic stressors during Navy training and testing. Additionally, the Navy has mitigation measures in place to reduce the likelihood of this occurring. Therefore we anticipate zero injury or mortality during a given year. We estimated the affected habitat area for a 20 lb. NEW charge to be 99 m^2. In this scenario, any scalloped hammerhead sharks within the 99 m^2 area could be behaviorally-harassed, or up to 99 m^2 of their habitat would be temporarily displaced during each detonation. However, sharks would be expected to return to this habitat soon after each (up to five detonations per day or 20 per week) of the 260 disturbances events and behavioral responses have concluded. We concluded that 260 instances of habitat displacement (each displacing 99 m^2) would not significantly reduce the amount (13,510,249 km^2) of habitat available to the Indo-West Pacific DPS and that scalloped hammerhead sharks would quickly recover from instances of behavioral harassment and TTS within these areas. Therefore, these temporary disruptions of available habitat would not have fitness consequences to individual scalloped hammerhead sharks since they are highly mobile and could find suitable habitat in near proximity to the habitat they were displaced from. We also determined that any instances of temporary hearing loss would not be expected to have fitness consequences to individuals because scalloped hammerheads are long-lived animals and hearing would be expected to return within a short amount of time (hours). Given the nature of testing and training as described above, these periodic or episodic exposure and behavioral response scenarios, including responses to TTS, most often allow sufficient time to return to baseline conditions and resumption of normal behavioral activities such as feeding and breeding. As described previously, including in Section 6.4.7 of this Opinion, the available scientific information does not provide evidence that exposure to acoustic stressors from Navy training and testing activities will impact the fitness of any individuals of this species. Therefore exposure to acoustic stressors will not have population or species level impacts.

The Indo-West Pacific DPS of scalloped hammerhead sharks does not have a recovery plan; therefore, specific downlisting and delisting criteria are not established. We concluded temporary displacement of individuals belonging to this listed entity could occur and that sublethal effects

not rising to the level of injury from acoustic stressors would be temporary and not impact the fitness of individuals or the population.

Based on the evidence available, including the *Environmental Baseline* and *Cumulative Effects*, stressors resulting from training and testing activities the DoD and USCG will conduct in the MITT Action Area on an annual basis, cumulatively over the five year period from August 2015 through August 2020, or cumulatively for the reasonably foreseeable future (assuming there are no significant changes to the *Status of Listed Resources* or *Environmental Baseline*), would not be expected to appreciably reduce the likelihood of the survival of the Indo-West Pacific DPS of scalloped hammerhead sharks in the wild by reducing the reproduction, numbers, or distribution of that species. We also conclude that effects from ongoing DoD and USCG training and testing activities continuing into the reasonably foreseeable future would not be expected, directly or indirectly, to appreciably reduce the likelihood of recovery of the Indo-West Pacific DPS of scalloped hammerhead sharks in the wild by reducing the reproduction, numbers, or distribution of that species. We do not anticipate any reductions in survival rate or trajectory of recovery of the species as listed pursuant to the ESA that would be sufficient to be readily perceived or estimated.

7.1.8 Acropora globiceps

In determining whether U.S. Navy training and testing activities in the MITT Action Area are likely to jeopardize the survival and recovery of *Acropora globiceps*, we assessed effects of the action against the aggregate effects of everything in the *Environmental Baseline* that has led to the current *Status of Listed Resources* and, those effects of future non-Federal activities that are reasonably certain to occur within the Action Area in the reasonably foreseeable future. Many U.S. Navy training exercises and testing activities in the MITT Action Area over a five-year period and continuing into the reasonably foreseeable future will occur without any *Acropora globiceps* colonies being exposed to U.S. Navy vessels, sound fields associated with active sonar pings, or shock waves associated with underwater detonations. Those individuals that are exposed would only be so periodically or episodically.

Based on our analysis on the effects of in-water explosions and direct strike from live and inert ordnance, we determined that mortality of 6.78 m^2 of habitat (which could be approximated to 384 colonies) occupied by live *Acropora globiceps* from Navy explosive ordnance activities around FDM would occur each year. We estimated the area of live *Acropora globiceps* cover around FDM to total 6,322.3 m^2. Therefore, we determined that Navy activities will result in mortality of 0.11 percent of the *Acropora globiceps* reef habitat around FDM each year. In addition to mortality, our analysis estimated 20.34 m^2 of habitat occupied by *Acropora globiceps* will be injured (recoverable injury to approximately 1,152 colonies) from Navy explosive ordnance activities around FDM each year. We also estimated two instances of recoverable injury to *Acropora globiceps* habitat around FDM from ordnance other than high-explosive bombs will occur on an annual basis. Based on coral reef surveys around FDM (DoN 2005a), we estimated 6,322 m^2 of *Acropora globiceps* habitat (roughly equating to 357,800 colonies) may exist around FDM. According to the final listing rule for the species (NMFS 2014, 79 FR 53852) *Acropora globiceps*' rangewide abundance is at least tens of millions of colonies at the time of listing. Using this information and our assumption on average colony size, we estimate that there is likely more than 176,700m^2 of live *Acropora globiceps* cover (roughly 10 million colonies)

rangewide. The estimated annual mortality of live coral cover (6.78 m^2) assumed to be occupied by *Acropora globiceps* (approximately 384 colonies) around FDM is roughly 0.1 percent of available habitat assumed to be occupied by *Acropora globiceps* around FDM and and no more than 0.004 percent of the habitat occupied by *Acropora globiceps* range-wide. The mortality of *Acropora globiceps* embryos and larvae around FDM potentially occurring from in-water explosions of HE-bombs that miss their targets on FDM is expected to be minimal. Additionally, explosions would need to occur when larvae are present and would not represent a significant increase in natural mortality of larvae which can be up to 90 percent annually. This level of mortality from explosives around FDM is expected to have negligible impacts to growth and recruitment of *Acropora globiceps* at the population and rangewide scale.

Injuries could include varying degrees of abrasion, breakage, and/or pieces of debris settling upon portions of the coral colony. However, because only a portion of the coral colony polyps would be affected, we do not expect injuries to result in coral colony mortality. Uninjured coral polyps within the colony affected would be able to sustain the "individual" as defined in Section 6.5. The tissue thickness of *Acropora* species is 1 to 2 mm thick, considerably thinner than many coral species, which allows them to grow quicker than many other species (Loya et al. 2001). Therefore, injured *Acropora globiceps* colonies would likely be able to bud and develop new polyps to replace those lost in the injury. Fragmentation may also occur where pieces of the coral colony break off, separating a single colony into two or more individuals. Fragmentation may lead to a large number of asexually-produced, genetically identical colonies, commonly resulting in a population made up of more asexually-produced colonies than sexually-produced colonies (Hughes 1984). Injuries to portions of colonies are also not expected to substantially impact coral gamete production. As described in Section 4.2.11.3, the reproductive biology of *Acropora globiceps*, and other coral species, results in prolific larval production and high natural mortality from a combination of factors including predation and dispersal to areas within the ocean without appropriate settlement habitat (e.g., deeper or colder water, unsuitable substrate). Therefore, a temporary decrease in the number of gamete producing coral polyps within a coral colony is expected to result in a negligible decrease in the overall number of gametes produced by the colony and population of *Acropora globiceps* around FDM. Because we do not expect temporary injuries to last for substantial durations and we do not expect these injuries to result in lost reproductive potential, we do not expect injuries to result in fitness consequences to individual colonies or the populations they represent.These conclusions are further supported by coral reef surveys that have been conducted around FDM in the recent past. U.S. military training has been occurring in the MITT Action Area for many years and, although injury and mortality of *Acropora globiceps* in these areas has likely occurred from this historical activity, reefs in these areas continue to survive and reproduce. A 2013 report presented the findings of the calender year 2012 U.S. Navy coral reef survey and compares findings from those of the previous 12 surveys (Smith et al. 2013). The report indicates that despite ongoing use by the Department of Defense as a live and inert range, no significant impacts to the physical or biological environment were detected between 1999 and 2012. We acknowledge our estimation of effects on ESA-listed corals for activities around FDM is based on limited observations on the effects of in-water explosions of military ordnance, but it provides a reasonable estimate of what could be expected in a given year or over the reasonably foreseeable future and that most impacts to *Acropora globiceps* colonies would often be temporary and recoverable.

Acropora globiceps does not have a recovery plan; therefore, specific downlisting and delisting criteria are not established. We concluded mortality of this species will likely occur. Considering the total available reef habitat around FDM and range-wide for the species and estimated instance of mortality, we conclude that the mortality of 6.78 m^2, and injury to 20.34 m^2, of live *Acropora globiceps* would not be an appreciable reduction in survival or recovery of the species. Additionally, the extent of mortality of embryonic and larval life stages of *Acropora globiceps* prior to settling would be insignificant to the overall recruitment potential for individual colonies or the population.

As described in the *Status of Listed Resources* and *Environmental Baseline* sections of this Opinion, one of the primary anthropogenic threats to reef-building corals, including *Acropora globiceps*, is climate change induced ocean warming. This threat is expected to continue into the future. However, the proposed action will not worsen this threat and it will not lessen the species' traits that mitigate its extinction risk, including its abundance and life history characteristics (e.g., resilience to bleaching events, reproductive strategy). Based on the evidence available, including the *Environmental Baseline* and *Cumulative Effects*, stressors resulting from training and testing activities the Navy will conduct in the MITT Action Area on an annual basis, cumulatively over the five year period from August 2015 through August 2020, or cumulatively for the reasonably foreseeable future (assuming there are no significant changes to the *Status of Listed Resources* or *Environmental Baseline*), would not be expected to appreciably reduce the likelihood of the survival of *Acropora globiceps* in the wild by appreciably reducing the reproduction, numbers, or distribution of that species. While a small number of individual colonies would be killed each year around FDM, this number is likely replaced with new polyps in the population a rate greater than is lost in a given year from Navy activities and continuing into the reasonably foreseeable future. Instances of recoverable injury such as breakage resulting from these stressors may also serve to propagate coral colonies in and around areas where mortality is estimated. In our analysis, we also assumed that *Acropora globiceps* would be present in all instances of detonations and impacts from military expended materials. We acknowledge that this is likely an overestimate of actual distribution and level of effects. We also conclude that effects from ongoing Navy training and testing activities continuing into the reasonably foreseeable future would not be expected, directly or indirectly, to appreciably reduce the likelihood of recovery of *Acropora globiceps* in the wild by reducing the reproduction, numbers, or distribution of that coral species.

8 CONCLUSION

During the consultation, we reviewed the current status of endangered blue whales, fin whales, humpback whales, sei whales, and sperm whales, threatened green sea turtles, endangered hawksbill sea turtles, endangered leatherback sea turtles, endangered loggerhead sea turtles, endangered olive ridley sea turtles, the threatened Indo-West Pacific DPS of scalloped hammerhead sharks, and threatened *Acropora globiceps*. We also assessed the status of the proposed endangered Central West Pacific DPS of green sea turtle and threatened Central North Pacific DPS of humpback whale as part of our conference report. We also assessed the *Environmental Baseline* for the MITT Action Area including ongoing DoD and USCG training and testing in the MITT Action Area along with the potential effects of DoD and USCG

proposed Mariana Islands Training and Testing Study from August 2015 through August 2020 along with the National Marine Fisheries Service's Permit Division's proposed rule on the take of marine mammals incidental to training and testing activities and proposed letter of authorization for the five-year period.

We conclude that Navy training and testing activities in the MITT Action Area and NMFS' issuance of the MMPA regulations and LOA are likely to adversely affect but will not appreciably reduce the ability of these threatened and endangered species under NMFS' jurisdiction to survive and recover in the wild. Therefore, we conclude that these activities are not likely to jeopardize the continued existence of any endangered or threatened species. The actions also will not result in the destruction or adverse modification of critical habitat during the five-year period of the MMPA rule or continuing into the reasonably foreseeable future. These conclusions will remain valid assuming that the type, amount and extent of training and testing do not exceed levels assessed in this opinion and/or the status of the species affected by these actions does not change significantly from that assessed in this Opinion.

9 INCIDENTAL TAKE STATEMENT

Section 9 of the ESA prohibits the take of endangered species without special exemption. ESA § 9 statutory prohibitions are limited to "endangered" species unless extended to "threatened" species. In the case of threatened species, section 4(d) of the ESA leaves it to the Secretary's discretion whether and to what extent to extend the statutory 9(a) ''take'' prohibitions, and directs the agency to issue regulations it considers necessary and advisable for the conservation of the species. At the time of this consultation, take prohibitions have not been extended to the threatened Indo-Pacific DPS of scalloped hammerhead shark or the threatened species of Indo-Pacific corals, including *Acropora globiceps*. However, consistent with *CBD v. Salazar*, 695 F.3d 893 (9th Cir. 2012), we assessed the amount or extent of take to these threatened species that is anticipated incidental to Navy training and testing activities and include this information in the ITS. Inclusion of these species in the incidental take statement serves to assist the Action Agency with monitoring of take and provides a trigger for reinitiation if levels of estimated take are exceeded.

Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by NMFS to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the Marine Mammal Protection Act, there is a definition of what is referred to as Level B harassment: "any act of pursuit, torment, or annoyance which... has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering but which does not have the potential to injure a marine mammal or marine mammal stock in the wild" 16 U.S.C. §1362(18)(A)(ii). For this consultation, we interpret "harass" using the MMPA definition to marine mammals. For other species, specifically sea turtles, we apply "harass" to mean an intentional or negligent action that has the potential to

injure an animal or disrupt its normal behavior to a point where such behaviors are abandoned or significantly altered. Section 7(b)(4) and section 7(o)(2) provide that taking that is incidental to an otherwise lawful agency action is not considered to be prohibited taking under the ESA if that action is performed in compliance with the terms and conditions of this incidental take statement.

9.1 Amount or Extent of Take

The section 7 regulations require NMFS to specify the impact of any incidental take of endangered or threatened species; that is, the amount or extent, of such incidental taking on the species (50 CFR §402.14(i)(1)(i)). The amount of take represents the number of individuals that are expected to be taken by proposed actions while the extent of take or "the extent of land or marine area that may be affected by an action" if we cannot assign numerical limits for animals that could be incidentally taken during the course of an action (51 FR 19953). The amount of take resulting from the Navy's activities was estimated based on the best information available.

9.1.1 Take Incidental to Mariana Islands Training and Testing Activities and Issuance of the MMPA Rule and Letters of Authorization

In the following sections we summarize the anticipated take from annual training and testing activities by species as proposed by the Navy and the interrelated and interdependent actions of issuance of a five-year regulation and LOAs by NMFS' Permits Division to authorize take of marine mammals pursuant to the MMPA.

Section 7(b)(4)(C) of the ESA provides that if an endangered or threatened marine mammal is involved, the taking must first be authorized by Section 101(a)(5) of the MMPA. Accordingly, the terms of this incidental take statement and the exemption from Section 9 of the ESA become effective only upon the issuance of MMPA authorization (i.e., five year regulations and LOA) to take the marine mammals identified here. Absent such authorization, this statement is inoperative for marine mammals.

Table 69 provides the anticipated take incidental to training and testing activities in a given year where all possible activities are carried out in that year.

Table 69. Take Authorized Incidental to Training and Testing Activities, Issuance of the MMPA Regulation and Issuance of the LOA

ESA-Listed Species	Impulsive and Non-Impulsive Acoustic Stressors				Military Expended Material (Inert Munitions) and Detonations (Live Munitions)	Vessel Strike
	Behavioral Harassment	Harm (PTS)	Harm (Slight Lung Injury)	Mortality	Injury / Mortality	Mortality
Cetaceans (Mysticetes)						
Blue Whale	**28 (25)/yr** [3]	0	0	0	-	-
Fin Whale	**28 (24)/yr** [3]	0	0	0	-	-
Humpback Whale – Range-wide[1]	**860 (679)/yr** [3]	0	0	0	-	-
Humpback Whale – Western North Pacific DPS[1]	**860 (679)/yr** [3]	0	0	0	-	-
Sei Whale	**319 (258)/yr** [3]	0	0	0	-	-
Cetaceans (Odontocetes)						
Sperm Whale	**506 (54)/yr** [3]	0	0	0	-	-
Sea Turtles						
Green Turtle – Range-wide[2]	**2,099 (262)/yr** [3]	**1/yr**	**3/yr**	**1/yr**	**-**	**1/yr**
Green Turtle – Central West Pacific DPS[2]	**2,099 (262)/yr** [3]	**1/yr**	**3/yr**	**1/yr**	**-**	**1/yr**
Hawksbill Turtle	**149 (20)/yr** [3]	0	**1/yr**	**1/yr**	**-**	**-**
Leatherback Turtle	**61 (12)/yr** [3]	0	0	0	-	-
Loggerhead Turtle – North Pacific DPS	**69 (15)/yr** [3]	0	0	0	-	-

Fish						
Scalloped Hammerhead Shark – Indo-West Pacific DPS	**Temporary effects to 99 m^2 of available habitat no more than 260 times per year (No more than 5 times per day or 20 times per week at all sites)[4]**	-	-	**0/yr[5]**	-	-
Invertebrates (Corals)						
*Acropora globiceps**	-	-	-	-	**Mortality and injury of reef area around Farrallon de Medinilla up to 6.78 m^2 and 20.24 m^2, respectively, from HE bombs, annually and continuing into the reasonably foreseeable future.[6] Additionally, two (2) instances of reef area injury around FDM annually continuing into the reasonably foreseeable future from ordnance other than HE bombs.**	-

[1]During this consultation, NMFS proposed to divide the globally listed endangered species (humpack whale) into 14 DPSs and to remove the species-level listing, and in its place list two DPSs and endangered and two DPSs as threatened. If the proposed rulemaking becomes effective and if the proposed listings are finalized as proposed and assessed in this Opinion, incidental take estimates for the range-wide species will become null and void and the estimated incidental take for the Western North Pacific DPS will take effect.

[2] During this consultation, NMFS proposed to redesignate the breeding populations of green sea turtles in Florida and the Pacific coast of Mexico (currently listed as endangered); and elsewhere currently listed as threatened. NMFS proposed eight threatened DPSs and three endangered DPSs. Green turtles in the MITT Action Area would occur in the proposed endangered Central West Pacific DPS. If the proposed rulemaking becomes effective and if the proposed listings are finalized as proposed and as assessed in this Opinion, incidental take estimates for the range-wide threatened species will become null and void and the estimated incidental take for the Central West Pacific DPS will take effect.

[3]The subset of estimated instances of TTS as a subset of the total instances of behavioral harassment are provided in parenthesis.

[4]The estimated extent of take is provided in terms of a habitat surrogate (i.e., area of affected habitat) for behavioral harassment. Reinitation will be required if (1) effects to scalloped hammerhead sharks attributable to UNDET activities exceed temporary behavioral effects or temporary habitat displacement, (2) effects to scalloped hammerhead sharks attributable to UNDET activities occur beyond 99m^2 from the detonation location, or (3) more than 260 explosive detonations at Apra Harbor, Agat Bay, and Piti Point occur in a year (not to exceed five detonations in a day and not to exceed 20 detonations in a week).

[5]In the absence of any empirical data that mortality has resulted from Navy training and testing, we anticipate zero mortalities; however, if a single mortality is observed, reinitiation of consultation would be required.

[6]The estimated extent of take is provided in terms of an ecological surrogate (i.e., coral habitat area). Reinitiation will be required if the Navy: (1) exceeds a one percent miss rate when the total number of expended HE bombs in Table 66 is reached, or (2) exceeds the number of items expended by type in Table 66 in a given year. In either scenario, the estimated area of coral habitat impacted (injury and mortality) could be exceeded and reinitiation would be required.

- Either exposures to the stressor are not expected or responses to exposures rising to the level of "take" are not expected.

9.2 Effects of the Take

In the accompanying biological opinion, we determined that the anticipated take levels specified above are not likely to result in jeopardy to any of the affected species or destruction or adverse modification of critical habitat that has been designated for such species.

9.3 Reasonable and Prudent Measures

The following reasonable and prudent measures are necessary and appropriate to minimize impacts of incidental take of the species listed in Table 69 in the incidental take statement of this biological opinion.

1. The Navy and NMFS' Permits Division shall have measures in place to limit the potential for interactions with ESA-listed species that may rise to the level of take as a result of the proposed actions described in this Opinion. Standards and procedures should be incorporated into policy and guidance, directives, and standard operating procedures as appropriate.

2. The Navy and NMFS' Permits Division shall report all observed interactions resulting in take with any ESA-listed species (marine mammals, fish, adult corals (reefs, etc.) and sea turtles) resulting from the proposed actions that are observed during the course of Navy training and testing activities and while implementing monitoring requirements for marine mammals as required by the LOA.

3. The Navy shall monitor effects to coral reef habitat at FDM.

9.3.1 Monitoring

As discussed in Section 9.1 of this Opinion, the estimated take of ESA-listed sea turtles and marine mammals from acoustic stressors is based on Navy modeling, which represents the best available means of numerically quantifying take. As the level of non-impulsive or impulsive acoustic activities increases, the level of take is likely to increase as well. For non-lethal take from acoustic sources specified above, feasible monitoring techniques for detecting and calculating actual take of marine mammals and sea turtles at the scale of MITT activities do not exist. We are not aware of any other feasible or available means of determining when estimated take levels may be exceeded. Therefore, we must rely on Navy modeling (for marine mammals and sea turtles), and the link between sonar or explosive use and the level of take, to determine when anticipated take levels have been exceeded.

The take levels specified above also include one annual mortality each for green and hawksbill sea turtles from acoustic sources (based on Navy modeling) and one annual green sea turtle mortality resulting from a vessel strike. It is very difficult to detect the occurrence of a vessel strike involving a sea turtle. Even with regional stranding network data, it is exceedingly difficult to attribute injury or mortality to Navy training or testing activities given multiple use of harbors, coastal zones, and offshore areas by Navy and non-Navy entities. Although we believe that Navy monitoring may detect some, sea turtle mortalities most likely go undetected. Therefore, for these forms of take as well, we must again rely on estimated take associated with levels of activities and any opportunistic observations of sea turtle mortalities during or following testing or training activities as measurements of take and a trigger for reinitiation of consultation. We

are aware of no other feasible or available alternative means of determining when estimated levels of these forms of take are exceeded.

The amount of anticipated take of the Indo-West Pacific DPS of scalloped hammerhead sharks and *Acropora globiceps* from acoustic stressors and military expended materials (*Acropora globiceps*) are expressed as habitat surrogates, consistent with 50 C.F.R. § 402.14(i).

The Navy is required under the final MMPA rule and the reasonable and prudent measures in this Opinion to report activity levels (including sonar hours and the type and number of explosives used) to NMFS. As such, we established a term and condition of this Incidental Take Statement, requiring the Navy to report to NMFS any exceedance of activity levels or planned testing or training events specified above and in the final MMPA rule before the exceedance occurs (if operational security considerations allow), or as soon as operational security considerations allow after the relevant activity is conducted. Exceedance of an activity level will require the Navy to reinitiate consultation.

Reinitiation of consultation shall also be required if Navy monitoring programs detect any unanticipated form of take of ESA-listed species not specified above.

9.3.2 Reporting

The Navy and NMFS' Permits and Conservation Division shall submit reports that identify the general location, timing, number of sonar hours and other aspects of the training exercises and testing activities, and any potential to exceed levels of training and testing analyzed in this Opinion they conduct in the MITT Action Area over the five year period of the MMPA regulations and letters of authorization to help assess the actual amount or extent of take incidental to training and testing activities.

The Navy shall also submit annual reports on the levels and types of ordnance used at FDM that impacts coral reef habitat, and shall provide summary reports for required coral surveys to the ESA Interagency Cooperation Division upon completion but not less than once every five years.

9.4 Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the ESA, the Navy (as Executive Agent for DoD and USCG activities) and NMFS' Permits Division must comply with the following terms and conditions, which implement the reasonable and prudent measures described above and outline required reporting and monitoring requirements. These terms and conditions are nondiscretionary:

1. To satisfy the reasonable and prudent measures above, the Navy must report to NMFS any exceedance of activity levels (e.g. sonar hours and the type and numbers of explosives used) of planned testing or training events specified in the preceding Opinion and in the final MMPA rule before the exceedance occurs (if operational security considerations allow), or as soon as operational security considerations allow after the relevant activity is conducted. Exceedance of an activity level will require the Navy to reinitiate consultation.

2. To satisfy reasonable and prudent measure number one in Section 9.3, the Navy shall implement all mitigation and monitoring measures as proposed in the action described in the final EIS/OEIS and consultation initiation package, as specified in the final MMPA rule and LOAs, and as described in this Opinion in Section 2.9.

3. To satisfy reasonable and prudent measure number two in Section 9.3, the Navy shall immediately (or as soon as operational security considerations allow) notify NMFS if a dead or seriously injured sea turtle is observed during Navy testing or training activities that is potentially attributable to these activities, including but not limited to the use of explosives and vessel strike. If the Navy observes one or more dead or seriously injured sea turtles in each of two consecutive years during Navy testing and training activities that is potentially attributable to these activities, the Navy shall contact NMFS to determine if reinitiation is required.

4. To satisfy reasonable and prudent measure number three in Section 9.3, the Navy shall monitor and report annual numbers of ordnance by type (e.g., Bomb HE, Bomb NEPM, Projectiles, Missiles, Rockets, etc.) expended at FDM. Navy will report all observed ricochets and misses that land in waters surrounding FDM occupied by corals. Additionally, the Navy shall provide reports of any observed in-water effects (e.g., crater size, observed mortality) to corals resulting from detonations of high-explosive bombs as they are discovered incidental to routine operations or during coral reef surveys to confirm or to help revise assumptions on the effects of high-explosive bombs to corals at various depths.

5. To satisfy reasonable and prudent measure number three in Section 9.3, the Navy shall compile existing baseline information and then, no less than once every five years, shall survey coral reef habitat around FDM within 20 meters of water depth. These surveys shall be structured to confirm presence or absence and abundance of ESA-listed corals and to assess general trends in coral reef species composition, percent coral coverage, and condition (disease, predators, extent of breakage, etc.).

6. To satisfy reasonable and prudent measures number one and two in Section 9.3, NMFS' Permits Division shall ensure that all mitigation and monitoring measures as proposed by the Navy and as proposed by NMFS in the final MMPA rule and in Section 2.9 of this Opinion are implemented by the U.S. Navy through the issuance of a final rule and subsequent letters of authorization (LOA) pursuant to the MMPA.

7. To satisfy reasonable and prudent measures number one and two in Section 9.3, the Navy as the Executive Agent for DoD and USCG activities, shall coordinate the execution of these required actions with other affected military services and the USCG and shall compile and summarize any and all annual monitoring and exercise reports and describe observed interactions with ESA-listed species [marine mammals, fish, adult corals (reefs, etc.) and sea turtles] that involve their actions.

8. To satisfy reasonable and prudent measures number one and two in Section 9.3, the Navy shall annually request sea turtle stranding data from the regional NMFS stranding office

and will review any data provided by the regional office to determine if any unusual stranding events or increases in stranding rates may be attributed to Navy training and testing. If the Navy identifies an increase in sea turtle stranding data potentially associated with Navy training and testing activities, the Navy shall contact NMFS to determine if reinitiation is required.

10 CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs Federal agencies including the U.S. Navy, U.S. Air Force, U.S. Coast Guard and NMFS to utilize their authority to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat to help implement recovery plans or to develop information.

1. Monitor sighting, location, and stranding data for ESA-listed marine mammals, sea turtle species, scalloped hammerhead shark, and adult corals in the MITT Action Area.

2. As practicable, develop procedures to aid any individuals of an ESA-listed marine mammals, sea turtle species, scalloped hammerhead shark, and adult corals that have been impacted by DoD and USCG training and testing activities and is in a condition requiring assistance to increase likelihood of survival.

3. Continue to model potential impacts to ESA-listed species using NAEMO and other relevant models; validate assumptions used in risk analyses; and seek new information and higher quality data for use in such efforts.

4. Continue technical assistance/adaptive management efforts with NMFS to help inform future consultations on DoD and USCG training and testing in the MITT Action Area.

5. The Navy should coordinate with NMFS to monitor for presence of ESA-listed corals in and around the Piti Point Mine Neutralization site and Underwater Detonation Sites within Apra Harbor, Guam to ensure the absence of these species and to avoid interactions.

6. The Navy should coordinate with NMFS to understand scalloped hammerhead shark abundance and density estimates for the MITT Action Area.

7. The Navy should explore methods to better quantify behavioral take of sea turtles not rising to the level of TTS.

8. The Navy should explore methods to better quantify the risk of vessel strike to sea turtles.

In order for NMFS to be kept informed of actions minimizing or avoiding adverse effects or benefitting listed species or their habitats, NMFS requests notification of the implementation of any conservation recommendations.

11 REINITIATION OF CONSULTATION

This concludes formal consultation on proposed Mariana Islands Training and Testing activities the DoD and USCG will conduct from August 2015 through August 2020. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, the U.S. Navy and NMFS' Permits Division must contact the ESA Interagency Cooperation Division, Office of Protected Resources immediately.

12 INFORMATION QUALITY ACT

Section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001 (Public Law 106-554, AKA the Data Quality Act or Information Quality Act) directed the Office of Management and Budget (OMB) to issue government-wide guidelines that "provide policy and procedural guidance to federal agencies for ensuring and maximizing the quality, objectivity, utility, and integrity of information (including statistical information) disseminated by federal agencies." OMB complied by issuing guidelines which direct each federal agency to 1) issue its own guidelines; 2) establish administrative mechanisms allowing affected persons to seek and obtain correction of information that does not comply with the OMB 515 Guidelines or the agency guidelines; and 3) report periodically to OMB on the number and nature of complaints received by the agency and how the complaints were handled. The OMB Guidelines can be found at:

http://www.whitehouse.gov/omb/fedreg/reproducible2.pdf

The Department of Commerce Guidelines can be found at:
http://ocio.os.doc.gov/ITPolicyandPrograms/Information_Quality/index.htm

The NOAA Section 515 Information Quality Guidelines, created with input and reviews from each of the components of NOAA Fisheries, went into effect on October 1, 2002. The NOAA Information Quality Guidelines are posted on the NOAA Office of the Chief Information Officer Webpage. http://www.cio.noaa.gov/Policy_Programs/info_quality.html

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United States Department of the Interior

FISH AND WILDLIFE SERVICE

Pacific Islands Fish and Wildlife Office
300 Ala Moana Boulevard, Room 3-122
Honolulu, Hawaii 96850

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In Reply Refer To:
01EPIF00-2014-F-0262

Rear Admiral Bette Bolivar
Department of the Navy
Joint Region Marianas
Building 200, Room 326
Halsey Drive, Nimitz Hill
Piti, Guam 96915

Subject: Mariana Islands Training and Testing Program

This document transmits the U.S. Fish and Wildlife Service's (Service) Biological Opinion (Opinion) addressing the subject action as proposed by the Department of the Navy (Navy). The Navy is serving as the lead Federal agency for implementation of Department of Defense (DoD) readiness training under the Mariana Islands Training and Testing (MITT) program. At issue are the effects of the proposed action on the threatened Mariana fruit bat (*Pteropus mariannus mariannus*) and the endangered Micronesian megapode (*Megapodius laperouse*). The enclosed Opinion was prepared in accordance with the requirements of section 7 of the Endangered Species Act (ESA) of 1973 as amended (16 U.S.C. 1531 et seq.). The Service initiated formal consultation on the proposed MITT program on August 4, 2014 (Service 2014a).

This Opinion is based primarily on information provided in: (1) the Navy's Biological Assessment (BA) for the MITT program, dated August 2014, as amended (Navy 2014a,b); (2) the Service's Opinion addressing the U.S. Air Force's (USAF) Intelligence, Surveillance, Reconnaissance, and Strike Capability (ISR Strike) project (Service 2006a); (3) the Service's Opinion on the Mariana Islands Range Complex (MIRC) program (Service 2010a), as amended (Service 2013a, 2014a), on which the MITT program is based; and (4) other sources of information cited herein. A complete decision record for this consultation is on file at the Service's Pacific Islands Fish and Wildlife Office (PIFWO).

This Opinion also serves as the ESA section 7 compliance document for the proposed MITT program for the Navy, USAF, U.S. Army, U.S. Coast Guard, and the U.S. Marine Corps.

CONSULTATION HISTORY

On October 3, 2006, the Service issued an Opinion to the USAF addressing the ISR Strike action. The conservation measures included in the proposed action subsequently became a component of the MIRC program. That Opinion (Service 2006a) is herein incorporated by reference.

On February 22, 2010, the Service issued an Opinion to the Navy addressing the MIRC program. That Opinion (Service 2010a) and amendments to that Opinion dated June 27, 2013 and June 11, 2014 are herein incorporated by reference (Service 2013a, 2014a).

On April 3, 2014, the Navy transmitted a letter requesting the reinitiation of formal consultation and the BA for the MITT program, formerly identified as the MIRC program.

On May 9, 2014, the Service determined that the information in the BA was insufficient to initiate the consultation and requested additional information from the Navy on the MITT program.

On June 19, 2014, the Navy transmitted an addendum to the BA for the MITT program (Navy 2014b) in response to the Service's May 9, 2014, request.

On August 7, 2014, the Service formally advised the Navy that formal consultation had been initiated on the proposed MITT program.

On October 31, 2014, the Navy informally amended (via email) the BA for the MITT program based on discussions with the Service during October of 2014. The Navy and the Service corresponded by email on multiple occasions during November of 2014 to clarify aspects of the proposed MITT program and the findings presented in the BA.

On November 6, 2014, the Navy confirmed via an email to the Service that the Navy had made "no effect" determinations relative to the proposed MITT program for the following listed species and critical habitats: the endangered hayun lagu (*Serianthes nelsonii*), *Osmoxylon mariannense*, *Nesogenes rotensis*, Guam Micronesian kingfisher (*Todirhamphus c. cinnamominus*), Guam rail (*Gallirallus owstoni*), short-tailed albatross (*Phoebastria albatrus*), Hawaiian petrel (*Pterodroma sandwichensis*), and Rota bridled white-eye (*Zosterops rotensis*), the threatened Newell's shearwater (*Puffinus auricularis newelli*), Rota bridled white-eye critical habitat on Rota, Mariana crow critical habitat on Guam and Rota, Mariana fruit bat critical habitat on Guam, and Guam Micronesian kingfisher critical habitat on Guam.

On December 18, 2014, the Service provided a draft of this Opinion to the Navy for review and comment.

On January 9, 2015, the Service received comments from the Navy on the draft Opinion.

On January 22, 2015, the Navy provided a comprehensive list of conservation measures for the MITT program. The Navy also provided clarification regarding sea turtle conservation measures that were previously agreed to by the Navy in December 2014.

On February 20, 2015, the Navy provided a final revised list of conservation measures for the MITT program.

On February 20, 2015, the Service formally advised the Navy that we concur with the determinations in the BA that the proposed MITT program is not likely to adversely affect the threatened green sea turtle (*Chelonia mydas*), endangered hawksbill turtle (*Eretmochelys*

imbricate), endangered nightingale reed-warbler (*Acrocephalus luscinia*), endangered Mariana crow (*Corvus kubaryi*), endangered Mariana swiftlet (*Aerodramus bartschi*), and the endangered Mariana common moorhen (*Gallinula chloropus guami*).

DESCRIPTION OF THE PROPOSED ACTION

As noted above, the proposed MITT program is an amendment of the MIRC program currently being carried out by the Navy, U.S. Air Force, U.S. Army, U.S. Coast Guard, and the U.S. Marine Corps on Guam, Rota, Tinian, Saipan, and Farallon de Medinilla (FDM). The Navy continues to be the designated lead Federal action agency for purposes of conducting ESA consultation on this action. The BA for the MITT program is herein incorporated by reference and includes a detailed description of the proposed action. In general, the proposed MITT program involves strike warfare and use of FDM, amphibious warfare on Guam and Tinian, Naval special warfare on Guam, Rota, Tinian, Saipan, and FDM, and other activities described below; see also Table 1-1 in the BA.

According to the BA, the types of proposed training activities under the MITT program are the same as those being implemented under the MIRC program, but with increases in the number of training activities that would occur within the Action Area. In particular, the "…cumulative net explosive weight (NEW) for munitions use on FDM would increase…" under the proposed MITT program.

According to the addendum to the BA, as proposed, the MITT program would be implemented into the "reasonable foreseeable future", which has been interpreted by the Service to mean an indefinite period of time within the context of our analysis. In addition, the BA includes the following increases in training activities compared to levels currently being implemented under the MIRC program:

Strike Warfare and Use of FDM. The number of activities, the amount of ordnance, and the use of rockets would increase on FDM. The increase in activities pertains to bombing, gunnery, and missile exercises. The increase in activities will result in a higher NEW being expended, as measured cumulatively over the course of a year.

Amphibious Warfare on Guam and Tinian. The number of amphibious warfare training activities, amphibious assaults, amphibious raids, and urban warfare training and noncombatant evacuation actions would increase on Guam and Tinian.

Naval Special Warfare on Guam, Rota, Tinian, Saipan, and FDM. Within these four islands, there would be an increase in personnel insertion/extraction, parachute insertion, direct action (combat close quarters), direct action (breaching), and tactical (air control party) training activities as well as humanitarian assistance/disaster relief operations. Firing exercises that target the Naval Surface Fire Support targets (i.e., cliff targets on FDM) are also included under the MITT program.

Naval special warfare activities that do not change relative to those currently being implemented under the MIRC program include intelligence, surveillance, and reconnaissance activities as well as embassy reinforcement exercises. These activities primarily occur on Guam, but Rota, Tinian,

and Saipan may also be used. Military training based out of the Rota International Airport for combat search and rescue currently being implemented under the MIRC program would not change under the MITT program.

Other Activities. Under the MITT program, water purification activities are proposed. All other training activities currently being implemented under the MIRC program relative to convoy and navigation maneuvers, field training exercises, force protection, anti-terrorism, seize airfield, airfield expeditionary, and land demolitions would continue under the MITT program.

The proposed increases in the frequency of the above training activities are discussed in detail in Appendix A of this Opinion.

Conservation Measures for ESA-listed Species. In response to a request from the Service during this consultation, the Navy provided (via email) the Table in Appendix B characterizing the current conservation measures being implemented under the MIRC program and those proposed under the MITT program. Included are specific measures for brown treesnake (BTS) control and interdiction, specific measures to avoid and minimize invasive species transport and introduction, and specific measures to provide for a rapid response to such introductions. These conservation measures are incorporated into the proposed action. These measures are also detailed in the Effects of the Action section, below.

Term of the Proposed Action. As discussed above and in the addendum to the BA (Navy 2014b), and recognizing that DoD requirements change overtime in response to global or geopolitical events and other factors, the activities addressed by this consultation are expected to continue into the reasonably foreseeable future, along with associated impacts. This timeframe is generally assumed to be no less than 5 years, but for purposes of this consultation, we interpret to mean the proposed activities, and associated adverse effects to the listed species, may continue into the future for an indefinite period of time.

DESCRIPTION OF THE ACTION AREA

The term "action area" is defined in the implementing regulations for section 7 at 50 CFR 402.02 as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action."

The action area for this consultation includes portions of Guam, Rota, Tinian, and Saipan, plus the entire island of FDM. The specific areas likely to be affected, directly or indirectly, by the proposed action are discussed in detail in the BA.

ANALYTICAL FRAMEWORK FOR THE JEOPARDY DETERMINATION

The analysis in the following sections relies on four components to support the jeopardy determination for each of the listed species considered herein: (1) the *Status of the Species*, which evaluates the species' range-wide condition, the factors responsible for that condition, and its survival and recovery needs; (2) the *Environmental Baseline*, which evaluates the condition of the species in the action area, the factors responsible for that condition, and the relationship of

the action area to the survival and recovery of the species rangewide; (3) the *Effects of the Action*, which determines the direct and indirect impacts of the proposed Federal action and the effects of any interrelated or interdependent activities on the species; and (4) *Cumulative Effects*, which evaluates the effects of future, non-Federal activities in the action area on the species.

In accordance with the implementing regulations for section 7 and Service policy, the jeopardy determination is made in the following manner: the effects of the proposed Federal action are evaluated in the context of the aggregate effects of all factors that have contributed to the species' current status and, for non-Federal activities in the action area, those actions likely to affect the species in the future, to determine if implementation of the proposed action is likely to cause an appreciable reduction in the likelihood of both the survival and recovery of the species in the wild.

STATUS OF THE SPECIES

Micronesian Megapode

The Micronesian megapode, once referred to as LaPerouse's megapode, was federally listed as endangered in 1970 (Service 1970, p. 8,496). No critical habitat has been designated for this species. The recovery plan for the Micronesian megapode was finalized in 1998 (Service 1998, pp. 62). The most recent five-year status review addressing the megapode was completed in 2010 (Service 2010b).

The Micronesian megapode is endemic to Guam, the Commonwealth of the Northern Mariana Islands (CNMI), and Palau. Populations on Guam and Rota are considered extirpated (Service 1998, p. 3; Stinson 1992, p. 220; Amidon and Kessler, 2009; pers. comm.). The megapode population on Anatahan was thought to have been extirpated after the 2003 Anatahan eruption, but have recolonized since (Kessler 2006, p. 3; Kessler 2009, pers. comm.; Amidon et al. 2011, p. 28). Currently, megapodes from Micronesia and Palau are considered different races of the same species, *M. l. laperouse* and *M. l. senex*, respectively (Service 1998, p. 4-5).

In general, the population status and rangewide trends of the Micronesian megapode are difficult to assess because population data have been collected and estimates have been made using a variety of methods at differing time periods. Increases and decreases in population numbers may be indicative of population trends or may reflect detection bias from implementing different survey and data analysis methods. Recent surveys and modeling suggest that islands with low human presence and without ungulates have the highest densities of the Micronesian megapode (Amidon et al. 2011).

In 2010, a survey for the Micronesian megapode was conducted in the Northern Mariana Islands. Based on the results of the 2010 surveys and previous surveys on FDM, Tinian, and Aguiguan, the rangewide population of the megapode is estimated to be a minimum of 10,827 individuals (Table 1; Amidon et al. 2011, p. 29; Service 2009b).

Table 1. Micronesian megapode population estimates based on 2010 surveys

Island	Estimated Population
Alamagan	529
Asuncion	5,714
Guguan	1,507
Maug	544
Pagan	147
Saipan	151
Sarigan	2,135
Total	10,727

Individual megapodes detected on Tinian are likely transients (Radley 2009, pers. comm.; Camp et al. 2009, p. 12; Service 2009b, p. 124; Service 1998, p. 19). FDM and Aguiguan have small megapode populations that are likely stable with the reported increase in these populations largely being attributed to improved survey methods and differences in data analysis (Service 2009b, p.124; Vogt 2009a, p. 3). However, it is also possible that the reported increase on FDM is due to dispersal of Micronesian megapodes from Anatahan due to recent volcanic eruptions (Vogt 2009, p. 4). At least 20 megapodes are estimated to occur on Anatahan (Amidon et al. 2011). The Micronesian megapode was incidentally observed once on the island of Uracus (Service 1998, p. 35). Uracus does not support forest habitat and is subject to volcanic activity on a sporadic basis, thus the likelihood of the island supporting a megapode population is low (Service 1998, p. 35).

The Micronesian megapode can use a variety of habitat types. Typically, native and secondary forest are considered the primary habitats for foraging while nesting may occur in forests, open fields, cinder and ash fields, and coastal strand edges with sand substrates. The Micronesian megapode is generally restricted on Saipan and Tinian to native limestone forest remnants along and below cliff lines and in secondary forest adjacent to limestone forest (Service 1998, p. 11). However, the association with cliff lines is likely an artifact of the location of the native forest as these uneven areas are generally the only native forest strands that were not disturbed during the long history of habitat removal on Saipan and Tinian (Service 1998, p. 11). Micronesian megapodes have been observed using tangantangan forests on Saipan (Glass and Aldan 1988, p. 142). On Aguiguan, megapodes typically occur in limestone and secondary forests, and have been observed in *Lantana* sp. scrub, but not in open areas of weedy vegetation (Service 1998, p. 11; Amidon and Kessler 2009, pers. comm.). On FDM there are stunted trees (about 7-13 feet tall) but no forest habitat (Vogt 2009a, p. 5). Micronesian megapodes were detected on FDM wherever tree or shrub cover was present (Vogt 2009, p. 5). Megapodes on islands north of FDM are present in forested habitats, including coconut forest and other native vegetation (Service 1998, pp. 11-12).

The Micronesian megapode is vocal and has been documented to duet (Service 1998, pp. 5-6 and references within). Duetting is correlated with year-round territoriality and prolonged monogamous pair bonds (Farabaugh 1982, p. 93). Duetting by the Micronesian megapode has been documented in each month of the year (Service 1998, p. 6 and references within; Amidon and Kessler 2009; pers. comm.). Glass and Aldan (1988, p. 141) reported that megapodes on Saipan remain together throughout the year in territories that are defended at least part of the year. Territory size was estimated between 2.47 acres and approximately 9.4 acres depending on the habitat type (Glass and Aldan 1988, pp. 141-142; Service 2009b, p. 124 and 126). Megapode dispersal between islands of the CNMI is not well documented. On Palau, megapodes are known to fly several miles between islands (Pratt et al. 1980, p. 121) and other species of megapodes are considered to be strong fliers (Dekker 1989, p. 317 and references within). We expect that the Micronesian megapode could fly between Saipan and Tinian (2.9 miles) or between Tinian and Aguiguan (5.5 miles) (Service 1998, pp. 9-10). The northern islands in the CNMI are 18 to 37 miles apart. Although no megapodes have been observed flying over the ocean in the Mariana Islands, anecdotal information regarding fluctuations in numbers on Tinian and the recolonization of Anatahan post-eruption suggests that they do fly between islands (Amidon et al. 2011, p. 5). Glass and Aldan (1988, p.135) reported that megapodes may have been transported by humans between islands within the CNMI, which may have assisted in maintaining its widespread distribution.

The Micronesian megapode is omnivorous and forages under ferns, branches, and leaf litter on the forest floor and in trees within bird's nest ferns (*Asplenium nidus*) (Glass and Aldan 1988, p. 142). Its diet includes seeds and other plant matter, beetles, ants, ant larvae, and other insects and crabs (Glass and Aldan 1988, p. 142; Pratt et al. 1980, p. 121; Stinson 1992, p. 230).

The reproductive cycle of the Micronesian megapode is not well understood. Megapodes, including the Micronesian megapode, do not incubate their eggs with their own body heat. Instead, megapodes will construct burrows or mounds at beaches and cinder fields, or at geothermal sites that provide heat for egg incubation. Micronesian megapodes also will make burrows or mounds in between the roots of trees and in soil with decomposing vegetation where heat generated from decomposing organic materials incubates the eggs (Decker et al. 2000, p. 2; Wiles and Conry 2001, p. 270; Glass and Aldan 1988, pp. 135-137). Micronesian megapodes lay large eggs (approximately 18 percent of the female body weight); however, the total number of eggs laid per female per breeding season, the interval between laying eggs, and the incubation period are unknown (Service 1998, p. 9 and references within). Other species of megapodes lay between 10 and 13 eggs per year (Service 1998, p. 9 and references within). In other species of megapode, eggs are laid one at a time, with each egg laid between 9 and 13 days apart (Service 1998, p. 9 and references within). Megapode chicks are precocial and able to fly upon emergence from the egg and nest (Service 1998, p. 9).

Breeding by the Micronesian megapode has been observed (eggs, chicks, and juveniles) on Anatahan, Sarigan, Guguan, Pagan, Agrihan, and Maug during all months except October, November, and December (Service 1998, pp. 6-7 and references within; Amidon and Kessler 2009; pers. comm.). The absence of breeding activity in October, November, and December is more likely a reflection of the lack of surveys during these months, and difficulty in finding megapodes during traditional avian surveys (Amidon and Kessler 2009, pers. comm.).

Factors Influencing the Current Rangewide Condition of the Micronesian Megapode

The Micronesian megapode is threatened by habitat loss and degradation due to agriculture, military operations, urban development, volcanic activity, wildfire, invasive vegetation species, overgrazing by feral ungulates (Service 1998, pp. 35-38); predation by dogs, cats, monitor lizards, pigs, and possibly rats (Dekker 1989, pp. 318-320; Dekker et al. 2000, p. 5 and references within; Service 1998, p. 37); and human exploitation (Dekker et al. 2000, p. 2; Service 1998, p. 37; Vogt 2009, p. 5; Amidon and Kessler 2009, pers. comm.). Threats from competition and disease are not well understood, but are possible. Competition for nesting and foraging areas is possible if introduced game birds and domestic or feral chickens (which forage on the same prey items as megapodes) become established in megapode habitats (Service 1998, p.38; Vogt 2009, p. 6). Additionally, the import of game birds or chickens and existing feral chicken colonies on Rota, Tinian, Saipan, Anatahan, Alamagan, and Pagan could expose megapodes to avian diseases (Service 1998, pp. 38-39), as many of these species are susceptible to West Nile virus (UC Davis 2009, pp. 2-3).

The possibility of avian flu or West Nile virus reaching the Mariana Islands from Asia or the U.S. mainland is a recent concern. The impact these two diseases may have on the Micronesian megapode is not known at this time, but both diseases have had deleterious impacts to many avian species elsewhere, and could negatively affect the Micronesian megapode if they reach the Mariana Islands. Another unknown is the potential impact of climate change on ecosystems in the Mariana Islands.

Conservation Needs of the Micronesian Megapode

The most recent 5-year status review for the Micronesian megapode (Service 2010b) lists the following conservation needs for this species:

- Survey, protect, and manage existing populations.
- Conduct essential research on the ecology and biology.
- Assess and control threats.
- Promote expansion of megapodes in suitable habitat.
- Monitor megapode populations.
- Continue implementation of BTS interdiction and control plans and establish new plans as needed.

The recovery plan for the Micronesian megapode (Service 1998) includes the following criteria for downlisting and delisting:

Downlisting Criteria

The following steps must be accomplished for downlisting: (1) a BTS interdiction and control plan must be in place and implemented throughout the Mariana Islands; (2) current threats to all extant megapode populations must be assessed and controlled; and (3) the comparatively large populations of the megapode on Anatahan, Sarigan, Guguan, Pagan, and Maug must remain at their current population levels or be increasing for 5 consecutive years.

Delisting Criteria

The total number of Micronesian megapodes in the Mariana Islands should be at least 2,650 birds distributed over 10 islands, including at least 2 populations of 600 birds or greater, 3 populations of 300 or greater, 2 populations of 200 or greater, and 3 populations of 50 or greater. All populations must be stable or increasing for 5 consecutive years after achieving these levels.

At this time, none of the recovery criteria in the recovery plan have been met. Of particular concern is the lack of an archipelago-wide BTS interdiction and control plan.

STATUS OF THE MARIANA FRUIT BAT

Species Description. The Mariana fruit bat or flying fox, known as "fanihi" in Chamorro, is a medium-sized fruit bat in the family *Pteropodidae* that weighs 0.66 to 1.15 pounds. Males are slightly larger than females. The underside (abdomen) is black to brown with gray hair interspersed that creates a grizzled appearance. The shoulders (mantle) and sides of the neck are bright golden brown, but may be paler in some individuals. The head varies from brown to dark brown. The well-formed, rounded ears and large eyes give the face a canine appearance.

Listing Status. The Guam population of the Mariana fruit bat was listed as endangered in 1984 (Service 1984). In 2005, the subspecies was listed as threatened throughout the Mariana archipelago and downlisted to threatened on Guam (Service 2005); that rule includes a complete five-factor analysis of the species' status, life history requirements, habitat needs, threats, and management efforts to conserve the Mariana fruit bat. On October 28, 2004, approximately 376 ac were designated as critical habitat for the Mariana fruit bat on Guam (Service 2004). All of the critical habitat for this species is designated on the fee simple portion of the Guam National Wildlife Refuge.

Distribution, Numbers, and Reproduction

Historic and Current Distribution. This subspecies of *Pteropus mariannus* is endemic to the Mariana archipelago, where it is present on most of the 15 islands. To the best of our knowledge, there are no records of fruit bats on Uracas, and only a few incidental observations of fruit bats have occurred on FDM (see Environmental Baseline section below). No known historical records exist to document the status of the Mariana fruit bat prior to the 20th century.

The total population of the Mariana fruit bat is estimated to be approximately 6,000 animals (USGS 2010, p. 36; CNMI 2011, p. 6). Surveys suggest populations are stable or declining throughout most of their range. Surveys on most or all of the islands in the archipelago were

conducted in 1983 (Wiles et al. 1989), 2000 (Cruz et al. 2000a-f), 2001 (Johnson 2001), and 2010 (USGS 2010, p. 1). The relatively isolated northern islands support the majority of the fruit bats in the archipelago, but because of their remote location, these islands have not been surveyed as frequently as the southern islands (i.e., Saipan, Tinian, Aguiguan, and Rota). Individual surveys have been conducted on several of the southernmost islands at relatively frequent intervals (e.g., USGS 2010, Kessler 2000; Worthington et al. 2001; Wiles and Johnson 2004). A comparison of survey results was excerpted from the USGS 2010 report (see Table 2 below). An interpretation of these data indicates a 41 percent decline in fruit bat numbers between 1983 and 2010 in the northern islands. The majority of this decline was recorded on two of the three largest northern islands, Anatahan and Pagan, which together harbored roughly 70 percent of the archipelago's fruit bats in the 1980s (Wiles et al. 1989).

A notable exception to the declining trend is the island of Rota, where the population has increased since 2008 (CNMI 2008, p. 11; CNMI 2011, p. 6). The population increase on Rota is due to a recent decrease in illegal hunting at roost sites of fruit bat maternity colonies, and the decrease in illegal hunting can be attributed to an increase in enforcement of wildlife regulations that began in 2009 (CNMI 2010, pp. 7-9).

The fruit bat population on Rota is estimated at approximately 2,600 (CNMI 2011; p. 6). Although comprehensive surveys have not been conducted on Saipan, there have been no confirmed observations of maternity colonies in recent years, and the island-wide population is expected to be less than 50 individuals (T. Willsey, pers. comm. 2014). On Guam, the sighting of fruit bats was considered to be "not...uncommon" in the 1920s (Crampton 1921). Woodside (1958) reported that in 1958, the Guam population was estimated to number no more than 3,000, although the method used to make this estimate is not known. This estimate had dropped to between 200 and 750 animals by 1995 (Wiles et al. 1995, Wiles 1996). The current population of fruit bats on Guam is estimated to be less than 30 bats (SWCA 2013, pp. 19-22; NAVFAC 2013, pp. 11-15). The most recent and last colony to exist on Guam was at Pati Point, but recent surveys indicate that this colony no longer exists (SWCA 2013, pp. 19-22). On July 3, 2014, a morning survey was conducted on Andersen Air Force Base which resulted in the observation of ten bats; however the data is being analyzed to determine duplicate observations and detection probability given the amount of area surveyed on the Base (Mildelstein 2014).

Ecology. During the day, Mariana fruit bats roost in colonies of a few to over 800 individuals (Wiles 1987; Pierson and Rainey 1992; Worthington and Taisacan 1995). Bats are typically grouped into harems (one male and two to 15 females) or bachelor groups (predominantly males). Some single males reside at the colony's periphery (Wiles 1987a). On Guam, the average estimated sex ratio in one colony varied from 37 .5 to 72. 7 males per 100 females (Wiles 1982a).

Table 2. Summary of the maximum number of bats counted in 2010 (USGS 2010, p. 36).

Summary of the maximum number of bats counted at Anatahan, Sarigan, Guguan, Alamagan, Pagan, Agrihan, Asuncion, and Maug from this study and minimum population estimates reported by Johnson (2001), Cruz and others (2000a-f), and the 1983 findings by Wiles and others (1989). Superscripts denote method(s) used to arrive at the maximum number of bats counted or minimum population estimate. Asterisks denote studies with some island estimates that were arrived from multiplying counts by a correction factor; adjusting counts based on size of island, amount of forest cover, plant diversity and abundance; or combination of these variables.

Island	2010	2001*	2000*	1983*
Anatahan	150[a]	1,000[g]	1,000[b,e,f]	3,000[c,f]
Sarigan	157[b]	400[a,b,d]	150-200[b,e,f]	125[e]
Guguan	226[c]	550[b]	350[b,c,e,f]	400[e]
Alamagan	86[d]	100[g]	200[e,f]	0[e]
Pagan	1,017[d]	1,500[a,b,c]	1,500[c,e,f]	2,500[c,f]
Agrihan	858[d]	1,000[a]	1,000[b,c,e,f]	1,000[c,e]
Asuncion	573[b]	800[a,e,f]	NA	400[e]
Maug	11[b]	50[g]	NA	<25[g]
TOTAL	**3,078**	**5,400**	**NA**	**7,450**

a. Visual estimate from helicopter.
b. Direct counts of bats at roosts.
c. Exit count of bats at roosts.
d. Counts of bats in photograph taken from helicopter.
e. Evening flight activity count (aka, station count).
f. Visual sightings from the ground.
g. Estimate not based on a count taken during that study.

Reproduction in Mariana fruit bats has been observed year-round on Guam (Perez 1972; Wiles 1983) and on Rota; individual females have a single offspring each year (Pierson and Rainey 1992). Wiles (1987) found no apparent peak in births on Guam, but a peak may occur in May and June on Rota (Glass and Taisacan 1988). Although specific data for the Mariana fruit bat are lacking, female bats of the family *Pteropodidae* have one offspring per year, generally are not sexually mature until at least 18 months of age, and have a gestation period of four to six months (Pierson and Rainey 1992). The average lifespan of this species is unknown; the longevity of a similar species in Australia is four to five years, with a maximum of eight years (Yardon and Tidemann 2000).

Roost sites are an important aspect of the Mariana fruit bat's biology because they are used not only for sleeping, but also for grooming, breeding, and intra-specific interactions (Service 1990). Published reports of roost sites on Guam indicate these sites occur in mature limestone forest and are found within 262 to 328 ft of tall cliff lines (Service 1990). On Guam, Mariana fruit bats prefer to roost in mature *Ficus* spp. and *Mammea odorata* trees, but will also roost in other tree species such as *Casuarina equisetifolia, Macaranga thompsonii, Guettardaspeciosa,* and *Neisosperma oppositifolia* (Wheeler and Aguon 1978; Wiles 1981, 1982b). On other islands in the Mariana archipelago, Mariana fruit bats have been observed in secondary forest and *Casuarina equisetifolia* groves (Glass and Taisacan 1988, Worthington and Taisacan 1996,

Worthington et al. 2001). Factors involved in roost site selection are not clear, but data from Guam indicate that some sites may be selected due to their inaccessibility by humans. Fruit bats may abandon roost sites if disturbed (Julia Boland, Service, pers. comm. 2015). Fruit bats have been reported to move to new locations up to six miles away in response to disturbance (Service 1990).

Several hours after sunset, bats depart their roost sites to forage for fruit and other native and non-native plant materials such as leaves and nectar (Service 1 990). This species feeds on a variety of plant material but is primarily frugivorous (Wiles and Fujita 1992). Specifically, Mariana fruit bats forage on the fruit of at least 28 plant species, the flowers of 15 species, and the leaves of two plant species (Wiles and Fujita 1992). Some of the plants used for foraging include *Artocarpus* sp., *Carica papaya, Cycas circinalis, Ficus* spp., *Pandanus tectorius, Cocosnucifera,* and *Terminalia catappa.* Many of these plant species are found in a variety of forested habitats on Guam, including limestone, ravine, coastal, and secondary forests (Stone 1970; Raulerson and Rhinehart 1991). Little is known about their nightly movements, but fruit bats have been observed foraging as far as 7 miles from roosting sites on Guam (Wiles et al. 1995).

Factors Influencing the Current Rangewide Condition of the Mariana Fruit Bat

The loss and degradation of native forest, illegal hunting of the species, and predation by the BTS are the primary threats to the survival of the Mariana fruit bat in the wild (Service 2005).

Conservation Needs of the Mariana Fruit Bat

A draft revised recovery plan for the Mariana fruit bat (Service 2009a) addressed actions needed for the survival and recovery needs of the Mariana fruit bat. Since publication of the draft revised recovery plan new information on the Mariana fruit bat has resulted in changes to how we look at recovery for the species. We now consider recovery in terms of stable or increasing subpopulations of sufficient size distributed across Guam and the Mariana Islands. To meet recovery objectives, stable or increasing fruit bat subpopulations should at a minimum be distributed on the islands that currently have extant populations. Actions to address the survival and recovery needs of the Mariana fruit bat are listed below (Service 2009a):

- Outreach, education, and enforcement programs need to be implemented to control illegal hunting of the Mariana fruit bat.

- Sufficient amounts of functional habitat need to be protected and restored to support persistent subpopulations of the Mariana fruit bat.

- Ungulates on Guam, Rota, Tinian, Aguiguan, and Saipan need to be controlled.

- Invasive plant species that limit native forest persistence and sustainability in areas supporting fruit bat subpopulations need to be controlled.

- Control of the BTS threat on Guam and prevention of the introduction of the BTS elsewhere within the Mariana Islands needs to be achieved.

- Control and management of other invasive species on the Mariana Islands and prevention of further inter-island transport and introduction of invasive species on the Mariana Islands needs to be achieved.

- Development and implementation of conservation projects is needed on Federal and non-Federal lands that are necessary to support persistent subpopulations of the Mariana fruit bat.

- Additional fruit bat monitoring and research is needed to better inform effective subpopulation management.

ENVIRONMENTAL BASELINE

The preamble to the implementing regulations for section 7 of the ESA provides good context for understanding the meaning of the term "Environmental Baseline." On page 19932 of the regulations (51 FR 19926), it states "In determining the "effects of the action," the Director first will evaluate the [rangewide] status of the species or critical habitat at issue. This will involve consideration of the present environment in which the species or critical habitat exists, as well as the environment that will exist when the action is completed, in terms of the totality of factors affecting the species or critical habitat. The evaluation [of the rangewide status of the species] will serve as the **baseline** [emphasis added] for determining the effects of the action on the species or critical habitat. The specific factors that form the environmental baseline are given in the definition of "effects of the action…"

Under the regulatory definition of "Effects of the action" at 50 CFR 402.02, it states: "…The environmental baseline **includes** [emphasis added] the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process." Use of the term "includes" referenced above acknowledges that the environmental baseline considers the present range-wide environment in which the species or critical habitat exists as well as the specific environmental conditions in the action area. The discussion of Environmental Baseline below addresses the current condition of the listed species in the action area, the factors responsible for that condition, and the role of the action area in the survival and recovery of the species. The findings presented under the *Status of the Species* and the *Environmental Baseline* sections of this Opinion for each listed species addressed herein provide essential context for interpreting the significance of any adverse or beneficial effects of the proposed action considered herein as well as for interpreting the significance of any adverse or beneficial cumulative effects reasonably certain to occur in the action area for this consultation.

Micronesian Megapode

Current Condition of the Micronesian Megapode in the Action Area

The following information supplements the *Status of the Species* discussion above regarding the status of and threats to the Micronesian megapode on the portions of Guam, Rota, Tinian, Saipan, and the FDM that are likely to be affected by the proposed action.

The Micronesian megapode was extirpated from Guam and Rota in the ninetieth and early twentieth centuries (Service 1998, p. 3 and 15). Amidon et al. (2011) reported an anecdotal observation of a megapode on Rota in 2010. If the Micronesian megapode persists on Rota, it is likely confined to limestone forested portions of the island and not collocated with potential training areas.

The few megapode detections on Tinian are likely transient individuals that do not breed there (O'Daniel and Kreuger 1999, Navy 2013a,b). Megapodes have been sighted within forested portions of the Maga area to the northwest of the Voice of America Relay Station, a small section of native forest adjacent to Cross Island Road in the Bateha area, and the Mount Lasso area south of the overlook on the ridgeline (O'Daniel and Kreuger 1999). Based on these sightings and other suitable habitat indicators, the Navy-established monitoring transects in 1999, which were surveyed on a monthly basis through 2011 using point count stations where trained observers listened for responses to recorded megapode vocalizations. The Navy re-evaluated this methodology and determined that a larger survey conducted approximately once per year would be more likely to detect megapodes (Navy 2013b). One megapode was observed on Tinian in February of 2013 using this new methodology. Prior to this detection, one megapode was observed in February 2004 and two others in June 2005 by biologists transiting between point count stations (Navy 2013b).

The action area on Tinian includes the Exclusive Military Use Area, which consists of 7,600 acres of land in the northern one-third of Tinian (Navy 2009, p. 3.11-26). The Exclusive Military Use Area is leased by DoD from the CNMI. The action area on Tinian also includes the Military Lease Back Area, which includes the central one-third of the island and consists of 7,800 acres (Navy 2009, p. 3.11-27). Habitats on Tinian pre-World War II were extensively altered for agriculture. Military actions (both bombing during World War II, reconstruction, and ongoing training), fire, and invasive vegetation species encroachment continue to shape the habitat. Currently, both military areas support lowland habitats consisting of native forest, tangantangan thickets, secondary growth forests, and open fields (Navy 2009, pp. 3.11-26, 3.11-28). Although Micronesian megapodes were not detected on Tinian during 2008 (Service 2009b, p. 124), both action areas on Tinian support foraging and roosting habitat for the Micronesian megapode (Navy 2009, pp. 3.11-26, 3.11-44). Incidental reports and regular sightings (1995 to 2005) of the Micronesian megapode on Tinian indicates that either a small but persisting population of Micronesian megapodes exists on Tinian or that Micronesian megapodes routinely use habitats on Tinian when flying between Aguiguan and Tinian or Tinian and Saipan (Service 1998, pp. 10, 18; Navy 2009, p. 3.11-44). Due to the presence of suitable habitat and the occasional but routine observations of Micronesian megapodes on Tinian, the Micronesian megapode is at least transient and reasonably certain to occur within the Military Lease Area on Tinian.

On Saipan, Amidon et al. (2011) estimated a population between 130 and 174 Micronesian megapodes. Previous studies on Saipan provide lower island-wide population estimates, but these lower estimates are likely due to a less thorough survey effort relative to the 2010 surveys on Saipan (Amidon et al. 2011). Almost all of the detections of the megapode on Saipan occurred in native limestone forest, including detections in small remnant patches of limestone forest. Amidon et al. (2011) surveyed a transect adjacent to the Marpi Maneuver Area, and verified the continued persistence of a megapode population below the Marpi cliffs (the Marpi Maneuver Area is north of and below the Marpi cliffs). Remnant patches of limestone forest occur within the Marpi Maneuver Area, and may support Micronesian megapodes (Navy 2014a, p. 57). Figure 3-5 in the BA shows the distribution of megapode detections by Saipan-based Service staff as of 2013 adjacent to the Marpi Maneuver Area.

On Saipan, the Army Reserve Center and Commonwealth Port Authority actions areas do not support habitat for the Micronesian megapode, nor have megapodes been detected within these areas. The Marpi Maneuver Area is located on the northern portion of the island approximately one mile north and below the cliff line from the Saipan Upland Mitigation Bank (Navy 2009, p. 3.11-24). Craig (1993, pp. 99-100) summarized the habitat disturbance on Saipan and noted the Marpi area, except some of the limestone escarpments, was cleared for sugarcane (*Saccharum officinarum*) cultivation and developed for military operations during World War II. In areas where vegetation was allowed to re-grow post World War II, non-native species are the dominant vegetation. Currently, the Marpi Maneuver Area is still dominated by elephant grass (*Pennistum purpureum*) meadows and tangantangan thicket (Navy 2009, p. 3.11-24 through 3.11-25) and a remnant area of limestone forest (Navy 2009, p. 14) and this area is used to support recreation and tourism, agricultural leases, and homesteads.

Between the cliff line and the Marpi Maneuver Area is a 43-acre protected area for the Micronesian megapode (USEPA 2009, pp. 2, 8). The protected area is known to support at least one Micronesian megapode (Rounds 2009, pers. comm.). Other areas, including tangantangan thickets adjacent to limestone forests and elephant grass meadows adjacent to the Marpi Maneuver Area, are known to support Micronesian megapodes as well (Mosher 2009; Service 2002, p. 8).

The Micronesian megapode may be using scattered tangantangan strands within the Marpi Maneuver Area for feeding, resting, and as a corridor between limestone forests. Because of the continued sightings of the Micronesian megapode in adjacent limestone forest, the Micronesian megapode is reasonably certain to occur within the Marpi Maneuver Area on Saipan (Shelly Kremer, Service, pers. comm. 2015).

FDM is leased by the DoD from the CNMI and is approximately 183 acres in size (Navy 2009, p. 3.11-29). Habitat used by the Micronesian megapode on FDM is characterized as predominantly dense herbaceous communities, scrubby brush, stunted trees, grasslands, and bare earth and include the following plant species: *Wollastonua biflora*, *Mariscus javanicus*, *Capparis spinosa*, *Ipomoea pes-caprae*, *Boerhavia* spp., *Portulaca lutea*, *Operculina ventricosa*, and stunted *Pisonia grandis* (Lusk et al. 2000, p. 24; Navy 2009, p. 3.11-30). The habitat is maintained in a low to mid-successional stage due to wind conditions (northern portion) and previous military readiness training (middle and southern portion) (Navy 2009, p. 3.11-61).

Surveys on FDM in 1996 documented the presence of the Micronesian megapode (Lusk et al. 2000; Service 1998). Based on this survey, a population of 10 Micronesian megapodes was estimated to occur on FDM (Lusk et al. 2000; Service 1998). However, due to an approaching typhoon, biologists conducting the survey were only on the island for about 5.5 hours, so this estimate was based on limited data. FDM was surveyed more thoroughly in December 2007 by Navy biologists, who estimated 21 adult megapode pairs on the island (Navy 2008a,b). Vogt (2009, pp. 3, 5) reported the observation of a chick and a juvenile Micronesian megapode indicating that reproduction is occurring on the island. Based on the size of FDM and the potential territory size of the Micronesian megapode, Vogt (2009, p. 4) estimated that the island could likely support a population of 50 megapodes. The most recent megapode survey on FDM was completed in 2013. Navy biologists detected 11 megapodes while surveying a limited transect in the north part of the island (within impact areas 1 and 2) (Navy 2013d). Measures implemented by the Navy under the MIRC program likely minimized impacts to the megapode population on FDM. These measures included maintaining a No Drop Zone on the northern portion of the island and the use of inert ordnance in an area south of the No Drop Zone (explosive ordnance is deployed south of this area). Megapodes have persisted on FDM through various phases of intense bombardment of the island from the 1970s to the present.

Factors Influencing the Condition of the Micronesian Megapode in the Action Area

On Saipan and Tinian, ongoing implementation of the MIRC program is causing noise from aircraft and vehicles, physical disturbance caused by vehicles and people, and the potential for introduction of invasive species are factors that are or may influence the current condition of the Micronesian megapode within the Action Area (see Table 3-2 in the BA).

On FDM, ongoing implementation of the MIRC program is causing noise from aircraft, percussive force caused by explosives, direct strikes by aircraft and munitions, physical disturbance caused by vehicles and people, habitat loss and degradation, the potential for introduction of invasive species, and wildland fire are factors that are or may influence the current condition of the Micronesian megapode (see Table 4-2 in the BA). The avoidance and minimization measures currently being implemented on FDM by the DoN are designed to protect the area of the island occupied by the Micronesian megapode in the "No Drop Zone." As of 2000, Lusk et al. (2000, p. 33) reported that the vegetation and avian communities in that area had not changed substantially since 1974. While these data were not specific to the megapode, this may be an indication that the avoidance and minimization measures are providing some level of protection to the species and its habitats in this area while military training occurs on FDM. However, take of the Micronesian megapode is likely occurring on FDM due to military training activities (Service 2010a).

Role of the Action Area in the Conservation of the Micronesian Megapode

The final recovery plan for the Micronesian megapode identifies the need to maintain a stable or increasing population of 50 megapodes on Saipan or Tinian (Service 1998, p. 43).

Although FDM is not essential for recovery (Service 1998, pp. 42-42), the DoN's implementation of the avoidance and minimization measures discussed above has resulted in the persistence of a small population of Micronesian megapodes in the "No Drop Zone." That

population may provide a genetic link between the northern and southern populations of the rangewide population of the megapode, and FDM may function as a rest stop for dispersing megapodes (Lusk et al. 2000, p. 29).

Mariana Fruit Bat

The following information supplements the *Status of the Species* discussion above regarding the status of and threats to the Mariana fruit bat on the portions of Guam, Rota, Tinian, Saipan, and the FDM that are likely to be affected by the proposed action.

Current Condition of the Mariana Fruit Bat in the Action Area

The following discussion relies heavily on the findings presented in the BA for the proposed MITT program (Navy 2014a) and on the Service's draft revised recovery plan for the Mariana fruit bat (Service 2009a).

Guam

On Guam, the sightings of Mariana fruit bats were considered to be "not...uncommon" in 1920 (Crampton 1921 in Service 2009a). In 1958, the Guam population was estimated to number no more than 3,000. This estimate had dropped to between 200 and 750 animals by 1995. Over the past several decades, the population of fruit bats on Guam has continued to decline (Brooke 2008). Other than a few isolated periods of increase, fruit bats have been in long-term decline on Guam (Service 2009a). The population of fruit bats on Guam is estimated to be less than 30 bats (SWCA 2013, pp. 19-22; NAVFAC 2013, pp. 11-15). The primary threats include poaching, predation (primarily by the BTS on fruit bat pups), and low population size reducing gene flow (Service 2009a). Recently completed and ongoing ESA section 7 consultations between the DoD and the Service include habitat removal actions associated with remedial cleanup activities as part of the Andersen AFB Installation Restoration Program (Consultation # 2013-I-0392, Service 2013), ISR Strike (Consultation # 2006-F-0266, Service 2006a), Parachute Cargo Drop Training at Northwest Field (Consultation # 2001-F-0001, Service 2001), Beddown of Training and Support Initiatives at Northwest Field Project (Consultation # 2006-I-281, Service 2006b) and the missile defense system at Northwest Field (emergency consultation pending). These projects may increase the vulnerability of the Mariana fruit bat to adverse effects caused by the training activities included in the BA for the MITT program.

On Andersen AFB, individual bats and small groups have been observed roosting in both primary (mature and native-dominated) and secondary growth limestone forest cover (Janeke 2006). The majority of the bats at Andersen AFB roosted at a single site on Pati Point, and an unknown number of solitary bats use the limestone and secondary forests of Guam. Fruit bats forage in forests and coastal areas, and they are occasionally sighted at Tarague Beach (USAF 2008a, b, c, d).

The Mariana fruit bat colony on Andersen AFB has used the same roost location at Pati Point since 1994. Except for the punctuated increase in the early 1980s, the overall population trend of this species at this site has been declining. In 2006, Janeke (2006) estimated fewer than 100 fruit bats at Pati Point. A survey conducted on Andersen AFB from June 2007 until April 2008 indicated counts from 31 to 54 individuals with an average count of 40 bats (SWCA

Environmental Consultants 2008). Surveys in 2011 by SWCA observed 2 to 3 bats below Pati Point, but the colony is no longer present and surveys have not found that the colony has relocated (SWCA Environmental Consultants 2012). Northwest Field likely continues to support Mariana fruit bat foraging, and possibly solitary roosts in the intact limestone forests above the plateau at Ritidian Point and along the northeast fringe of Northwest Field.

The Mariana fruit bat is rarely observed at Naval Base Guam. The last recorded fruit bat occurrence on the Orote Peninsula was of a colony of 332 in 1967. A single bat was sighted on Naval Base Guam lands in 2008 during 90 hours of fruit bat surveys at 14 survey locations there and on nearby lands. A small number of solitary bats may persist on Naval Base Guam, however, it is possible that solitary individuals move to and from areas throughout the year.

Mariana fruit bats were seen sporadically on the Naval Base Guam Munitions Site between 1985 and 1999 (Morton and Wiles 2002). In 2010, three sightings of the same individual Mariana fruit bat were reported within the Naval Base Guam Munitions Site. Seven observations of one Mariana fruit bat in flight, each on a different day, were recorded at the Naval Base Guam Munitions Site between 10 May and 22 June, 2012 (Navy 2014a, p. 38). On August 27, 2014, two observations of a Mariana fruit bat in flight occurred at the Fena Reservoir within the Munitions Site (Leilani Takano, Service, pers. comm. 2014). It could not be determined if these observations at the Munitions Site represented one or multiple individual fruit bats.

Mariana fruit bats may forage or roost in the Finegayan area of Naval Base Guam, Telecommunication Site (Navy 2013a). Naval Base Guam Barrigada does not likely support fruit bat roosting sites, however, foraging activity possibly occurs there.

Mariana fruit bat surveys were conducted at Andersen South between 18–20 March 2013 (Vogt and Farley 2013). No bats were detected during these surveys. There are no recent records of Mariana fruit bat use of the Andersen South area.

Rota

The fruit bat population on Rota is estimated at approximately 2,600 (CNMI 2011; p. 6) and has increased since 2008 (CNMI 2008, p. 11; CNMI 2011, p. 6) due to a recent decrease in illegal hunting at roost sites of fruit bat maternity colonies. The decrease in illegal hunting can be attributed to an increase in enforcement of wildlife regulations that began in 2009 (CNMI 2010, pp. 7-9). Mariana fruit bats from Rota move episodically among the southern islands, and this island thus is considered to be important to the long-term stability of the species in the southern part of the Mariana archipelago and to the sporadic existence of the colony on Guam (Wiles and Glass 1990; Wiles et al. 1995).

Illegal hunting is the primary threat to Mariana fruit bats on Rota. Although law enforcement efforts have increased since 2009 (CNMI 2008, 2009a-b, 2010), illegal hunting continues and will likely resume to historical levels unless consistent, effective law enforcement in tandem with education and outreach programs continue. Recovery of the fruit bat on Rota and other human-inhabited islands will not likely be possible without strong education programs combined with effective control of illegal hunting. It is unlikely that the naturally low reproductive rate of this species can sustain the level of hunting pressure currently observed on Rota.

Severe storms (and associated hunting) at short intervals combined with low and fluctuating numbers could erode what resilience exists in this population. Fruit bat numbers on Rota declined following Typhoon Roy in 1988 from an estimated 2,400 animals to just under 1,000 (Stinson et al. 1992). Prior to Typhoon Pongsona in 2002, fruit bat numbers on Rota had risen to about 1,300-2,000 bats (Esselstyn et al. 2006). However, in the months following the storm, repeated surveys indicated that numbers had again declined sharply to perhaps 500 bats (Esselstyn et al. 2006). The number of fruit bats detected by surveys remained relatively low through April 2004, when about 700 bats were counted (Esselstyn et al. 2006

Saipan

Schnee (1911; cited in Service 2009a) reported that Mariana fruit bats were commonly seen and heard on Saipan, where they were heavily hunted by local residents. The Navy restricted civilian access to the northern part of Saipan until the early 1970s, effectively providing the bats with protected roost sites. Fruit bats on Saipan were observed to decline rapidly after the Navy turned over control of this area to the CNMI government, and access to the entire island became unrestricted (Wiles et al. 1989). Observations made between the late 1970s and 2007 suggest that Saipan harbored a small number of bats during that period; typically 50 bats or fewer (Wheeler 1980; Lemke 1984, cited in Service 2009a; Glass and Taisacan 1988; Wiles et al. 1989; Worthington and Taisacan 1996; Johnson 2001; Ann Marshall, Service, pers. comm. 2007).

Tinian

Fritz (1901; cited in Service 2009a) reported a "large number" of bats on Tinian in 1900. Since the late 1970s fruit bats have been seen rarely and only in small numbers, with estimates of fewer than 25 animals usually given for the island (Wheeler 1980; Glass and Taisacan 1988; Wiles et al. 1990; Marshall et al. 1995; Krueger and O'Daniel 1999; Johnson 2001). Observations during the 1990s suggested that the presence of bats on Tinian was intermittent, and their numbers were low (Worthington and Taisacan 1996). Brief surveys on Tinian conducted in 2001 found no fruit bats (Johnson 2001), and between 2002 and 2007 fruit bats have been observed only once during forest surveys conducted on Tinian each month by Navy biologists (Scott Vogt, Navy, pers. comm. 2007). A few Mariana fruit bats were observed on Tinian during surveys conducted by the Navy, and island residents reported occasionally seeing Mariana fruit bats (Navy 2008a). Mariana fruit bats also reside on Aguiguan and travel to Tinian to forage (Cruz et al. 1999, 2000, 2002). In June 2005, approximately five Mariana fruit bats were seen in the cliff-line forest during a routine forest bird survey of the Maga bird transect (Navy 2008a).

FDM

FDM may serve as a stopover location for Mariana fruit bats while transiting between islands or may support a small resident population. Incidental observations of Mariana fruit bats on FDM during recent bird surveys, along with fisherman reports from the early 1970s, suggest a small number of Mariana fruit bats use FDM. Use of the island by Mariana fruit bats may have been greater prior to the use of the island as a bombing range. A historical photograph included in the BA (p. 77) shows a more intact, forested areas on the mesic flats in the northern portion of the island than is the case today based on the photograph of the same area taken in 2013 (see BA, p. 77). This forested area likely provided foraging and roosting habitats for the Mariana fruit bat.

Factors Influencing the Condition of the Mariana Fruit Bat in the Action Area

As discussed above under the *Status of the Species*, poaching, habitat loss and degradation caused by humans (inclusive of human disturbance at roosting sites and military bombardment on FDM) and feral ungulates, and invasive plants are the primary factors influencing the condition of the Mariana fruit bat in the Action Area.

Role of the Action Area in the Conservation of the Mariana Fruit Bat

The draft revised recovery plan for the Mariana fruit bat (Service 2009a), considers federally administered lands in the Mariana Islands to be important sites for the protection and management of the Mariana fruit bat and its habitat. The maintenance and enhancement of fruit bat populations, especially through habitat preservation, restoration, and creation, on these lands, inclusive of those associated with the MITT program, is fundamental to the conservation and recovery of this species.

EFFECTS OF THE ACTION

Invasive Species Transport and Introduction

As discussed in the BA (see pp. 66 and 83), the Navy recognizes the potential for catastrophic effects to wildlife on Rota, Tinian, Saipan, and the FDM resulting from the accidental introduction of the BTS or other vertebrate predators from Guam or elsewhere. Accidental introductions of potentially invasive pests and plants could establish populations and further degrade habitats on these islands. Rota is of particular concern because of close proximity and shorter transit times from Guam and because of the high quality habitats located throughout the island. Figure 2-6 in the BA (p. 38) shows a conceptual model of potential pathways of invasive species introductions to Rota, Tinian, Saipan, and the FDM. These islands are linked together and to Guam by marine and air transportation routes that support military training activities. The Navy's strategy to avoid and minimize the adverse effects of invasive species introductions is to identify critical control points within the potential pathways depicted in Figure 2-6 of the BA, then design and implement exercise-specific invasive species interdiction plans. Such an approach is currently being implemented under the MIRC program.

Under the proposed MITT program, the Navy proposes to implement the following measures; these are described in more detail in Appendix B:

- Upon completion of the MIRC Reinitiation BO and other pending consultations, Navy will update the COMNAVMARIANASINST 3500.4A to reflect the language contained in these Biological Opinions applicable to range users. Navy will also finalize a new Joint Region COMNAVMAR Brown Treesnake instruction, which will contain the Brown Treesnake Control and Interdiction Requirements. These efforts shall be prepared in coordination with the Service and other stakeholder agencies.

- Training activities will undergo a pathway risk analysis as a tool to improve programmatic efficiency while preventing the spread or introduction of BTS.

- The Navy, in compliance with Public Law 110-417, [Division A], title III, Section 316, October 14, 2008, 122 Statute 4410 and per Department of Defense (DoD) Transportation Regulations, Chapter 505 protocols, is committed to implementing 100% inspection of all aircraft and all cargo/equipment leaving Guam via vessel or aircraft for an off-island destination with trained brown treesnake personnel and qualified canine detection teams. The skills and standards required to certify personnel, including canine inspection teams, as "qualified" will be agreed upon mutually by DoD and the Service. These teams may be supplemented with qualified personnel to meet 100 percent inspection goals for training activities.

- In the event military units, vehicles, or equipment accidentally leave Guam without inspection, as soon as possible, the Navy will notify the qualified brown treesnake interdiction program and the destination port or airport authorities. The Navy will work with the destination authority(ies) to resolve the issue. Urgency of notification is a priority so that rapid response or other actions can be implemented to reduce risk, if warranted.

- To the maximum extent practicable, the Navy will route inbound personnel and cargo for tactical approach exercises (that require an uninterrupted flow of events) directly to CNMI training locations to avoid Guam seaports and airfields to the extent possible. If Guam cannot be avoided for tactical approaches, the Navy will work with the U.S. Fish and Wildlife Service to identify and implement appropriate interdiction methods at the receiving port (Rota, Saipan or Tinian). Methods may include redundant inspections or other interdiction actions, such as multiple inspections or barrier use on Guam. In addition, tactical approach exercises will involve only cargo/equipment that has not originated from areas containing a brown treesnake population or will be 100 percent inspected by qualified brown treesnake canine detection programs.

- The Navy will establish snake-free quarantine areas (barriers) as deemed necessary by the Navy and U.S. Fish and Wildlife Service for cargo/equipment traveling from Guam to CNMI and locations outside of the MITT action area. Barriers will be used if the volume of cargo/equipment/vehicle movement out-paces the available canine inspection capacity or BTS quarantine capacity. The snake-free quarantine areas will be subject to: (1) multiple day and night searches with appropriately trained interdiction canine teams, (2) snake trapping, and (3) visual inspection for snakes. Standard operating procedures will be developed based on the barrier size needed for the training event(s). Temporary barriers will be constructed and maintained in a manner that assures the efficacy of the barrier. Staff constructing and maintaining the temporary barriers will receive training related to this activity prior to barrier construction and operation. Barrier specifications as well as the qualifications of BTS barrier maintenance and management staff will be mutually agreed upon by DoD and the Service.

- Navy will (1) coordinate closely with the Service[1] and the CNMI Department of Land and Natural Resources staff on planning for training activities in the CNMI; (2) coordinate with the other DoD action agencies implementing the MITT program and the Service to identify

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1 Currently, the Service point-of-contact (POC) for these planning activities is the CNMI Brown Tree Snake Program Coordinator (Coordinator). If the agency affiliation of that Coordinator changes, the Service shall formally designate a new Service POC and advise the DON and other DOD action agencies associated with the MITT Program within 10 working days.

the inspection and interdiction requirements for MITT program-related training activities, including the number of trained quarantine officers and canine detection teams required to ensure that the inspection and interdiction requirements for MITT program-related training activities can be met; (3) coordinate with the Service on the inspection and interdiction requirements identified by the Navy prior to the implementation of the exercise or training activity; and (4) identify the support that the Navy will need to provide for the inspections and develop plans to ensure that inspection personnel are available and all requirements are met.

- Navy will utilize ongoing adaptive management to improve methods for BTS rapid response, including detection of low-density snake populations using all technologies as they become available. The Navy will annually review BTS rapid response needs with the Service to mutually determine if refined methods need to be implemented; the Navy will support such refinement based on that mutual agreement.

- MITT action proponents will provide support for BTS rapid response associated with a BTS sighting within the JRM AOR related to a MIRC program-related training activity subject to this consultation.

- Prior to each exercise that involves the movement of equipment and troops between islands, a pathway risk analysis will be conducted and biosecurity protocols confirmed by the DoD (JRM). Implementation of biosecurity protocols will be a requirement for training. An adaptive management review of risk analyses and biosecurity protocols will be conducted periodically with the Service. Initially, this adaptive management review will include the development of Standard Operating Protocols (SOPs) for biosecurity by the DoN in support of training activities covered under the MITT program. These DoN biosecurity SOPs will be reviewed by the Service when initially developed. Once the MITT program is implemented, MITT program-related SOPs will be reviewed with the Service annually.

- In coordination with the Service, the DoD action agencies implementing MITT activities will establish a contractual agreement for adequate rapid response capabilities with appropriate agencies having invasive species rapid response expertise and technology within three months of the Service's issuance of this Biological Opinion. The contracted services will focus on control and eradication of introduced non-established, non-native invasive species sighted in the vicinity of: (1) DoD MITT training areas, and (2) DoD areas and facilities used for the staging, storage and movement of MITT personnel, cargo, and MITT-associated vehicles (e.g., planes, trucks, and vessels). Priority should be given to non-native invasive species that pose a high risk of being transported elsewhere due to MITT-related training actions. This arrangement will be in place until superseded by a regional rapid response plan[2]. Monitoring will consist of the established protocols for USDA inspections, personnel awareness during pre-event preparations, and self-inspections. As noted above, an adaptive management review of risk analyses and biosecurity protocols will be conducted periodically with the Service.

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2 The regional rapid response plan discussed refers to the full implementation of a comprehensive Emergency Response Plan for Guam and the CNMI in association with the Regional Biosecurity Plan (RBP) for Micronesia and Hawaii. The RBP is discussed further in the MIRC re-initiation / MITT Biological Opinion.

Currently, the proposed MITT program includes provisions for detecting the inter-island transport of invasive species in terms of applying established protocols for USDA inspections, military personnel awareness during pre-event preparations, and self-inspections by military personnel involved with the proposed training activities. To date, annual reports prepared by the Navy under the MIRC program that are on file at the Service's PIFWO have not reported any incidents of introduced species being transported inter-island and introduced elsewhere. However, given the proposed increase under the MITT program in the frequency of military training currently being implemented under the MIRC program (see Appendix A), it is reasonable to anticipate a higher potential for such introductions to occur under the MITT program.

Given that higher potential, the Service believes additional monitoring/response capability may be needed under the MITT program to ensure early detection and eradication of inter-island introductions of invasive species that may be caused by MITT program-related activities. During this consultation, the Service and the Navy discussed this matter and informally agreed that such capability should be provided under a multi-agency programmatic action to implement the Regional Biosecurity Plan for Micronesia and Hawaii (RBP; Navy 2015). The Navy is committed to coordinating with the Service and other stakeholders on the development and implementation of this programmatic action (D. Schregardus, Deputy Assistant Secretary of the Navy, Environment, pers. comm. to Theresa Rabot, Service, Assistant Regional Director, Ecological Services, Region 1). The Navy also requested that the Service include a conservation recommendation in this Opinion addressing this matter (see *Conservation Recommendation* section below). For purposes of this analysis, within the term of the proposed action, the Service anticipates the above programmatic action will be developed and implemented region-wide, will include an effective rapid response plan that relies on an adequate monitoring program, and will serve to supplement or replace the currently proposed biosecurity measures under the MITT program.

Micronesian Megapode

Tinian

The nature of the proposed training activities on Tinian involves noise generation by aircraft and vehicles, and the potential for transport and introduction of invasive species. No training is proposed within areas of suitable habitat for the megapode. Given that physical separation, above ambient noise levels that may disrupt the feeding or sheltering behavior of transient megapodes are considered unlikely to occur.

Saipan

On Saipan, megapodes may use the intact limestone forests located within the Marpi Maneuver Area. At least one Micronesian megapode has been detected in the limestone cliff forest across the road from and within the Marpi Maneuver Area. Under the proposed action, only pedestrian land navigation training would occur in the Marpi Maneuver Area and no training will occur in the native limestone forest. Pedestrian land navigation training is designed to facilitate navigation to a location undetected, as quietly as possible. The proposed training within the Saipan Marpi Maneuver Area would be infrequent and would avoid the limestone forest habitat used by the megapode. Further, the types of training activities that do occur within the Marpi

Maneuver Area are more likely to occur in the open, more disturbed areas away from where megapodes would likely occur. Therefore, there is little likelihood of disturbance from noise and human presence caused by the proposed military training activities.

FDM

With implementation of the proposed action, the Micronesian megapode would be exposed to noise and pressure waves from explosions on FDM from strike warfare and firing exercises. Response of the Micronesian megapode to explosive noise has not been evaluated (Service 2010a); however, Micronesian megapodes are vocal and presumably find mates and defend territories by duetting (Service 1998). Therefore, explosive noise and pressure waves generated from explosions are likely to impact the Micronesian megapode if it physically damages the ears such that the affected individual: cannot hear and locate a mate; produces abnormal calls (hearing impaired learning) and cannot attract a mate; or is unable to defend a territory.

Other concerns from noise impacts to avian species are related to nesting and impacts to eggs or chicks (e.g., mortality through kicking eggs or young out of the nest during flushing; exposing eggs or young to temperature changes during nest flushing; causing adults to not feed and care for young during nest flushing; and exposing eggs and young during nest flushing to increased predation). Micronesian megapodes generally bury their eggs in mounds in which temperature is controlled by sources other than the bird (Service 2010a). Megapode chicks are precocial, are able to fly upon emergence from the egg and do not require parental care (Service 1998). Therefore, the above behavioral responses to noise impacts typical of other avian species are not likely to be exhibited by Micronesian megapodes.

FDM supports at least 11 Micronesian megapodes, therefore, concentrations of these birds at different times of the year are likely to coincide with strike warfare training exercises. On the FDM range area where ordnance is restricted to inert munitions, vegetation is recovering in vertical structure and surface cover in contrast to range areas where high explosive ordnance is permitted (Navy 2013b). Micronesian megapodes have been observed within the inert target area, although in lower densities relative to areas north of the "special use area" where no live-fire training occurs (Navy 2013b). The potential for injury to Micronesian megapodes on FDM associated with direct strike from inert munitions is considerably lower than the potential for blast effects associated with explosive munitions. Blast effects from explosive munitions are likely to injure and kill Micronesian megapode. The Service's 2010 Opinion on the MIRC program, as amended in 2013, anticipated and authorized the incidental take by kill and injury of 5 pairs (10 individuals) of the Micronesian megapode on FDM over the 5-year term of the MIRC program in part due to the effects of strike warfare training exercises. This amount of anticipated take was derived on the basis of five pairs (ten individuals) of the Micronesian megapode being detected using the area around the inert and live-fire target areas on FDM. That level of impact on the megapode is highly likely to continue and increase under the proposed MITT program, which increases the number of bombing exercises on FDM from 1,300 per year under the MIRC program to 2,300 per year, and the number of gunnery exercises on FDM from 22 per year under the MIRC program to 96 per year (see Appendix A). On the basis of these increases in bombing, gunnery, and missile exercises, two pairs of the megapode are likely to be killed each year on FDM.

Helicopter landings and approaches, expected to occur north of the no fire line within the special use area, may expose Micronesian megapodes to aircraft strike hazards during approaches and takeoffs. More megapodes are expected to occur within this area because of higher quality habitat relative to the impact areas on FDM. The proposed action includes 18 direct action-type training activities on FDM, which is a 5-fold increase over current training operations. Micronesian megapode behavioral responses to an approaching helicopter may include flushing and flying away from the sound source, or if in air, flying away from the sound source. As a ground-nesting bird, seeking cover on the ground is also likely a reasonable response. These behavioral responses may reduce the likelihood of megapodes being struck by aircraft. Helicopter landings need to occur in open areas free of debris or woody vegetation. Although Micronesian megapodes may nest within landing areas, especially after periods of nonuse, the potential for helicopters to physically land on a nest is extremely low because of higher quality habitat in other portions of the special use area that is likely to be used for nesting by the megapode.

On FDM, Micronesian megapodes use habitats within the target areas (estimated five pairs) and within areas north of the no-fire line (estimated 16 pairs) (Navy 2009, Service 2010a). Chicks and juveniles have been observed on FDM, along with habitat manipulations suggestive of megapode burrows north of the no-fire-line (Lusk et al. 2000). Habitats within the inert and live-fire target areas south of the no-fire-line will continue to be degraded, fragmented, and possibly lost due to continued military use of the island. Strike warfare training may make habitats within the inert and live-fire areas more prone to the compounding effects of drought and typhoons, and increase fine fuel (grasses and other herbaceous vegetation) availability for wildland fires to spread into edge habitats.

Wildfire intensity may vary based on the amount and type of munitions, wind speed, levels of humidity, seasonal variation in vegetation thickness and composition, and successional state of vegetation. Fire effects in habitats used by Micronesian megapodes could include a variety of direct and indirect effects. Megapodes could be exposed to smoke inhalation, resulting in mortality, nest abandonment, or injury. Direct exposure to flames would destroy nests and may kill individual megapodes. Micronesian megapodes on FDM would be expected to fly away from smoke, but exposure to smoke inhalation would result in some form of respiratory distress (Service 2010a). Direct mortality of megapodes could result from intensive respiratory distress. Megapode eggs, even in burrows, would not likely survive a wildfire overburn. Likewise, any fledglings within a burn area would be expected to suffer intensive respiratory distress, and unable to flee smoke or burning vegetation. The likelihood of a wildland fire spreading north out of the impact zones into more intact forests on the northern portion of the island cannot be negated, however, factors such as a relatively higher fuel moisture content and mesic conditions in the higher stature vegetation may limit the spread of fires. Therefore, the northern portion of the island is likely to continue to serve as a refugium for Micronesian megapodes that either reside in this area or for megapodes able to move away from smoke and flames in the target areas. Indirect effects include a general reduction of organic matter available on FDM, such as litter and duff used by the megapode to build nests and incubate eggs.

There are three designated bombing target areas on FDM south of the no-fire zone: Impact Area 1, the northernmost of the three, is designated for inert ordnance only; Impact Areas 2 and 3 are designated for both live and inert ordnance (see Figure 4-2 in the BA). Placement of the inert-only target area farthest north provides a buffer between the live ordnance targets to the south

and the area north of the no-fire zone, providing megapodes and their more favorable habitat a degree of protection. While unintentional and not part of the proposed action, inert and live bombs may miss their intended targets and land anywhere on the island including within areas occupied by megapodes. These unintentional impacts are likely to continue and increase, with the increased bombing of FDM,

Megapodes have persisted on FDM through various phases of intense bombardment of the island from the 1970s to the present. Recent surveys in 2013 detected 11 megapodes within the limited survey area in Impact Areas 1 and 2 (Navy 2013b). Megapode densities in portions of the FDM no-fire zone are analogous to densities on other uninhabited islands considered to be refugia for this species, such as Sarigan and Guguan (Navy 2008d), suggesting that Navy measures implemented under previous actions have minimized impacts to megapodes on FDM. Although megapode numbers have increased, the frequency of explosive ordnance use on FDM will also increase under the proposed action. Coupled with the recovery of vegetation within the no-fire zone and inert ordnance zone, megapode exposure to direct mortality from munitions and potential wildfires (from increased fuel loading) will continue for the term of the proposed action (see Description of the Proposed Action above). Although a population of megapodes on FDM continues to persist on the island, military activities are likely to negatively impact all megapodes on FDM that occur inside and outside of the impact areas.

As noted above, the Service's 2010 Opinion on the MIRC program, as amended in 2013, anticipated and authorized the incidental take by kill and injury of 5 pairs (10 individuals) of the Micronesian megapode on FDM over the 5-year term of the MIRC program. Those levels of take are highly likely to continue and increase under the proposed action for the reasonably foreseeable future. Given the term of the proposed action and the proposed increases in strike warfare training on FDM as discussed above and in Appendix A, it is possible, but not reasonably certain, that the Micronesian megapode may be extirpated from FDM as a result of the MITT program. Since FDM is not considered to be essential to the recovery of the megapode (Service 1998, p. 42), that potential outcome of the proposed action is not considered to be a significant impact to the Micronesian megapode at the rangewide scale.

Mariana Fruit Bat

Guam

In addition to specific provisions for BTS interdiction and control and other biosecurity measures described above and detailed in Appendix B, the proposed MITT program also includes the following provisions (excerpted from pp. 22 and 23 of the BA; detailed in Appendix B) to avoid and minimize adverse effects to the Mariana fruit bat from training activities on Guam:

Conservation measures on Guam that limit the impacts associated with aircraft training activities include:

- Helicopter overflights as part of training activities are prohibited below 1,000 feet (305 meters) above ground level (AGL) over Northwest Field north of the South Runway. This measure is designed to minimize visual disturbance and acoustic noise impacts on foraging or roosting Mariana fruit bats in the Northwest Field area. The satellite tracking station

located at Northwest Field also has a flight restriction of 2,500 feet (760 meters) AGL within 1 nautical mile of the station.

- Overflights as part of training activities along all Andersen AFB clifflines are prohibited below 1,000 feet (305 meters) AGL.

- Helicopter overflights as part of training activities are restricted throughout the Naval Base Guam Munitions Site below 500 feet (150 meters) AGL. Fixed-wing aircraft are restricted below 1,000 feet (305 meters) AGL as part of training activities.

Conservation measures on Guam that limit the impacts associated with ground maneuvers include:

- "No Wildlife Disturbance" and "No Training Areas" are designated on Naval Base Guam Orote Point, Naval Base Guam Navy Munitions Site, and Andersen AFB Tarague Beach. Vegetation removal would be limited to maintaining existing bivouac areas. No new bivouac areas are proposed in this BA. Maneuver units will remain tactical and not establish support camps.

- All training activities that involve ground maneuvers on Guam will be consistent with the fire management plan included in COMNAVMARIANASINST 3500.4A. A description of this plan is included in BA Section 2.3.6 (Wildland Fires).

- Riparian wetlands are dispersed throughout the Southern Land Navigation. No maneuver and navigation training will occur in riparian wetlands in this area.

- The Navy will locate ground-disturbing training activities on previously disturbed sites whenever possible. Training areas, including transit routes necessary to reach training areas will be clearly marked. Vehicular activities will be restricted to designated and previously identified areas. Off-road vehicle use will only occur in designated off-road areas or on established trails.

Conservation measures on Guam that limit impacts associated with established range use include:

- The USAF implements training and operation restrictions at the Combat Arms Training and Marksmanship (CATM) range at Tarague Beach, Guam to minimize effects to sea turtles and Mariana fruit bat. Night-training occurs at the CATM range; therefore night-lighting is installed. The lighting configuration at this location is maintained with four flood lights, located below the tree canopy level that are directed inland and parallel to the coast. Lighting in this configuration will avoid impacts to nesting and hatching sea turtles and Mariana fruit bats.

- The CATM range allows for training with small arms, inert mortars to 60 millimeter, and 40 millimeter grenade launchers. These weapons do not produce percussive force and no weapons that produce percussive force can be used at this facility.

Given the above measures and considering both the current distribution and abundance of the fruit bat on Guam and the exclusion of USAF aircraft staging and takeoff and landings at Andersen AFB from the MITT program, the Service finds that implementation of the proposed MITT program on Guam:

1. Is not likely to adversely affect the roosting behavior of the fruit bat in the Action Area on Guam. Historically, the primary roosting area for the Mariana fruit bat on Guam was located at Pati Point. That roost site is not currently being used by fruit bats. Should fruit bat occupation of that site resume during the term of the proposed action, the proposed MITT program is compatible with that use.

2. Is likely to adversely affect the foraging behavior of the fruit bat as a result of noise caused by nighttime training activities particularly at Andersen AFB and the Naval Base Guam Munitions Site. However, these adverse effects are not anticipated to significantly disrupt fruit bat foraging behavior to an extent that is reasonably certain to cause injury or death of the affected bat(s) because the affected bats are likely to shift their foraging sites away from areas used for nighttime training activities.

Rota

The Service's Opinion on the MIRC program (Service 2010a) did not anticipate adverse effects to the Mariana fruit bat to be caused by proposed military training activities other than on Guam. The BA for the MITT program includes the following discussion on pages 60, 65, 66, 68, and 69 regarding the effects of the MITT program on the fruit bat on Rota:

On Rota, Mariana fruit bats are found in mature limestone forests and coconut groves on the island. Most roosting activity and colony sites occur in the Sabana region of the island (see Figure 3-1), which coincides with the Mariana fruit bat critical habitat designation. Military training activities do not occur in these areas, however, Mariana fruit bats may be exposed to noise from training activities based out of the Rota International Airport. Mariana fruit bats also reside on Aguiguan and travel to Tinian to forage (Cruz et al. 1999, 2000, 2002). In June 2005, approximately five Mariana fruit bats were seen in the cliff-line forest during a routine forest bird survey of the Maga bird transect (Navy 2008a). Because of the few numbers of bat observations and the likelihood that Mariana fruit bats observed on Tinian are not residents, the Mariana fruit bat should be considered incidental on Tinian. Noise as a stressor for Mariana fruit bats on Tinian and Saipan are considered negligible.

The Rota International Airport is adjacent to foraging habitats for the Mariana fruit bat. Combat search and rescue training occasionally occur at the airport. This training activity, however, is generally confined to the airfield where fruit bats are unlikely to occur. Trainings may also occur in open areas in coordination with local authorities. The likelihood for aircraft strike during combat search and rescue training should be considered extremely low because of the infrequent occurrence of the training activity and the locations of where these training activities are actually scheduled.

On Rota, aircraft noise would be generated by helicopters during combat search and rescue training activities and may affect the Mariana fruit bat. Typically, the Navy uses H-60 helicopters to practice day or night rescues of personnel in a simulated hostile area with the

expectation of combat resistance. Crews typically include Naval special warfare personnel or combat trained personnel with rescue swimmer and medical qualifications. This activity is mostly restricted to the Rota International Airport; however, other locations may be used in coordination with local authorities (e.g., Rota's mayor office). Helicopters may also transit out to sea for rescue swimmer training.

Mariana fruit bats are generally more active at night (a primary time for foraging when bats would fan out over Rota from roost locations in the limestone forests of the Sabana Plateau). Because suitable foraging habitat is adjacent to the Rota International Airport, helicopter noise may affect the Mariana fruit bat. With low-level helicopter flights, there is also a potential for aircraft strike of Mariana fruit bats. Adverse effects associated with this training activity are anticipated to be insignificant because of the infrequent use of the Rota International Airport and the even more infrequent low light exercises associated with this training activity. The potential for invasive species introductions into Rota's port facility and airport are addressed through exercise specific interdiction plans and standard operating procedures.

The Navy recognizes the potential for catastrophic effects on wildlife on Rota, Tinian, and Saipan resulting from the accidental introduction of brown treesnakes or other vertebrate predators. Accidental introductions of potentially invasive pests and plants could establish populations and further degrade habitats on these islands. Rota is of particular concern because of close proximity and shorter transit times from Guam and high quality habitats located throughout the island. Figure 2-6 shows a conceptual model of potential pathways of invasive species introductions to Rota, Tinian, and Saipan. These islands are linked together and to Guam by marine and air transportation routes that support military training activities.

The Navy's strategy to reduce, minimize, or eliminate species from potential introduction pathways includes the identification of critical control points. Accordingly, the Navy designs and implements exercise-specific interdiction implementation plans, in accordance with Navy policy directives and previous consultation requirements. The Navy also coordinates with local stakeholders (e.g., CNMI Division of Fish and Wildlife and U.S. Department of Agriculture Wildlife Services) to conduct redundant inspections of cargo, equipment, and material as required for specific exercises.

Based on the above information and the findings in the Environmental Baseline section for the Mariana fruit bat, the Service finds that the proposed action is likely to adversely affect the foraging and roosting behavior of the fruit bat on Rota as a result of noise caused by training activities based out of Rota International Airport. However, these adverse effects are not anticipated to significantly disrupt fruit bat foraging and roosting behavior to an extent that is reasonably certain to cause injury or death of the affected bat(s) because the affected bats are likely to shift their foraging and roosting sites away from areas used for the training activities.

FDM

The BA for the MITT program includes the following discussion on pages 81-83, and 85 regarding the effects of the MITT program on the fruit bat on FDM:

Mariana fruit bats on FDM may be transient bats from other islands, and/or the island may support a small resident population. The limited forest structure and composition currently

found on FDM may support a small number of year-round residents. Natural resource experts expressed concern that volcanic eruptions could displace fruit bats to other islands (e.g., from Anatahan to FDM), thereby exposing an increased number of bats to potential impacts of military training on FDM (Service 2006a, 2010).

Mariana fruit bats are expected to occur north of the no-fire line within the relatively more intact forests that remain on FDM. Therefore, the likelihood of munitions strike of Mariana fruit bats is considerably reduced, but not negated, because the area north of the no-fire line is not targeted. Since the 2010 Biological Opinion was issued, training impacts (e.g., bomb craters, destroyed targets) have been observed within the no targeting area proving that despite best efforts, exercises sometimes miss their targets.

Helicopter landings and approaches would occur in areas that may support Mariana fruit bats on FDM. The vegetation structure north of the no-fire line within the special use area contains higher stature foraging and roosting trees relative to the impact areas outside of the special use area. The Proposed Action includes 18 direct action-type training activities on FDM, which is an increase from 3 over previous training requirements. Mariana fruit bat behaviors in response to an approaching helicopter may include flushing and flying away from the sound source, or if in air, flying away from the sound source. Alternatively, roosting bats may not exhibit any behavioral response. These behavioral responses may reduce the likelihood of aircraft strike of Mariana fruit bats.

Mariana fruit bats transiting from other islands through FDM or resident bats on FDM are likely limited to the more intact forested portions north of the no-fire line. Therefore, bats that transit between other islands and/or resident bats will likely continue to have a foraging base on FDM. In this location, Mariana fruit bat foraging habitat may be degraded through accidental target misses and impacts north of the no targeting line.

Catastrophic events within the Mariana archipelago may temporarily cause populations of fruit bats to fluctuate on different islands, although movement between islands seems to be a natural occurrence. These events may result from typhoons, poaching, or volcanic eruptions. Catastrophic events and other factors may cause Mariana fruit bat populations on FDM to temporarily increase, thereby exposing transient or resident bats to potential harassment and harm associated with live-fire training. Mariana fruit bats can be assumed to utilize FDM as a resting point for longer inter-island movements. Because of the location of likely foraging and roosting locations (located in the northern portion of the island north of the "no fire zone"), impacts associated with wildfires occurring primarily in the central portion of the island would be unlikely. The likelihood of a wildland fire spreading north out of the impact zones into more intact forests on the northern portion of the island cannot be negated; however, factors such as a relatively higher fuel moisture content and mesic conditions in the higher stature vegetation may limit the spread of fires.

The Navy recognizes the potential for catastrophic effects on wildlife on FDM resulting from the accidental introduction of brown treesnakes or other vertebrate predators. Accidental introductions of potentially invasive pests and plants could establish populations and further degrade habitats on FDM. Figure 2-6 shows a conceptual model of potential pathways of invasive species introductions to FDM. The only military activities that could introduce invasive species to FDM are activities requiring aircraft landings. Military boats do not come

ashore at FDM. Helicopters that land on FDM typically embark from Guam or Saipan, but some helicopters may originate from Tinian.

The Navy's strategy to reduce, minimize, or eliminate species from potential introduction pathways includes the identification of critical control points. Accordingly, the Navy has designed and implemented inspection and interdiction procedures specific to FDM, in accordance with Navy policy directives and previous consultation requirements. As stated in Section 1.2.3.1 (Brown Treesnake Interdiction and Control) Section 1.4.1.2 (Conservation Measures on Farallon de Medinilla), all aircraft and equipment originating from Guam and landing on FDM must undergo brown treesnake inspection procedures prior to departing Guam. Appendix B (Brown Tree Snake Control and Interdiction Requirements) of this BA is included in COMNAVMARIANASINST 3500.4A, adherence to this instruction is mandatory for training within the Mariana Islands.

Based on the above information and the findings in the Environmental Baseline section for the Mariana fruit bat, the Service finds that the proposed action is likely to adversely affect the foraging and roosting behavior of the fruit bat on FDM as a result of noise, percussive force, and wildfires caused by training activities. There is a high potential for these effects, at times, to injure or kill affected fruit bats, especially considering the increased training activity on FDM and project duration. However, given the low number of fruit bats that occur on FDM, the proposed action is not considered a significant impact to the Mariana fruit bat at the rangewide scale.

CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, tribal, local or private activities that are reasonably certain in the action area considered in this Opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA.

Recreation and tourism occur within the Military Lease Area on Tinian. In general, the tourists are bused to historical sites, while some use rental cars. These tourism activities are not anticipated to result in effects to the Micronesian megapode or Mariana fruit bat as the species are transient on Tinian and the majority of the sites are not in habitats that would be used by the megapode or fruit bat. There are no historical landmarks in the area where fruit bats or megapodes were last detected.

Homesteads, private development, tourism, and unauthorized clearings are likely to occur within the timeframe of this action within the Marpi Maneuver Area on Saipan. This clearing and development are likely to further reduce the amount and quality of megapode habitat in the area. Natural disasters, such as typhoons, also occur regularly on Saipan further damaging habitat. However, no nesting habitat is expected to be lost.

CONCLUSION

After reviewing the current status of the Mariana fruit bat and the Micronesian megapode, the environmental baseline for the action area, the effects of the proposed action and cumulative

effects, it is the Service's biological opinion that the Navy's proposed action is not likely to jeopardize the continued existence of the Mariana fruit bat and the Micronesian megapode.

The Service reached these findings based on the following reasons:

Activities under the proposed action will not remove habitat essential or important to the conservation of these species on Guam, Rota, Tinian, and Saipan. The proposed action is likely to cause the destruction and degradation of habitats utilized by small numbers of the fruit bat and the megapode on FDM. However, this island is not considered essential to the recovery of the megapode.

On Guam, proposed training areas avoid sites known to support Mariana fruit bat roosts, and proposed conservation measures related to aircraft use and ground maneuvers are likely to minimize noise, strike potential, physical disturbance, and habitat degradation impacts on the fruit bat. On Rota, the bat(s) that occur near the airport would likely shift their foraging and roosting sites away from proposed training activities at the airport. On Tinian and Saipan, proposed training activities avoid areas known or likely to be occupied by the fruit bat.

The Micronesian megapode is currently considered to be extirpated from Rota. On Tinian and Saipan, few proposed training activities are expected to occur in habitats likely to be occupied by the Micronesian megapode.

The potential for the proposed action to cause the inter-island transport and introduction of invasive species is minimized by proposed measures to develop and implement training exercise-specific interdiction plans, and to conduct redundant inspections of cargo, equipment, and other materials associated with specific training exercises. The Service is also relying on the Navy's commitment to prepare, along with other stakeholders, a program to implement the Regional Biosecurity Plan for Micronesia and Hawaii.

INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and federal regulation pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by the Service as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the ESA, provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The measures described below are non-discretionary, and must be undertaken by the action agencies for the exemption in section 7(o)(2) to apply. The action agencies have a continuing duty to regulate the activities covered by this Incidental Take Statement. If the action agencies fail to assume and implement the terms and conditions of this Incidental Take Statement, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the action agencies must report the progress of the action and its impact on the species to the Service as specified in this Incidental Take Statement in accordance with the implementing regulations for section 7 at 50 CFR §402.14(i)(3).

Amount or Extent of Take Anticipated

Two pairs of the Micronesian megapode are likely to be killed every year on FDM as a result of bombing, gunnery, and missile exercises implemented under the MITT program. One Mariana fruit bat is likely to be killed every five years on FDM as a result of bombing, gunnery, and missile exercises implemented under the MITT program.

Effect of the Take

In the accompanying Opinion, the Service determined the above level of anticipated take is not likely to result in jeopardy to the Micronesian megapode and the Mariana fruit bat.

Reasonable and Prudent Measures

The Service believes the following reasonable and prudent measures (RPMs) are necessary and appropriate to further minimize the effect of take on the Micronesian megapode and to monitor the impacts of take of the Micronesian megapode and Mariana fruit bat on FDM caused by the proposed action.

1. Minimize the effect of take from training and range maintenance to Micronesian megapodes.

2. The baseline condition for the Micronesian megapode and Mariana fruit bat shall be tracked to ensure that proposed minimization measures on FDM are implemented and to ensure no unauthorized take occurs.

Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the ESA, the DoD action agencies for the MITT program must comply with the following terms and conditions that implement the above RPMs. These terms and conditions are non-discretionary and must be implemented.

1.1 The DoD action agencies for the MITT program shall complete an island-wide ungulate eradication on Aguiguan (Goat Island). This action will benefit the Micronesian megapode by increasing vegetation on the island and creating suitable habitat, and will minimize the effects of take from the proposed action. This eradication will occur within six years of the issuance date of the Biological Opinion.

2.1. The DoD action agencies for the MITT program shall establish a formal protocol for the timing and implementation of megapode surveys on FDM in coordination with and the approval of the Service within 180 days of the issuance date of the accompanying Opinion.

2.2. The DoD action agencies for the MITT program shall conduct surveys for the Micronesian megapode along trails or paths that have been established during target refurbishment and operational range clearance activities. The results of these surveys shall be used as an index of megapode population change over time due to take impacts on FDM caused by the proposed action. Mariana fruit bats observed during surveys shall be recorded.

2.3. The DoD action agencies for the MITT program shall establish an appropriate monitoring protocol for ground surveys in conjunction with range maintenance activities on FDM to monitor megapode and bat habitat changes over time on FDM, and for reporting the results of this analysis in coordination with and the approval of the Service within 180 days of the issuance date of the accompanying Opinion.

2.4. The DOD action agencies for the MITT program shall provide the results of each survey and the change in habitat on FDM and concisely discuss the successes and challenges of implementing all the avoidance, minimization and conservations measures and terms and conditions listed in the Biological Opinion in an annual report submitted to the Service. The report also shall include the changes to the no impact area as a result of the accidental bombing and destroyed targets entering this area. The report is due at the end of the calendar year, December 31st, for the life of the project.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs Federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

The Service believes the following conservation action may facilitate further conservation of listed species within the Action Area:

1. The Navy is committed to coordinating with the Service and other stakeholders on the development of a programmatic action to implement the Regional Biosecurity Plan for Micronesia and Hawaii, inclusive of an effective rapid response plan (D. Schregardus, Deputy Assistant Secretary of the Navy, Environment, pers. comm. to Theresa Rabot, Service, Assistant Regional Director, Ecological Services, Region 1). The Service believes that effective rapid response is predicated on early detection of introduced species based on an adequate monitoring program. The Service supports and recommends that the DoD action agencies for the MITT program work aggressively with the Service and other stakeholders to develop and implement the above programmatic action region-wide in as timely a manner as possible.

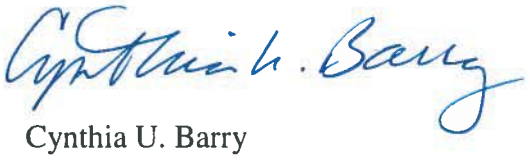
2. The Service recommends that the DoD agencies implementing the MITT program place a high priority on developing and implementing biosecurity monitoring measures in a timely manner that are adequate to detect an incipient population of the BTS that is introduced on or adjacent to lands used for training activities as a result of the proposed action. Such measures should also be part of the program discussed above for implementing the Regional Biosecurity Plan for Micronesia and Hawaii.

REINITIATION NOTICE

This concludes formal consultation on the proposed Project described in your Assessment. As provided in 50 CFR § 402.16, re-initiation of consultation is required where discretionary Federal agency involvement or control over the action has been maintained (or is authorized by law) and if: (1) the amount or extent of exempted incidental take is exceeded; (2) new information reveals effects of the agencies' action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to listed species or critical habitat that was not considered in this Opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. When consultation is reinitiated, the provisions of section 7(d) of the ESA apply.

This concludes formal consultation on the proposed MITT program. If you have any questions regarding this Opinion, please contact Kristi Young of the Service's Pacific Islands Fish and Wildlife Office at (808) 792-9400.

Sincerely,



Cynthia U. Barry
Acting Field Supervisor

Attachments:
Appendix A – Proposed MITT Program Training Activities
Appendix B – MITT Conservation Measures

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Appendix A. Increase in proposed MITT Program training activities currently being conducted under the MIRC Program.

2 ASSESSMENT OF MILITARY TRAINING ACTIVITIES ON GUAM

2.1 DESCRIPTION OF THE PROPOSED ACTION AND ACTION AREA

1.1.1 PROPOSED ACTIVITIES ON GUAM

Most of the land training activities considered in this BA are expected to occur on Guam. The land training areas are owned either by the U.S. Navy or the U.S. Air Force. Guam offers a variety of land training environments, including amphibious landing sites (within Naval Base Guam Main Base), field training exercises and land navigation training (portions of Andersen AFB, such as Northwest Field), airfield expeditionary and seizure trainings (Northwest Field and Naval Base Guam Main Base), land navigation areas (within the Naval Base Guam Munitions Site), and urban warfare, counter-terrorism, and humanitarian training areas on all military training areas on Guam.

Table 2-1 presents a list of training activities by warfare area, proposed location of the training activity, the number of training activities previously analyzed in the 2010 MIRC Biological Opinion, and the proposed increase in certain activities on Guam. Not all activities listed in Table 2-1 are proposed for increases (the activities proposed for increases are shown in bold). Most of the activities proposed for increases on Guam would occur on previously disturbed and developed areas, hardened surfaces, and urban warfare infrastructure (e.g., breacher houses and military operations on urban terrain [MOUT]) that are outside of habitat areas for ESA-listed species. Activities such as land navigation and field training exercises are not proposed for increases.

Table 2-1: Typical Training Activities in the Action Area on Guam

Activity Name	Location	Baseline Number of Activities (per year)	Proposed Number of Activities (per year)
Strike Warfare (STW)			
Combat Search and Rescue (CSAR)	**Airfields on Naval Base Guam and Andersen AFB (Northwest Field)**	**60**	**80**
Amphibious Warfare (AMW)			
Amphibious Assault	**Naval Base Guam Main Base landing sites**	**4**	**6**
Amphibious Raid	**Naval Base Guam Main Base landing sites**	**2**	**6**
Urban Warfare Training	**Naval Munitions Site, Andersen AFB, Andersen South, Naval Base Guam Barrigada, Navy Base Guam Telecommunications Site**	**17**	**36**

Table 2-1: Typical Training Activities in the Action Area on Guam (continued)

Activity Name	Location	Baseline Number of Activities (per year)	Proposed Number of Activities (per year)
Noncombatant Evacuation Operations	**Naval Munitions Site, Andersen AFB, Naval Base Guam Barrigada, Navy Base Guam Telecommunications Site**	**2**	**5**
Naval Special Warfare (NSW)			
Personnel Insertion/Extraction	**Naval Munitions Site, Andersen South, beach locations at Andersen AFB (Tarague Beach), Naval Base Guam Main Base, and Naval Base Guam Telecommunications Site**	**150**	**240**
Parachute Insertion	**Various drop zones on Navy lands**	**12**	**20**
Embassy Reinforcement	Naval Munitions Site, Andersen AFB, Andersen South, Naval Base Guam Barrigada, Navy Base Guam Telecommunications Site	50	50
Direct Action (Combat Close Quarters)	**Naval Munitions Site, Andersen AFB, Andersen South**	**40**	**72**
Direct Action (Breaching)	**Naval Munitions Site, Andersen AFB, Andersen South**	**40**	**72**
Intelligence, Surveillance, Reconnaissance (ISR)	Naval Munitions Site, Andersen AFB, Andersen South	16	16
Urban Warfare Training	**Naval Munitions Site, Andersen AFB, Andersen South**	**8**	**18**
Other Training Activities			
Maneuver (Convoy, Land Navigation)	Naval Munitions Site, Andersen AFB, Andersen South	16	16
Water Purification	**Naval Base Guam**	na	16
Field Training Exercise	Naval Munitions Site, Andersen AFB, Andersen South	100	100
Force Protection	Naval Munitions Site, Andersen AFB, Andersen South	75	75
Anti-terrorism	Naval Munitions Site, Andersen AFB, Andersen South	80	80
Seize Airfield	Airfields on Naval Base Guam and Andersen AFB (Northwest Field)	12	12
Airfield Expeditionary	Airfields on Naval Base Guam and Andersen AFB (Northwest Field)	12	12
Land Demolitions (Improvised Explosive Device Discovery/Disposal)	Hardened-surface airfields on Naval Base Guam and Andersen AFB (Northwest Field)	120	120
Land Demolitions (Unexploded Ordnance) Discovery/Disposal	**Explosive ordnance units conduct disposal of unexploded ordnance. Training is incidental to the emergency disposal of unexploded ordnance. Disposal occurs at Andersen AFB EOD Range. Emergency detonations may occur at Andersen AFB EOD Range and Naval Munitions Storage.**	**200**	**236**

Notes:
1. Activities in **bold text** are activities that are proposed to increase in the number of occurrences per year relative to the number of exercises previously analyzed in the 2010 MIRC Biological Opinion. Activities that are not in bold text will not increase in occurrences per year.
2. AFB = Air Force Base; na = not applicable, not analyzed previously in the 2010 MIRC Biological Opinion

Table 3-1: Typical Training Activities in the Action Area on Rota, Tinian, and Saipan

Activity Name	Location			Baseline Number of Activities	Proposed Number of Activities
	Rota	Tinian	Saipan		
Strike Warfare					
Combat Search and Rescue	X	X	-	60	80
Amphibious Warfare					
Amphibious Assault	-	X	-	4	6
Amphibious Raid	-	X	-	2	6
Urban Warfare Training	-	X	-	17	36
Noncombatant Evacuation Operations	X	X	-	2	5
Naval Special Warfare					
Personnel Insertion/Extraction	X	X	-	150	240
Parachute Insertion	X	X	-	12	20
Embassy Reinforcement	X	X	-	50	50
Direct Action (Combat Close Quarters)	-	X	-	40	72
Direct Action (Breaching)	-	X	-	40	72
Intelligence, Surveillance, Reconnaissance	X	X	X	16	16
Urban Warfare Training	X	X	X	8	18
Other Training Activities					
Maneuver (Convoy, Land Navigation)	-	X	X	16	16
Water Purification	X	X	X	NA	16
Field Training Exercise	X	X	X	100	100
Force Protection	X	X	-	75	75
Anti-terrorism	X	X	-	80	80
Seize Airfield	X	X	X	12	12
Airfield Expeditionary	X	X	X	12	12
Land Demolitions (Improvised Explosive Device Discovery/Disposal)	-	X	-	120	120
Land Demolitions (Unexploded Ordnance) Discovery/Disposal	-	X	-	200	236

4 ASSESSMENT OF MILITARY TRAINING ACTIVITIES ON FARALLON DE MEDINILLA

4.1 DESCRIPTION OF THE PROPOSED ACTION AND ACTION AREA

4.1.1 PROPOSED ACTIVITIES DESCRIPTION

4.1.2 FDM is the DoD's only U.S.-controlled range available for live-fire training for forward deployed military forces. The air and sea space surrounding FDM provides sufficient room for the many different attack profiles necessary to replicate training opportunities in the CNMI. FDM presents a unique opportunity to maintain capability and proficiency in precision-guided weapons and specific target engagement. The range supports strike warfare exercises (air to ground bombing exercises, air to ground gunnery exercises, and missile and rocket exercises), amphibious warfare activities (fire support exercises from cruisers and destroyers), and Naval special warfare activities (direct action exercises using tactical air control).

Number of Activities

Table 4-1 lists each training activity, the baseline number of activities and ordnance amount currently approved for FDM, and the proposed changes in frequency and ordnance use of the island.

Table 4-1: Baseline and Proposed Training Activities on Farallon de Medinilla

Activity Name	Baseline Activities	Proposed Activities
	Number of Exercises (per year)	Number of Exercises (per year)
Strike Warfare		
Bombing Exercise Air-to-Ground	1,300	2,300
Gunnery Exercise Air-to-Ground	22	96
Missile Exercise	60	85
Amphibious Warfare		
Fire Support Exercise-Land Based Target (FIREX [Land])	8	10
Naval Special Warfare		
Direct Action (Tactical Air Control Party)	3	18

Ordnance Expenditures The FDM range is operated in accordance with the terms and conditions specified in the 2010 Biological Opinion (U.S. Fish and Wildlife Service 2010), for the take of Micronesian megapodes on FDM.

Appendix B. MIRC/MITT Conservation Measures

MIRC/MITT Conservation Measures
February 20, 2015

The following list of Conservation Measures (CM) serves to consolidate those CMs offered in Navy's August 2014 BA for the action, the US Fish and Wildlife Service's (Service) draft Biological Opinion (BO) transmitted to the Navy on December 18, 2014, Appendix B of that draft (the MIRC BO and MITT BA Conservation Measures comparison table, as updated December 15, 2014) and December 2014 agreements between Navy and the Service regarding the description of the action on Tinian specific to beach use and potential effects to sea turtles.

This list replaces the December 18, 2014 draft BO Appendix B. It allows participating DoD Branches and units to more efficiently reference them to ensure their implementation.

I. CONSERVATION MEASURES APPLICABLE THROUGHOUT THE ENTIRE ACTION AREA

BIOSECURITY

Brown Treesnake (BTS) Interdiction and Control

1. Upon completion of the MIRC Reinitiation BO and other pending consultations, Navy will update the COMNAVMARIANASINST 3500.4A to reflect the language contained in these Biological Opinions applicable to range users. Navy will also finalize a new Joint Region COMNAVMAR Brown Treesnake instruction, which will contain the Brown Treesnake Control and Interdiction Requirements. These efforts shall be prepared in coordination with the Service and other stakeholder agencies.

2. Training activities will undergo a pathway risk analysis as a tool to improve programmatic efficiency while preventing the spread or introduction of BTS.

3. The Navy, in compliance with Public Law 110-417, [Division A], title III, Section 316, October 14, 2008, 122 Statute 4410 and per Department of Defense (DoD) Transportation Regulations, Chapter 505 protocols, is committed to implementing 100% inspection of all aircraft and all cargo/equipment leaving Guam via vessel or aircraft for an off-island destination with trained brown treesnake personnel and qualified canine detection teams. The skills and standards required to certify personnel, including canine inspection teams, as "qualified" will be agreed upon mutually by DoD and the Service. These teams may be supplemented with qualified personnel to meet 100 percent inspection goals for training activities.

a. Missed Brown Treesnake Inspections - In the event military units, vehicles, or equipment accidentally leave Guam without inspection, as soon as possible, the Navy will notify the qualified brown treesnake interdiction program and the destination port or airport authorities. The Navy will work with the destination authority(ies) to resolve the issue. Urgency of notification is a priority so that rapid response or other actions can be implemented to reduce risk, if warranted.

b. Tactical Approach Exercises/Events - To the maximum extent practicable, the Navy will route inbound personnel and cargo for tactical approach exercises (that require an uninterrupted flow of events) directly to CNMI training locations to avoid Guam seaports and airfields to the extent possible. If Guam cannot be avoided for tactical approaches, the Navy will work with the U.S. Fish and Wildlife Service to

identify and implement appropriate interdiction methods at the receiving port (Rota, Saipan or Tinian). Methods may include redundant inspections or other interdiction actions, such as multiple inspections or barrier use on Guam. In addition, tactical approach exercises will involve only cargo/equipment that has not originated from areas containing a brown treesnake population or will be 100 percent inspected by qualified brown treesnake canine detection programs.

c. Administrative/Logistic Movements - The Navy is committed to implementing redundant inspections after discussions with appropriate stakeholders. Redundant inspections include inspections on Guam and at the receiving ports (Rota, Saipan or Tinian) for administrative and logistical movements within the MITT action area that do not require a tactical approach to complete the training requirements. It is anticipated that redundant inspections would utilize existing quarantine and inspection protocols at receiving ports in the CNMI to the extent possible. However, should inspection coverage be inadequate, the Navy will provide inspection teams to fully implement quarantine and inspection protocols. Appropriate stakeholders include, but are not limited to the U.S. Fish and Wildlife Service to ensure the inspections are adequate to reduce risks to trust resources, receiving jurisdictions and their supporting agencies with expertise in invasive species control, and other inspection authorities as needed to ensure inspection methods are current and revised as new techniques, technology, or data become available.

d. Movements Involving Farallon de Medinilla (FDM) - The Navy will consider all movements between Guam and FDM as tactical in nature and work with appropriate stakeholders to determine the appropriate interdiction methods required for aircraft, personnel, and equipment/gear movements. All aircraft and equipment/gear will be 100 percent inspected prior to departing Guam. Additional interdiction measures on Guam may be required after discussions with appropriate stakeholders. Training operations that go from Guam to Saipan and then FDM will require canine inspection on Saipan or other BTS inspection as mutually agreed upon by the DoD and the Service. For training that starts on Guam and goes directly to FDM, visual inspections for BTS will be conducted by military or UXO personnel upon arrival on FDM.

4. The Navy will establish snake-free quarantine areas (barriers) as deemed necessary by the Navy and U.S. Fish and Wildlife Service for cargo/equipment traveling from Guam to CNMI and locations outside of the MITT action area. Barriers will be used if the volume of cargo/equipment/vehicle movement out-paces the available canine inspection capacity or BTS quarantine capacity. The snake-free quarantine areas will be subject to: (1) multiple day and night searches with appropriately trained interdiction canine teams, (2) snake trapping, and (3) visual inspection for snakes. Standard operating procedures will be developed based on the barrier size needed for the training event(s). Temporary barriers will be constructed and maintained in a manner that assures the efficacy of the barrier and that staff maintaining and constructing the temporary barriers will receive training related to this activity prior to construction and operation. Barrier specifications as well as the qualifications of BTS barrier maintenance and management staff will be mutually agreed upon by DoD and the Service.

5. Navy will (1) coordinate closely with the Service1 and the CNMI Department of Land and Natural Resources staff on planning for training activities in the CNMI; (2) coordinate with the other DoD action agencies implementing the MITT program and the Service to identify the inspection and interdiction requirements for MITT program-related training activities, including the number of trained quarantine

1 Currently, the Service point-of-contact (POC) for these planning activities is the CNMI Brown Tree Snake Program Coordinator (Coordinator). If the agency affiliation of that Coordinator changes, the Service shall formally designate a new Service POC and advise the DON and other DOD action agencies associated with the MITT Program within 10 working days.

officers and canine detection teams required to ensure that the inspection and interdiction requirements for MITT program-related training activities can be met; (3) coordinate with the Service on the inspection and interdiction requirements identified by the Navy prior to the implementation of the exercise or training activity; and (4) identify the support that the Navy will need to provide for the inspections and develop plans to ensure that inspection personnel are available and all requirements are met.

6. Navy will utilize ongoing adaptive management to improve methods for BTS rapid response, including detection of low-density snake populations using all technologies as they become available. The Navy will annually review BTS rapid response needs with the Service to mutually determine if refined methods need to be implemented; the Navy will support such refinement based on that mutual agreement. Support for this adaptive management approach will include financial support subject to Congressional funding guidelines and restrictions. All parties acknowledge financial support is subject to the availability of funds, and no provision herein shall be interpreted to require obligation of payment of funds in violation of the Anti-Deficiency Act, 31 U.S.C Section 1341

7. MITT action proponents will provide support for BTS rapid response associated with a BTS sighting with the JRM AOR related to MIRC training activities subject to this consultation.

8. The Navy will provide brown treesnake awareness briefings for all military and contractor personnel prior to all MITT training activities. Brown treesnake awareness briefings will be scaled to the type of training activity to take place. Awareness materials may consist of a brown treesnake educational video and distribution of brown treesnake information and personal inspection guidelines. Awareness briefs will emphasize that brown treesnake awareness must extend through the chain of command from the Commanding Officer to the individual military service member.

9. Joint Region Marianas (JRM) will assure that "Area Training" coordinates meetings for BTS interdiction on all training activities for the training execution phase and an after-action review phase. If a snake is found during training, the Navy policy is to kill the snake and is reported to Navy Environmental Staff.

10. The Navy will invite the Service to participate in the development of regional standard operating procedures and exercise planning to better meet BTS management needs associated with MITT training.

Other Invasive Species

11. Prior to each exercise that involves the movement of equipment and troops between islands, a pathway risk analysis will be conducted and biosecurity protocols confirmed by the DoD (JRM). Implementation of biosecurity protocols will be a requirement for training. An adaptive management review of risk analyses and biosecurity protocols will be conducted periodically with the Service. Initially, this adaptive management review will include the development of Standard Operating Protocols (SOPs) for biosecurity by the DoN in support of training activities covered under the MITT program. These DoN biosecurity SOPs will be reviewed by the Service when initially developed. Once the MITT program is implemented, MITT program-related SOPs will be reviewed with the Service annually.

12. In coordination with the Service, the DoD action agencies implementing MITT activities will establish a contractual agreement for adequate rapid response capabilities with appropriate agencies having invasive species rapid response expertise and technology within three months of the Service's issuance of this Biological Opinion. The contracted services will focus on control and eradication of introduced

non-established, non-native invasive species sighted in the vicinity of: (1) DoD MITT training areas, and (2) DoD areas and facilities used for the staging, storage and movement of MITT personnel, cargo, and MITT-associated vehicles (e.g., planes, trucks, and vessels). Priority should be given to non-native invasive species that pose a high risk of being transported elsewhere due to MITT-related training actions. This arrangement will be in place until superseded by a regional rapid response plan2. Monitoring will consist of the established protocols for USDA inspections, personnel awareness during pre-event preparations, and self-inspections. As noted above, an adaptive management review of risk analyses and biosecurity protocols will be conducted periodically with the Service.

13. All personnel involved in MIRC/MITT training will be responsible for conducting self-inspections to avoid potential introductions of invasive species to Guam and the CNMI. Troops will inspect all gear and clothing (e.g., boots, bags, weapons, and clothing) for soil accumulations, seeds, invertebrates, and vertebrates).

14. Navy will adhere to AFPMB Technical Guide 31 protocols on vehicle/equipment washdown procedures and other APHIS PPQ inspection procedures for deployments and redeployments.

EROSION CONTROL

15. The Navy will locate ground-disturbing training activities on previously disturbed sites whenever possible.
16. The Navy will ensure that all training areas, including transit routes necessary to reach training areas, are clearly identified or marked. Vehicular activities will be restricted to designated and previously identified areas.

17. The Navy will continue to control erosion through the "Site Approval Process," whereby the Navy environmental program reviews each proposed project for its erosion potential and involves the designated installation Natural Resource Specialist in the process.

18. The Navy will continue to manage erosion in accordance with the applicable storm water pollution prevention plan at each training location.

19. The Navy will prohibit off-road vehicle use except in designated off-road areas or on established trails.

20. The Navy will comply with existing policies and management activities to conserve soils, including requirements and restrictions outlined in the Marianas Training Handbook.

II. FARALLON de MEDINILLA

21. The Navy will continue to implement targeting and access restrictions, such as: (1) no targeting of the northern Special Use Area (north of the No Fire Line) and no targeting of the narrow land bridge, (2) only targeting Impact Areas 1, 2, and 3 during air-to-ground bombing exercises and air-to-ground missile

2 The regional rapid response plan discussed refers to the full implementation of a comprehensive Emergency Response Plan for Guam and the CNMI in association with the Regional Biosecurity Plan (RBP) for Micronesia and Hawaii. The RBP is discussed further in the MIRC re-initiation / MITT Biological Opinion.

and gunnery exercises; Impact Area 1 (closest to the northern Special Use Area) is for inert ordnance only, and (3) personnel are not authorized on FDM without approval from JRM Operations.

22. Live cluster weapons/scatterable munitions, fuel air explosives, incendiary munitions, depleted uranium rounds, or bombs greater than 2,000 pounds will be prohibited. It should be noted that some spotting charges use small amounts of phosphorous but are not main constituents of munitions dropped on FDM. In addition, smoke markers will be used during some direct action activities for targeting.

23. Nesting sea turtles are not expected; however, it is possible that a sea turtle may be basking on beaches or resting in holes or caves. If a sea turtle is seen on a beach by participating aircraft, training will be altered until the sea turtle leaves the beach and nearby waters.

III. SAIPAN

24. Training in the Marpi Maneuver Area is expected to be infrequent and limited to pedestrian land navigation training.

a. Training will be limited to open areas (i.e., grasslands; no forest or mixed shrub and scrub habitats) to minimize impacts to nightingale reed-warblers, Mariana fruit bat, and Micronesian megapodes.

b. There will be no digging in the soil or cutting of vegetation along the southern border of the Marpi Maneuver Area in the mixed limestone forest. No ground disturbance or vegetation removal of any kind is permitted in this area to avoid impacts to the Micronesian megapode and Mariana fruit bat. Vegetation removal would be limited to the maintenance of existing bivouac areas. No new bivouac areas are proposed. Maneuver units will remain tactical and not establish support camps. This measure is designed to minimize potential impacts associated with ground maneuvers on the Micronesian megapode No habitat will be removed for any training activity on Saipan.

c. Smoking is not permitted during training activities and fire-safe-portable receptacles for cigarette butts are used during periods of rest between training activities. No fires are permitted during bivouac activities.

d. If other areas are needed for training, the Navy will contact the Service regarding the need for reinitiation of this biological opinion.

e. All training activities that involve ground maneuvers in the Saipan Marpi Maneuver Area will be consistent with the fire management plan included in COMNAVMARIANASINST 3500.4A.

25. JRM will coordinate with CNMI-DLNR to determine the latest species locations as necessary prior to training actions. If a training exercise cannot be modified to avoid impacts on listed ESA species, the Navy will contact the Service as required by Section 7 of the ESA prior to conducting the training exercise. If CNMI-DLNR is not able to assist with best available data or surveys, Joint Region Marianas will provide in-house or contracted subject matter experts to conduct surveys if necessary.

IV. TINIAN

Training Restrictions:

26. All training activities that involve ground maneuvers on Tinian Military Lease Area will be consistent with the fire management plan included in COMNAVMARIANASINST 3500.4A.

27. The Navy will locate ground-disturbing training activities on previously disturbed sites whenever possible. Training areas, including transit routes necessary to reach training areas will be clearly marked. On Tinian, vehicular activities will be restricted to designated and previously identified areas.

28. The Navy will implement training restrictions at Unai Chulu, Unai Babui, and Unai Dankulo to avoid and minimize effects to sea turtles:

a. Unai Chulu, Unai Babui, and Unai Dankulo will not be designated as landing zones for mechanized amphibious vehicles at this time. Should mechanized amphibious vehicles (AAV and LCAC) landings on those beaches become necessary, Navy will reinitiate consultation for those activities.

b. Biologists trained in identifying sea turtle nests will survey landing beaches no more than six hours prior to the first non-mechanized craft landing or use of other beach landing equipment that is part of a training event that requires use of the beach. Any potential sea turtle nests will be flagged and avoided by landing craft and personnel, vehicles (including non-mechanized water craft) and equipment. The buffer zone will have a radius of 6 meters (20 feet) from the edge of the nesting activity (area disturbed by the turtle) to ensure complete avoidance. Use of a beach monitor during the training event and turtle-friendly lighting will avoid impacts to nesting females.

c. If an active nest has been discovered, night-training will not occur after 50 days of incubation until the nest has hatched OR a buffer (9 meters [30 feet] wide) from the active nest to the water will be in place to avoid any potential impacts to sea turtle hatchlings trying to reach the ocean. If an active nest has been discovered, night-training will not occur once a prehatch hole is detected. (A pre-hatch hole indicates that the nest will hatch that evening.) Evening training may resume five days after the pre-hatch hole is discovered.

d. For any training on beaches at night during the sea turtle nesting season, only turtle-friendly lighting will be used. No lighting will be used in the vicinity of nests that are past 50 days of incubation.

29. Improvements to any beaches to facilitate training will be coordinated with the Service if the action may affect listed species.

30. On Tinian, Hagoi and adjacent areas are designated as a "No Training Area." No ground disturbance or vegetation removal of any kind is permitted in this area. This measure is designed to avoid impacts associated with ground training activities on the Mariana common moorhen. Training also does not occur in the Bateha or Mahalang wetlands areas.

31. Aircraft overflights are restricted over Tinian wetland areas (Hagoi, Mahalang, and Bateha). If aircraft must fly over wetlands during training exercises, the aircraft must maintain a minimum altitude of 1,000 feet (305 meters) AGL. This measure is designed to minimize visual and noise disturbance for Mariana common moorhens, and to reduce the potential for aircraft strike.

32. On Tinian, training does not occur in limestone forests, found within the Tinian MLA along ridgelines associated with Mount Lasso (see COMMNAVMARIANAS 3500.4A, Figure 5-2). This measure is designed to avoid impacts associated with ground training activities on the Micronesian megapode. Vegetation

removal would be limited to the maintenance of existing bivouac areas. No new bivouac areas are proposed. Maneuver units will remain tactical and not establish support camps. This measure is designed to minimize potential impacts associated with ground maneuvers on the Micronesian megapode.

33. Aircraft overflights are restricted over limestone forest areas of Tinian, which are found within the Tinian MLA along ridgelines in the Mount Lasso area. If aircraft must fly over limestone forests during training exercises, the aircraft must maintain a minimum altitude of 1,000 feet (305 meters) AGL. This measure is designed to minimize visual and noise disturbance of Micronesian megapodes and fruit bats and to reduce the potential for aircraft strike (see COMNAVMARIANASINST 3500.4A, Figure 5-2).

Fire Prevention: (See COMNAVMARIANASINST 3500.4A Table 5-1)

34. No live-fire or tracer rounds will be used on Tinian except with the use of bullet traps. Use of pyrotechnics, flares, blank fire, and other potential fire-starting activities must be conducted on existing cleared runways and in accordance with the Fire Prevention Plan. The area authorized for open fires and pyrotechnics is restricted to the North Field and West Field on hardtop surfaces only (except for actual emergency signaling).

35. Cooking by individuals is not authorized in outdoor training areas (except for heating tabs and mechanisms in "meals ready to eat"). Large scale training exercises may include field kitchens in North Field in areas authorized for open fire.

36. North Field's existing runways and taxiways act as fire breaks and fire access roads, and the vegetation is primarily characterized by tangantangan *(Leucaena leucocephala)* thickets. Standard Operating Procedures for all exercises include fire response measures that must be implemented.

37. To date, no wildland fire has been ignited from MIRC training activities on Tinian (or on other DoD lands in the Mariana Islands). However, to further minimize risk and augment military fire response efforts, the Tinian Fire Department maintains a 300-gallon pump truck and fire crew to respond to wildland fires. The Tinian Fire Department also maintains a 750-gallon pumper truck and crew in San Jose to respond to and provide fire service for the southern Tinian and backup Crash-Fire-Rescue support to West Field. The Navy will request the use of Tinian Fire Department assets for major exercises. The request will be made through the West Field command post. The Navy will maintain airfield crash-fire-rescue equipment and crews at North Field for the duration of the exercise. Any military related fires will be controlled prior to the loss of any wetland or native limestone forest habitat is burned. Any military related fires in tangantangan will be controlled prior to the loss of five acres tangantangan habitat.

V. ROTA

38. No training activities will occur near or within critical habitat, habitat occupied by listed species, or other habitats designed for conservation use. If such activities are planned in the future, the Navy will consult with the USFWS pursuant to section 7 of the ESA. Prior to planning exercises on Rota, MIRC Operations (OPS) will coordinate with appropriate local officials on Rota to determine the latest status of species (e.g., species locations). MITT training will be planned such that ESA species will be avoided in accordance with the "areas to be avoided" map provided by USFWS. In May 2014, USFWS provided a map that represents all areas to be avoided that could be occupied by ESA-listed species at any time

throughout the year. This map was overlaid with proposed training locations, critical habitat, and other conservation areas resulting in MITT Biological Assessment Figure 3-1 (August 2014). Green shaded areas represent all areas that could be occupied by ESA-listed species at any time throughout the year. These areas are not proposed for training.

39. Aircraft overflights on Rota, with the exception of landings and takeoffs as part of training exercises (landings, takeoffs, and insertion events at the Rota International Airport), are prohibited below 1,000 feet (305 meters) AGL and within 1,000 feet of coastlines.

40. Activities that involve aircraft training primarily occur on Guam. Rota will only be used when other locations on Guam or the CNMI are not available, use of these locations is not practical, and/or the training mission requirements cannot be met without the use of Rota.

VI. GUAM

41."No Wildlife Disturbance" and "No Training Areas" are designated on Naval Base Guam Orote Point, Naval Base Guam Munitions Site, and Andersen AFB Tarague Beach. Vegetation removal would be limited to maintaining existing bivouac areas. No new bivouac areas are proposed in the MITT BA. Maneuver units will remain tactical and not establish support camps.

42. All training activities that involve ground maneuvers on Guam will be consistent with the fire management plan included in COMNAVMARIANASINST 3500.4A. DoD will continue to implement the following restrictions at all action areas on Andersen Air Force Base:

a. No vegetation clearing except: maintenance required to keep paved surfaces, landing zones, and the drop zones in a safe and useable condition and for bivouac purposes in the bivouac area. Tree species greater than 4-inches in diameter used for foraging, roosting, or nesting of bats and crows will not be removed.

b. Motorized vehicles shall be driven only on prepared surfaces, in the drop zone and landing zones as required and only rubber-tired vehicles will be allowed; no digging is allowed except in the Northwest Field bivouac area; and no harassment or killing of native wildlife is allowed.

c. Use of pyrotechnics and other incendiary devices is limited to paved surfaces, ground pits, or ceramic-lined rooms.

43. Helicopter overflights as part of training activities are prohibited below 1,000 feet (305 meters) above ground level (AGL) over Northwest Field north of the South Runway. This measure is designed to minimize visual disturbance and acoustic noise impacts on foraging or roosting Mariana fruit bats in the Northwest Field area. The satellite tracking station located at Northwest Field also has a flight restriction of 2,500 feet (760 meters) AGL within 1 nautical mile of the station.

44. Overflights as part of training activities along all Andersen AFB clifflines are prohibited below 1,000 feet (305 meters) AGL.

45. Helicopter overflights as part of training activities are restricted throughout the Naval Base Guam Munitions Site below 500 feet (150 meters) AGL. Fixed-wing aircraft are restricted below 1,000 feet (305 meters) AGL as part of training activities.

46. Riparian wetlands are dispersed throughout the Southern Land Navigation Area and recent surveys have detected moorhens in this area. No maneuver and navigation training will occur in riparian wetlands in this area, in accordance with COMNAVMARIANASINST 3500.4A (Table 3-4, pg. 38 and Fig 3-10, pg. 40).

47. Continuance of amphibious landing standard operating procedures; observation of normal harbor navigation rules, pre-exercise surveys for presence of sea turtles no more than six hours prior to an exercise, directing landing crafts to areas determined to be clear of sea turtles and sea turtle nests, restoration of beach topography using hand tools after exercises, monitoring of landing sites during night-time landing activities). These include:

a. The Navy implements restrictions on landings and launches at beach and boat ramp locations to minimize impacts to sea turtles and their habitats.

b. The Navy maintains restrictions on landings and launches, such as the use of the concrete boat ramp at Sumay Cove, which is across from potential sea turtle nesting habitat.

c. The Navy implements speed restrictions to avoid creating wakes; the use of the Sumay Cove ramp avoids and minimizes effects to sea turtle nesting sites.

d. Currently, training does not occur on other Guam beaches that support sea turtles. Should the Navy decide to use other Guam beaches for amphibious landings, the Navy will implement appropriate measures.

48. The USAF implements training and operation restrictions at the Combat Arms Training and Marksmanship (CATM) range adjacent to Tarague Beach, Andersen AFB to minimize effects to sea turtles and Mariana fruit bat.

a. Night-training occurs at the CATM range; therefore night-lighting is installed. The lighting configuration at this location is maintained with four flood lights, located below the tree canopy level that are directed inland and parallel to the coast. Lighting in this configuration will avoid impacts to nesting and hatching sea turtles and Mariana fruit bats.

b. The CATM range allows for training with small arms, inert mortars to 60 millimeter, and 40 millimeter grenade launchers. These weapons do not produce percussive force and no weapons that produce percussive force can be used at this facility.

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F1M USFWS, Revision to BO on the Mariana Islands Training and Testing Program (February 2016)

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United States Department of the Interior

FISH AND WILDLIFE SERVICE
Pacific Islands Fish and Wildlife Office
300 Ala Moana Boulevard, Room 3-122
Honolulu, Hawaii 96850

FEB 2 ' 2016

In Reply Refer To:
01EPIF00-2009-F-0345
01EPIF00-2014-F-0262

Rear Admiral Bette Bolivar
Department of the Navy
Joint Region Marianas
Building 200, Room 326
Halsey Drive, Nimitz Hill
Piti, Guam 96915

Subject: Revision to Biological Opinion on the Mariana Islands Training and Testing Program

Dear Admiral Bolivar:

This follows up on our letter of April 14, 2015, regarding a term and condition in our February 20, 2015 biological opinion on the Mariana Islands Training and Testing (MITT) Program. We are enclosing an amendment to the biological opinion that revises the term and condition.

As originally written, the term and condition called for the Defense Department (DoD) action agencies to eradicate introduced ungulates on the island of Aguiguan in order to minimize the effects of habitat destruction causing take of the endangered Micronesian megapode. After further discussion between DoD and the Fish and Wildlife Service (Service), we have prepared a revision to provide flexibility in how the intended result is achieved and address DoD's concerns regarding implementation. Under the term and condition as revised, DoD will provide funding, not to exceed $1.77 million, for invasive vertebrate pest control and the Service will implement the control action. As part of implementation, the Service will identify where control will be conducted, comply with all applicable legal requirements, and provide DoD with an implementation plan and budget. The term and condition also states that, except for the funding, DoD is not responsible for project implementation or results, and failure to implement or achieve the desired results will not be cause for reinitiation.

If you have any questions regarding this Biological Opinion, please contact Earl Campbell at the letterhead address or by telephone at (808) 792-9400.

Sincerely,

for Mary M. Abrams, PhD
Field Supervisor

cc: Richard Seman, Secretary, CNMI Department of Land and Natural Resources

COPY

ADDENDUM TO BIOLOGICAL OPINION ON THE MARIANA ISLANDS TRAINING AND TESTING (MITT) PROGRAM

The biological opinion for the MITT program, dated February 20, 2015, is hereby revised by deleting paragraph 1.1 of the Terms and Conditions and replacing it with the following.

1.1 The DoD action agencies for the MITT program shall provide funding, not to exceed $1.77 million, for invasive vertebrate pest control to be implemented by the Service to minimize the effect of take on the Micronesian megapode. The Service will be responsible for identifying where invasive vertebrate pest control will be conducted; complying with all applicable legal requirements and obtaining required approvals; providing DoD with an implementation plan and associated budget; implementing the control action; and responding to related media inquiries. Except for providing the necessary funding, DoD is not responsible for project implementation or the results thereof, and failure to implement the control project or achieve the desired results will not be cause for reinitiation.

F1N USFWS, BO for the Permanent Stationing of the Terminal High-Altitude Area Defense System on Andersen AFB, Guam (July 2016)

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United States Department of the Interior

FISH AND WILDLIFE SERVICE
Pacific Islands Fish and Wildlife Office
300 Ala Moana Boulevard, Room 3-122
Honolulu, Hawaii 96850

In Reply Refer To:
01EPIF00-2015-F-0020
01EPIF00-2001-F-0001

JUL 2 6 2016

Colonel Douglas Waddingham
Chief of Operations
94th Army Air and Missile Defense Command
Joint Base Pearl Harbor-Hickam, Hawaii 96818

Subject: Biological Opinion for Permanent Stationing of the Terminal High-Altitude Area Defense System on Andersen Air Force Base, Guam

Dear Colonel Waddingham:

This document transmits the U.S. Fish and Wildlife Service's (Service) biological opinion based on our review of the emergency placement and permanent stationing of the Terminal High-Altitude Area Defense System (THAAD), on Northwest Field, Andersen Air Force Base (AAFB), in northern Guam and its effects on the endangered Mariana crow (*Corvus kubaryi*) (crow), Guam rail (*Gallirallus owstoni*) (rail), Guam Micronesian kingfisher (*Todiramphus cinnamominus cinnamominus*) (kingfisher), the threatened Mariana fruit bat (*Pteropus mariannus mariannus*) (fruit bat), *Cycas micronesica* (cycad), and *Tabernaemontana rotensis*. Your request for formal consultation was received on February 9, 2016. Our response is in accordance with section 7 of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 *et seq.*). This biological opinion is based on information provided in your letter and biological assessment, discussions between the Service and the Army, and other information in our files. A complete administrative record of this consultation is on file at the Pacific Island Fish and Wildlife Office (PIFWO).

In addition, pursuant to the requirements identified in the Cooperative Agreement between the U.S. Air Force, Department of Navy (DON), and the Service for the establishment and management of the Guam National Wildlife Refuge, we have provided coordination regarding potential impacts to the Guam National Wildlife Refuge Overlay from the proposed project. This consultation reviews anticipated effects to the listed species and federally designated critical habitat in Guam. In this consultation, habitat is defined as the habitat that is currently suitable to support the survival and recovery of listed species.

Consultation History

March 12, 2013: JRM informs the Service of the emergency deployment of the THAAD.

August 7, 2013: JRM staff spoke with Service staff via phone and email about the necessity of a new consultation because the JGPO 2010 and Cargo Drop Zone (CDZ) (2001-F-0001) could

potentially cover the habitat modification and effects of the THAAD action. However, the Navy may decide to pursue a new and separate consultation.

August 27, 2013: Service staff informs Joint Region Marianas (JRM) staff that the THAAD missile defense system cleared area could be covered under the 2010 JGPO BO (2010-F-0122) and requested total acreage to confirm if the JGPO BO, combined with the Cargo Drop Zone BO would cover the extent of the THAAD clearing.

On May 16, 2013, Mark Cruz and Anne Brooke from JRM contacted Earl Campbell, Loyal Mehrhoff, and Leilani Takano of the Service by phone to discuss the consultation process for the THAAD missile battery that was deployed on an emergency basis in April 2013.

On May 30, 2013, Anne Brooke from JRM, and Leilani Takano and Ann Marie Gawel of the the Service, visited the THAAD site.

During August 2013, Anne Brooke (JRM) and Leilani Takano (Service) exchanged emails to clarify the consultation process and relation of expeditionary deployment of the THAAD battery to other completed and ongoing consultations for Department of Defense (DoD) activities on Guam.

During February 2014, Anne Brooke (JRM) and Leilani Takano (Service) exchanged emails regarding the status of the emergency consultation for the expeditionary deployment of the THAAD battery.

March 14, 2014: JRM email to Service staff informing the Service that JRM will be preparing a BA for THAAD.

In September 2014, the Air Force submitted a BA that describes the effects of modifying the CDZ training area on listed and proposed species (AAFB 2014) and requested re-initiation of consultation on September 25, 2014.

On September 10, 2014, representatives of the U.S. Army Space and Missile Defense Command on behalf of the 94th Army Air and Missile Defense Command (AAMDC), and their contractor HDR, met at Guam National Wildlife Refuge with Ecological Services and Refuge staff to discuss the expeditionary deployment of the THAAD battery, describe plans for permanent stationing and operation of the battery, and discuss plans for consultation on this project.

The Service responded on October 30, 2014, and concurred that the proposed modifications were not likely to adversely affect the Guam rail or Mariana fruit bat. However, the Service could not concur that the action was not likely to adversely affect the Mariana crow and Guam Micronesian kingfisher, and therefore requested additional information in order to complete a formal consultation (a Biological opinion) on these species.

On February 18, 2015, representatives of the 94th AAMDC and U.S. Army Space and Missile Defense Command met with Stephen Miller, of the Service, in Honolulu, Hawaii, to discuss the

content of this BA, and the plans of the 94th AAMDC to complete the consultation process for this emergency circumstance.

On March 18, 2015, the Service received a request from DON JRM to discontinue the reinitiation of consultation for Parachute Cargo Drop Training.

On March 26, 2015, the 94th AAMDC submitted a BA and request for concurrence that the emergency deployment and expeditionary operation of the THAAD missile battery in Guam may have affected, but was not likely to have adversely affected the Mariana fruit bat.

The Service responded on September 15, 2015 (letter from K. Young, Service, to Major D. Simmons, 94th AAMDC) stating that they have concluded that actions associated with the deployment and stationing of the THAAD missile battery may affect, and are likely to adversely affect the Mariana fruit bat, Mariana crow, Guam Micronesian kingfisher, and Guam rail, and that formal consultation is therefore required for this project.

On October 8, 2015, representatives of the 94th AAMDC and the Service held a teleconference to discuss the Service's September 15 letter, the future consultation process, and suggested conservation measures.

On 12 October, 2015, Service staff sent the 94th AAMDC revised data layers for habitat of the fruit bat, kingfisher, crow, and rail.

On February 9, 2016, the Service received a request from the 94th AAMDC for consultation on this action.

On February 29, 2016, the Service sent a letter indicating all information required to initiate formal consultation was provided or otherwise accessible for consideration and reference.

On March 18, 2016, Service staff met with representatives for 94th AAMDC via teleconference to discuss further clarifications and to touch base on status of the BO.

PROJECT DESCRIPTION

This action consists of the placement of the THAAD missile battery, which occurred through an emergency action, in April 2013. This consultation covers that emergency action, as well as proposed activities linked to it: a shift (compressed) placement of the THAAD facility, supporting infrastructure, as well as the proposed relocation of Parachute Cargo Drop Zone (CDZ) activities to an adjacent runway. The activities included in the CDZ were analysed in a previous biological opinion (2001-F-0001). The new clearing necessary to carry out these activities are analysed below, in conjunction with the THAAD placement and operation. Since no end date or project length can be anticipated at this time, the proposed action and resulting effects are considered to continue indefinitely in this analysis.
In April 2013, a THAAD missile battery was deployed to Guam on an emergency basis in response to potential hostile North Korean missile launch activity. Currently, the THAAD battery is still in place at Andersen AFB and operating as an expeditionary (temporary) mission.

The THAAD battery (including support facilities, radar, and launch platforms) was placed in an area surrounding the eastern end of the North and South Runways of Northwest Field (NWF) (Figure 1).

During the initial deployment of the expeditionary THAAD missile battery in April 2013, a 249.4-acre emplacement was occupied by Task Force Talon, including a 12.0-acre motor pool established south of the original expeditionary emplacement. Temporary fencing was placed around the site and temporary wooden guard towers were erected within cleared areas.

About 68.3 acres (28 percent) of the 249.4-acre original expeditionary emplacement was comprised of paved runways, taxiways, ramps, and other hard surfaces prior to the expeditionary emplacement. Approximately 145.4 acres (58 percent) of the emplacement, primarily between, and to the east of the runways, were maintained as low, mixed herbaceous scrub for safe operation and use for training activities. The remaining 35.7 acres (14 percent) were forest, scrub, and herbaceous cover. During site preparation for the expeditionary deployment of the THAAD missile battery, all trees and other vegetation on the remaining 35.7 acres were removed and piled within the project site. Estimates of vegetative cover are based on a survey of vegetation on Andersen AFB completed in 2007 (e2M 2008).

Based on habitat maps provided by the USFWS in 2015, 28 to 30 acres of the area cleared in April 2013 was habitat for the Mariana fruit bat, Guam Micronesian kingfisher, and Mariana crow, and 138 acres was habitat for the Guam rail.

• *Fire Control and Communication*: This system component exercises direct control and management of the missile battery, providing the human interface of the automated system functions.

• *Radar Unit*: The radar provides a broad range of surveillance services that perform target search, acquisition, identification, and tracking functions.

• *Interceptor*: The interceptor missile intercepts an incoming hostile missile threat.

• *Launch Platform/Fire Unit*: The truck mounted launchers transport, aim, and launch the interceptor missiles. The THAAD launcher carries a missile round pallet that contains up to eight missiles.

The 12.0-acre motor pool area was established for equipment maintenance and storage, on existing pavement south of Area 50 (which was established and fenced in 1991) (Figure 1). Within the motor pool, one office container (8 feet x 40 feet), one portable Airbeam shelter (40 feet by 56 feet), and other storage containers were installed.

Within the cleared emplacement area, additional changes were made in 2014 for improved system operations during the expeditionary mission. These changes have included compressing the THAAD emplacement perimeter into an 82.0-acre area to allow for greater operational flexibility (Figure 2). The boundary of this compressed expeditionary emplacement falls within the original expeditionary emplacement. Within the new fence line, additional temporary wooden guard towers have been erected.

To provide a more stable foundation for the primary THAAD equipment, several individual concrete pads have been added for the launchers and radar placement, for a total pad area of approximately 28,200 square feet. Additional grading within the compressed expeditionary emplacement was required prior to constructing some of these pads, but no additional vegetation clearing was required. No other clearing or construction is planned for the current expeditionary mission.

Existing billeting and support buildings within the Andersen AFB cantonment area have been repurposed to support the THAAD battery and mission-related personnel. The old base post office, for example, serves as headquarters for Task Force Talon and existing billeting (Tinian Hall) provides housing for the task force's soldiers. Additionally, for munitions storage, the THAAD mission is using existing bunkers located in the Munitions Storage Area 1 just south of the motor pool.

Current expeditionary operations consist of continuous radar surveillance, facility security, routine facility and equipment maintenance, and battle drills (i.e., computer simulations that do not include missiles being launched). Approximately 190 military and 10 civilian support personnel are deployed in support of the THAAD mission. Those personnel are housed in military transient quarters on Andersen AFB and deployed on a rotational, temporary duty assignment basis. Operations are in shifts, which include a mix of approximately 60 contract personnel, military police, and soldiers per shift. Government vehicles are used to travel to and from the battery site.

An X-band radar system has been operating and is proposed to continue operating as a part of this action. The radar system emits electromagnetic radiation (EMR) that could cause tissue damage to wildlife. Radar units normally operate in search/surveillance mode, except when tracking a target or being calibrated or tested. In search/surveillance mode, the main beam of the radar is not aimed at any area in space for more than a small fraction of a second, and the search beam moves in a random pattern. However, during tracking or calibration mode, the beam is steady. Calibration is performed on start-up and on regular intervals, issues, and tracking mode occurs when the unit is actively tracking a flying target such as a missile or a plane. In this mode, the main beam will move in an angle to keep the target in the center of the beam. Targets are normally hundreds of kilometres away. Therefore, while the moving beam might be tracking a fast-moving target, it will be moving slowly at close proximity to the unit – linear velocity of less than 2.5 meter/second (5.6 miles per hour) at 350 meters from the radar (Moran 2015, p. 3)

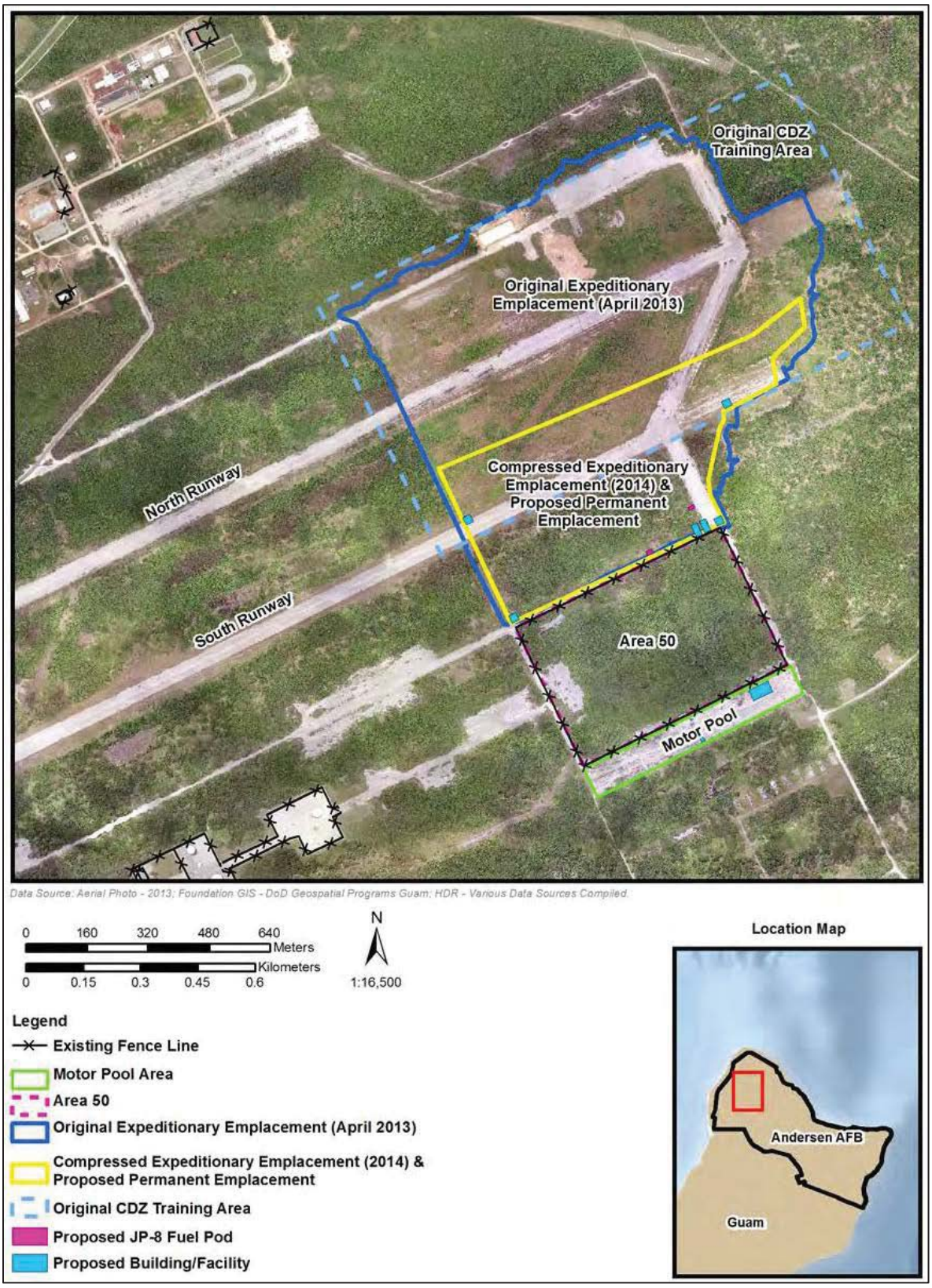

Figure 1. Original THAAD emplacement (figure taken from 2016 BA).

For the permanent stationing of the THAAD battery at NWF, all facilities would be located within the compressed expeditionary emplacement and motor pool footprints shown in Figure 2. All project facilities and activities, with the exception of a fiber-optic communication line

(described below), would be located on existing paved surfaces or within areas maintained or previously cleared of vegetation.

The following facility and site improvements would be installed or developed to meet operational requirements (e.g., power, communications, shelter, and motor pool support) and security protection requirements (e.g., fencing, lighting, and entry control and monitoring systems).

Two security fences would be installed along the perimeter of the proposed permanent emplacement. Each fence would be approximately 7 feet tall and spaced approximately 30 feet apart. Intrusion detection systems would be installed along the fence line. Lighting systems that are shielded and facing downward would also be placed along the fence perimeter. Electrical power and cabling along the new fence line would be trenched underground or encased in hardened conduit.

• *Motor Pool Fence*: The motor pool and roadway along the eastern side of Area 50 would be secured by a single, 7-foot-tall chain-link fence. This new single fence would connect to the existing Area 50 fence and to the dual perimeter fence securing the emplacement site.

• *Concrete Guard Towers*: The current temporary guard towers within the proposed permanent emplacement site would be replaced with four concrete guard towers measuring approximately 20–25 feet in height.

• *Entry Control Facility*: As part of the perimeter security system, an entry control facility building would be constructed at the western end of the motor pool to control entry to authorized personnel and vehicles. The one story building would be approximately 160 square feet.

• *Power Generators*: For improved power generation efficiency at the THAAD battery site, most of the system tactical generators would be replaced with fewer portable generators ranging from 420 kW to 1.3 MW, which would power the emplacement site at all times. To improve fuel storage requirements for the generators, two 10,000-gallon (37,854-liter) JP-8 above-ground fuel pods would be placed nearby. Each pod would be double walled with built-in spill sensors. Delivery and use of power from island electrical circuits is not contemplated at this time, but replacement of generator power with island commercial power could occur in the future.

• *Utilities*: A 2.9-mile fiber optic communications line would be trenched from the Rapid Engineer Deployable Heavy Operational Repair Squadron, Engineer installation on NWF to the emplacement site and to other facilities just to the west (Figure 3). The communication line would be located along existing roadways, paved surfaces, or other disturbances wherever possible. About 5.4 acres would be disturbed, 2.5 acres of which is developed land and 2.9 acres is vegetated with forest or scrub.

• *Big Voice System*: The installation of a big voice system would give the THAAD battery a means to warn personnel of an incoming missile attack or weather advisories. The system would include speakers mounted on a single pole and it would be tied to the phone system to announce warnings at the THAAD emplacement site. The system would be audible out to about 6,560 feet.

• *Roadways*: Within the compressed emplacement site, additional roadway segments would be graded for adequate vehicular access along the fence line. Additionally, pavement improvements to existing roadways leading to the site may be needed. All roadway improvements would be within the compressed expeditionary emplacement or within previously paved areas.

• *Fire Direction Center:* As part of permanent stationing, a fire direction center building for the THAAD battery would be constructed at the southern end of the current emplacement site for operations and administrative support. The single-story, reinforced concrete building would measure 20 feet by 50 feet.

• *Communication Trough*: Between the THAAD radar and the fire direction center, a communication trough would be excavated to run cables. The trough would measure up to 4 feet deep and be constructed of concrete.

• *Drainage System*: To channel storm water away from THAAD equipment at the southern end of the emplacement site, a drainage culvert would be excavated and lined with concrete to funnel water to a ravine at the eastern side of the site. The drainage system also would include installation of an asphalt pad to redirect storm water towards the culvert.

• *Security Control Center (SCC)*: A new building for the security control center also would be constructed at the southern end of the current emplacement site for security force use. The single-story, reinforced concrete building would measure 20 feet by 50 feet.

• *Tactical Equipment Maintenance Facility*: Within the next 3 to 5 years, the current AirBeam shelter in the motor pool area would be replaced with a permanent reinforced concrete, open bay warehouse building of larger size (measuring approximately 70 feet by 107 feet in area. The new facility would be used to provide space and equipment storage for maintaining THAAD mission-related vehicles and associated equipment for all levels of maintenance below depot level. Typical operations in the facility would include inspection, lubrication, preventive maintenance, diagnostic analysis, welding, and replacement of major components.

Once the new facilities are installed and other site improvements completed, day-to-day operations, training, and maintenance activities for the THAAD battery are expected to be similar to that of the expeditionary mission described above. Total THAAD personnel numbers would increase slightly, to approximately 225 of mostly military personnel. In addition, approximately 70 families (about 168 dependents) would move to Guam and be placed in existing or future JRM housing on the island (depending on availability of installation housing). Required support facilities for military personnel and their dependents would be provided through the JRM installations on Guam. No additional facilities, beyond the facilities within the JRM quality of life support structure have been identified.

Exclusion zones established to avoid injury and damage to personnel and equipment from EMR emitted from the THAAD system radar will be maintained, and a permanent airspace restriction will be developed pursuant to FAA regulations.

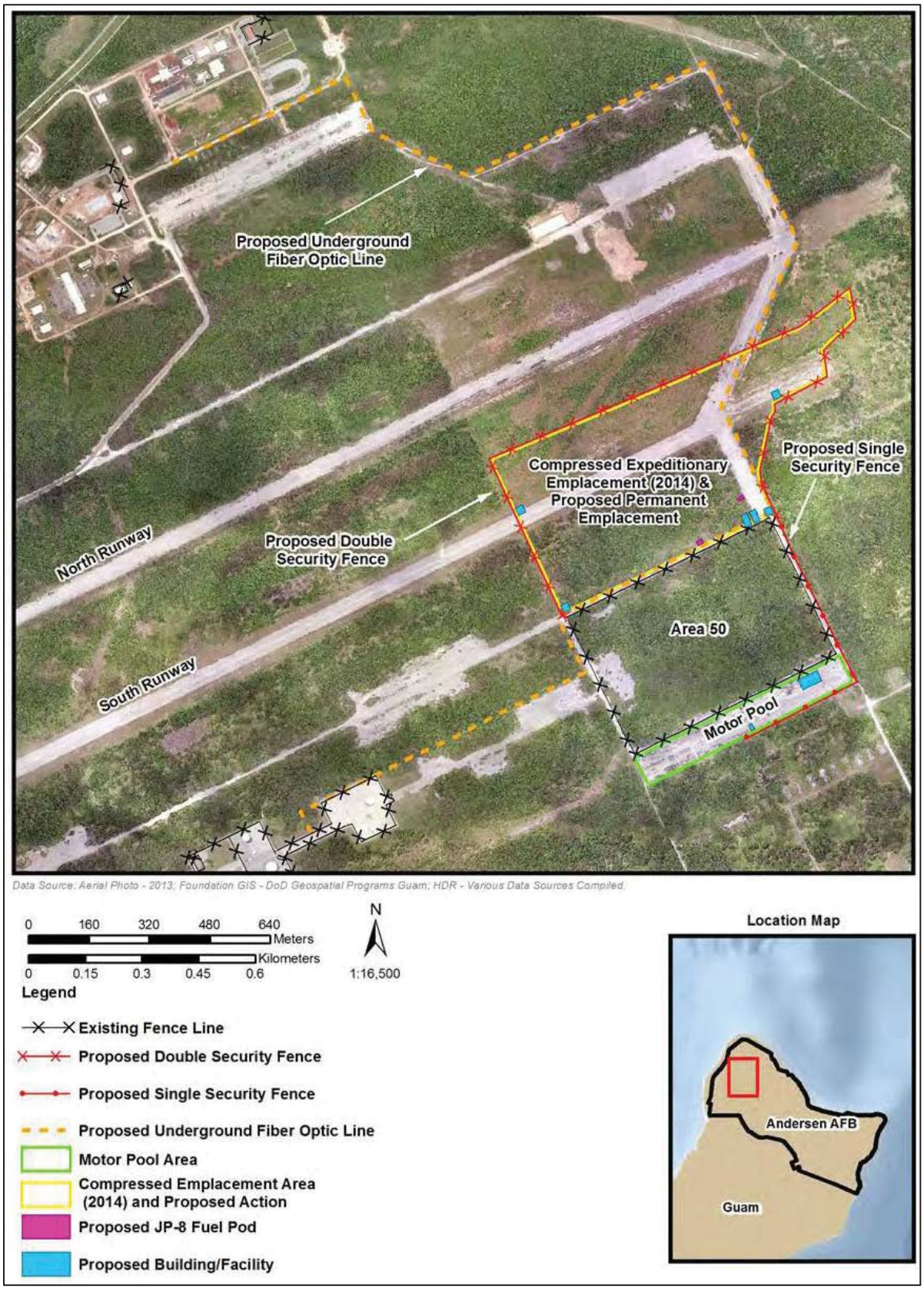

Figure 2. Permanent emplacement (taken from BA, 94th AAMDC 2016).

The new NWF CDZ training area will be approximately 1,950 by 4,500 feet (201.5-acres) (Figure 3) and will be located at the eastern end of the North Runway. To prepare that area, a

288-foot-wide, 29.7-acre area along the northern edge, and outside of, the original 248-acre NWF CDZ must be clear of vegetation. About 3.0 acres there were cleared for the THAAD expeditionary emplacement, leaving 26.7 acres remaining to be cleared. In addition, vegetation might be removed from some areas within the original NWF CDZ training area that remain partially forested, including within a 22.4-acre tract in the north eastern corner of that area. Vegetation might also need to be removed from other, smaller areas within the original training area. Clearing of vegetation within the original NWF CDZ, including the 22.4-acre tract and other small areas that might be cleared, was addressed in the 2000 CDZ biological opinion (USFWS 2000), and loss of habitat and other effects on the species listed at that time, are considered as part of the baseline for analysis of effects of the projects addressed in this BA. To comply with the United States Air Force's runway design specifications for C-130 and C-17 aircraft assault landing zone exercises, all vegetation along the north shoulder (19.0 acres), south shoulder (18.9 acres), and west glide slope area (14.0 acres) of the North Runway, will also be cleared of vegetation using heavy equipment (Figure 3). These areas, totalling 51.9 acres, are outside of the original NWF CDZ, and were not considered in the 2000 CDZ biological opinion.

The south western and south eastern corners of the original CDZ have not been cleared of vegetation, and will now be outside of the CDZ training areas (Figure 3). There are no plans to disturb these two forested areas, which total 15.9 acres, for either the CDZ modification or permanent stationing of the THAAD battery.

All areas to be cleared would be grubbed and graded, and the trees and other vegetative debris piled around the cleared perimeters. It is estimated that it will take about 3 months to complete the vegetation removal.

In summary, a total of 81.5 acres located outside of the original 248-acre NWF CDZ evaluated in the CDZ biological opinion (USFWS 2000) would be cleared, about 70.2 acres of which is forested or covered with perennial shrubs; the remainder is developed land or covered with herbaceous scrub.

In addition to vegetation clearing, resurfacing of the existing North Runway would occur as part of the reconfigured CDZ site. All such improvements would be conducted within previously paved areas. The airborne training activities and exercises at NWF are analysed in the CDZ biological opinion (USFWS 2000).

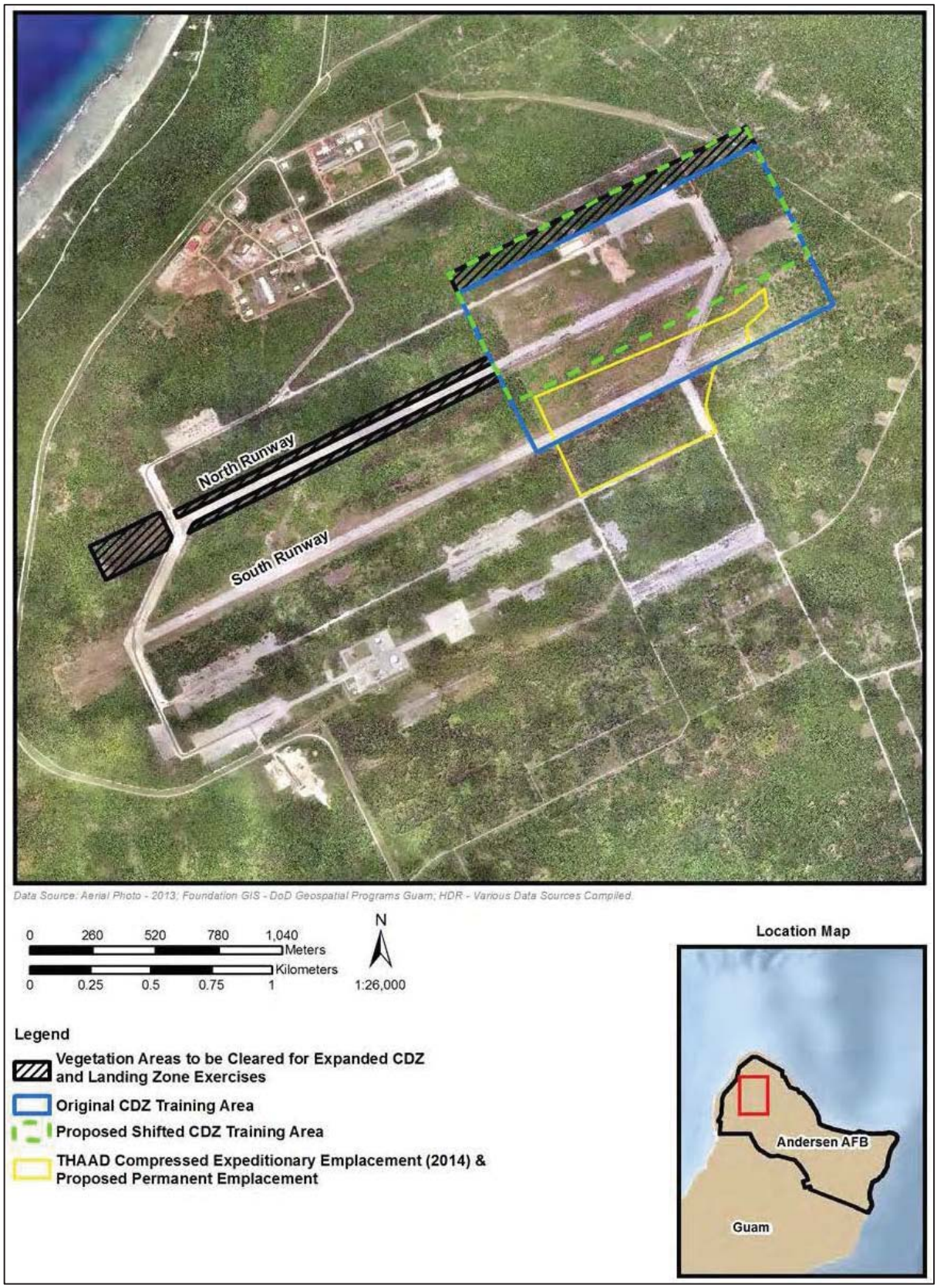

Figure 3. Cargo Drop Zone areas to be cleared (taken from BA, Army 2016).

Description of the action area

The action area consists of mixed limestone forest plateau (secondary), *Casuarina* forest, *Hibiscus* scrub, *Eugenia* forest, *Vitex* forest, mixed herbaceous scrub, and developed land (Figure 4) (e^2M 2008). The finished and proposed activities in this action are within or adjacent to the Northwest Field runways, which were constructed towards the end of World War II in 1944-1945. Much of the vegetation that has grown back over the past 70 years adjacent to these runways remains scrubby and disturbed, dominated by *Casuarina equisetifolia* (ironwood), a native tree characteristic of secondary growth and forest edges. However, many forest species characteristic of primary and secondary limestone forest are interspersed such as *Ochrosia oppositifolia*, *Algaia mariannensis*, and *Guamia mariannae* (A. Gawel, Service, pers. observations 2012-2015). Many invasive plant species also persist within the project footprint, such as *Lantana camara*, *Vitex parviflora*, and *Triphasia trifolia* (A. Gawel, Service, pers. observations 2012-2015).

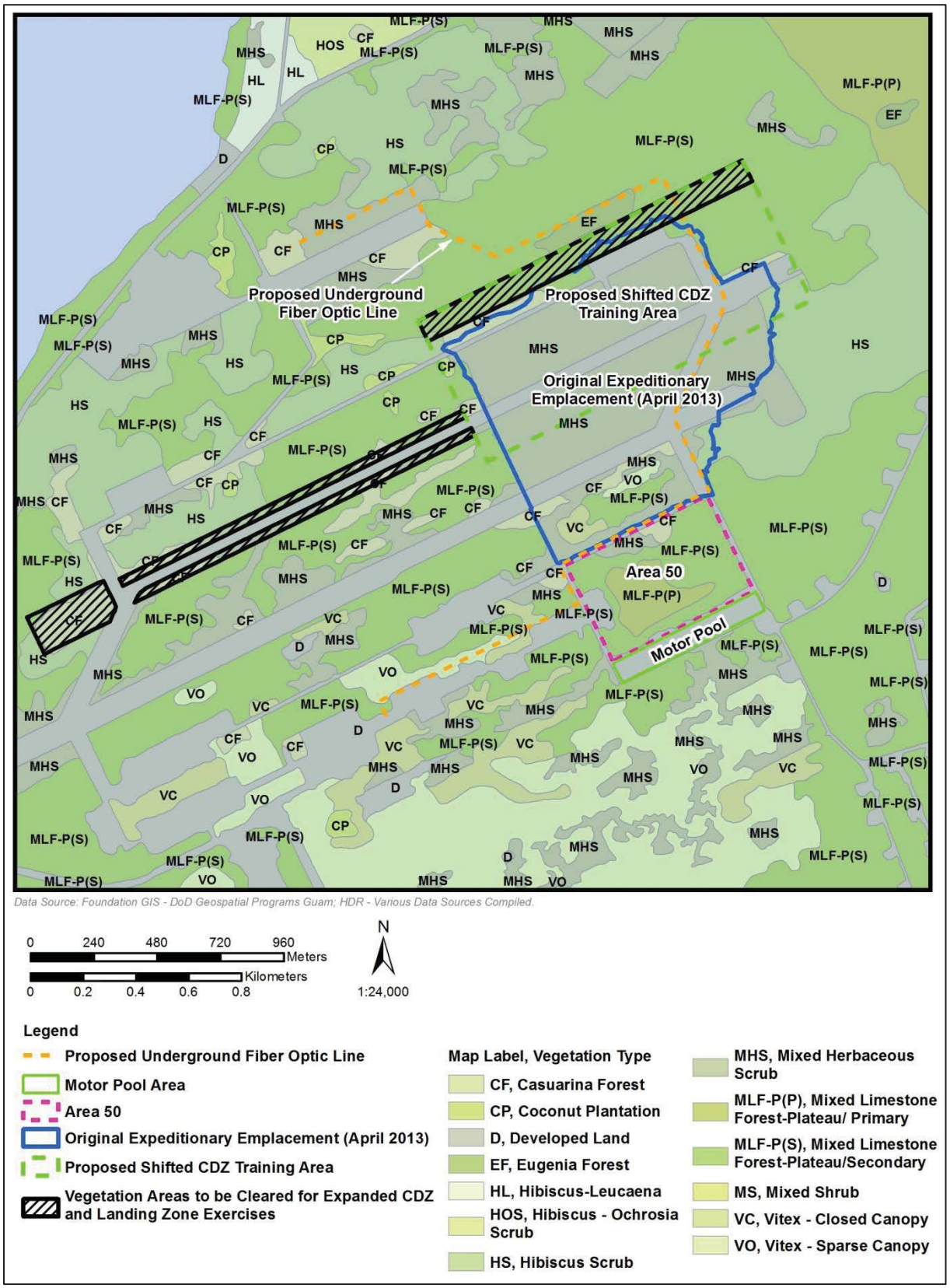

Figure 4. Vegetation communities within and around project footprint. (taken from BA, 94th AAMDC 2016).

Conservation, Avoidance, and Minimization Measures

The following measures to minimize and avoid effects of proposed activities; prevent or reduce the spread of invasive species; and compensate for the loss of habitat currently used by threatened and endangered species on Guam, and that could be used by extirpated species when reintroduced onto Guam, will be implemented by the U.S. Army for the emergency and permanent stationing of the THAAD missile battery on NWF and for modification of the CDZ training area. As the lead agency requesting consultation, the U.S. Army, 9^{4th} Army Air and Missile Defense Command (AAMDC) (94th AAMDC 2016, p. 1-1) will ensure that these measures are carried out. They are a part of the project description.

Avoidance and Minimization for fruit bats: All vegetation clearing and construction activities will occur during daylight hours in order to minimize disturbance to bats. One week prior to vegetation clearing and construction, a qualified biologist will survey the proposed project areas at night and during the day to determine of fruit bats are present. If fruit bats are observed in the project area, clearing and construction will be postponed until the fruit bats have left the area out of their own volition.

Fiber Optics Line Preconstruction Survey: Prior to installation of the fiber optics line, a survey would be conducted of the proposed route for listed species. If any individuals of those species are found, the route will be modified to the maximum extent possible to avoid harming, or otherwise adversely affecting, individuals of those species. Viable saplings and other small individuals of these species, that cannot be avoided, will be collected and transplanted to undisturbed areas.

CDZ Surveys and Plant Relocation: Before additional forested areas are cleared to relocate the CDZ and expand the glide slope and shoulders of the North Runway, a survey would be conducted to locate *Cycas micronesica, Tabernaemontana rotensis,* and any other listed plants. Transport all individuals of listed species, unless the advanced maturity of the plant and other biological circumstances would negate the safe transplant of that specimen, to protected areas.

Lighting: All security lighting on the perimeter fence, at the entry control facility, and elsewhere, will be shielded and pointed down to reduce lighting of surrounding forested areas.

Brown Treesnake Interdiction: THAAD, as a tenant Command located on AAFB within JRM, will continue to comply with 36 Wing Instruction 32-7004 Brown Treesnake Management and additional measures that may be developed by JRM in the future, and when applicable will participate in compliance with the *Regional Biosecurity Plan for Micronesia and Hawaii* (DON 2015). The equipment and materials to be shipped by the Task Force is a very small portion of the materials shipped through DoD and commercial ports on Guam; therefore, ongoing operations and permanent stationing of the THAAD missile battery should not stress the capacity to interdict brown treesnakes there.

Protection and Enhancement of Habitat: The 94th AAMDC, Andersen AFB, and JRM will establish two conservation areas on Andersen AFB totalling 334.7 acres to compensate for the loss of habitat of listed species Figure 5. One conservation area of 330.1 acres would be established south and east of the Andersen AFB main base. The site is contiguous with undisturbed land south of the installation that is owned by the Government of Guam. A second, 4.6-acre site would be conserved in an area northwest of the main base. This second site is

contiguous with a much larger conservation area that is being set aside for durable habitat protection as required by the BO for the JGPO Guam Military Relocation (USFWS 2015a), and as specified in the June 2015 *Memorandum of Agreement (MOA) between the Department of Navy and U.S. Fish and Wildlife Service Regarding Conservation of Guam, Micronesian Kingfisher Recovery Habitat in Northern Guam*.

The new conservation areas will be established and managed to support the following: 1) brown treesnake (BTS) control and suppression to facilitate the larger goal of suppressing snake population levels that will ultimately support kingfisher survival and recovery; 2) support for BTS control and eradication methods development, focusing on tools and techniques needed for landscape level survival and recovery of the kingfisher, 3) ungulate fencing and eradication; 4) control of small mammalian predators; 5) invasive plant control and eradication; 6) native plant restoration; and, 7) localized control of introduced invertebrates that may negatively impact kingfisher nesting/fledging. The Army will commit funding conservation actions within these 334.7 acres above execution year INRMP funding levels (as adjusted for inflation) for the next ten years, subject to Congressional authorization and appropriation. This additional funding will be used to support projects that fall within one of the seven focal activities identified

The conservation areas will total about 334.7 acres. The final size and shape of the established areas might differ from those shown in Figure 5, especially if and when a boundary fence is installed, as that fence will need to avoid steep topography and other obstacles. However, the areas will be designed to conserve approximately 3.9 acres for every acre of Guam Micronesian kingfisher habitat that has been or will be disturbed for the activities addressed in this BA, based on the September 15, 2015 letter from USFWS to the 94th AAMDC. A total of 85.8 acres of kingfisher habitat has been or will be disturbed for the expeditionary and permanent stationing of the THAAD missile battery and modification of the CDZ; thus, 334.7 acres will be protected to mitigate the loss of habitat due to project activities.

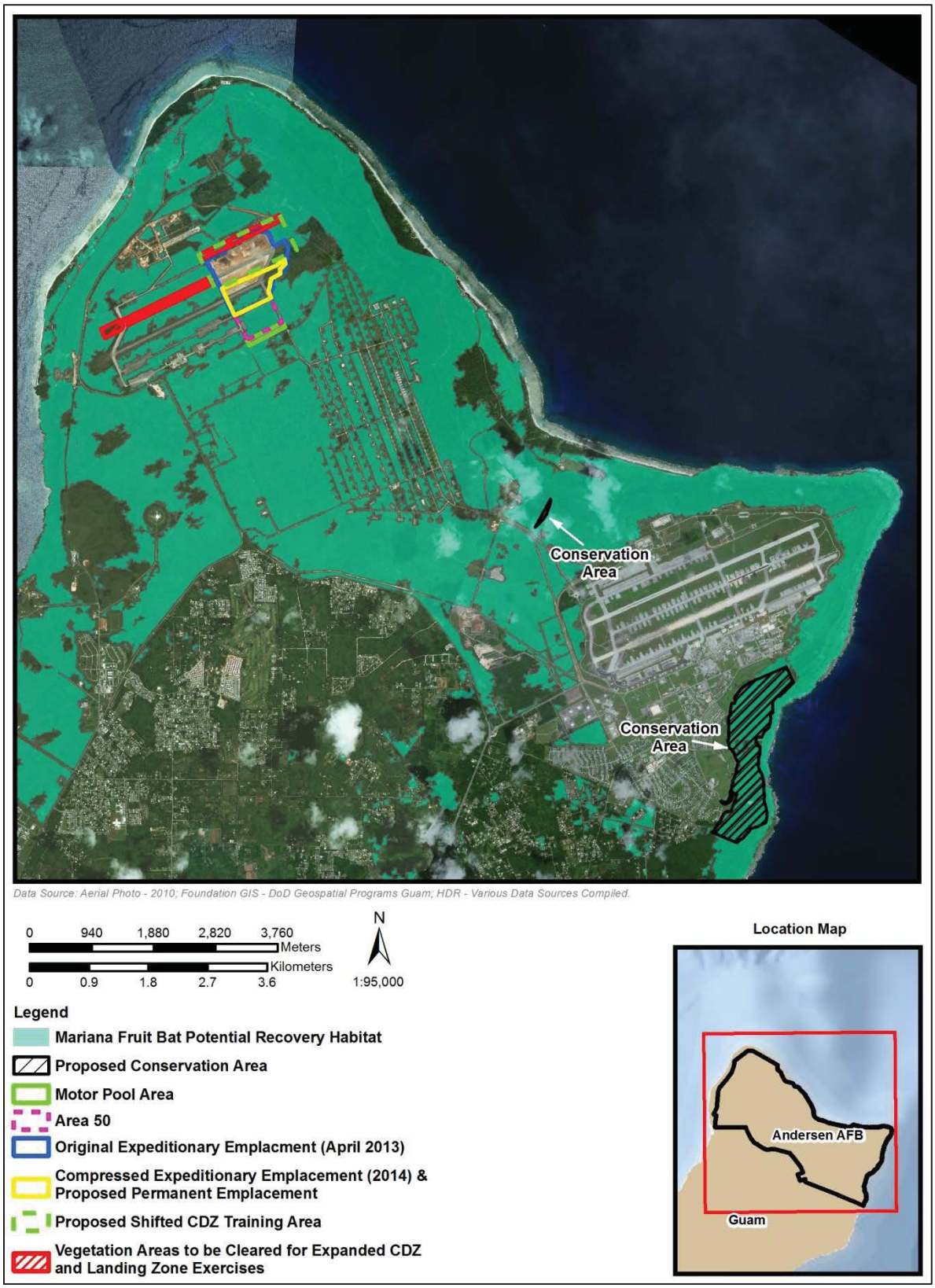

Figure 5. Potential recovery habitat for bats, indicating area proposed for conservation to mitigate impacts to listed species (taken from BA, 94th AAMDC 2016).

ANALYTICAL FRAMEWORK FOR THE JEOPARDY/ADVERSE MODIFICATION ANALYSES

Jeopardy Determination

In accordance with policy and regulation, the jeopardy analysis of this biological opinion relies on four components: (1) Status of the Species, which evaluates the range-wide condition of the species analyzed in this opinion, the factors responsible for that condition, and the survival and recovery needs of this species; (2) the Environmental Baseline, which evaluate the current condition of the species in the action area, the factors responsible for that condition, and the relationship of the action area to the survival and recovery of the species; (3) the Effects of the Action, which determines the direct and indirect impacts of the proposed Federal action and the effects of any interrelated or interdependent activities on the species; and (4) Cumulative Effects; which evaluates the effects of future, non-Federal activities in the action area on the federally listed species.

ENVIRONMENTAL BASELINE AND STATUS OF THE SPECIES

The environmental baseline describes the status of the species and factors affecting the environment of the species or critical habitat in the proposed action area during the consultation process. The baseline usually includes State, local, and private actions that affect a species at the time the consultation begins. Unrelated Federal actions that have already undergone formal or informal consultation are also part of the environmental baseline. Federal actions within the action area that may benefit listed species or critical habitat are also included in the environmental baseline.

The crow, kingfisher, and rail are all extirpated from the wild in northern Guam. However, maintaining necessary amounts of suitable habitat for eventual reintroduction is crucial to recovery of these species. This analysis looks at direct effects to species present in or near the action area as well as effects to habitat clearance and modification.

A number of recent or ongoing consultations affect the baseline and status of the species in regards to this action. They are described briefly below:

Intelligence, Surveillance, Reconnaissance – Strike (ISR Strike)
The ISR Strike action was analyzed for adverse effects to fruit bats, crows, kingfishers, and rails. Construction involved clearing approximately 180 acres and operations include aircraft flights 240 days per year as well as an increase in population of military and Air Force civilian and contractor staff (2006-F-0266) (USFWS 2006a, p. 9-11). As a conservation measure, this action was to include two ungulate exclosures, totaling approximately 494 acres to offset the loss of habitat from clearing and aircraft operations. In addition, additional staffing, native vegetation outplanting, and BTS interdiction and research were included in the project description. To date, AAFB is out of compliance with the ISR Strike BO as many conservation measures have yet to be implemented. While one ungulate exclosure, encompassing just over 300 acres, was constructed, it is slated for removal or modification for construction of a live-fire training range complex under the proposed relocation of marines to Guam, and there is no clear plan for its replacement to date.

Mariana Islands Training and Testing (MITT)
This action, formerly referred to as the Mariana Islands Range Complex (MIRC), covers most of the islands and surrounding waters of the Mariana Archipelago. Training under the MITT action includes night-time work on AAFB that results in noise disturbance. Mitigation for effects to listed species in Guam includes brown treesnake interdiction efforts. The most recent reinitiation of this action (formerly known as Mariana Islands Range Complex or MIRC) did not propose any conservation measures for listed species.

Guam Marine Relocation and Memorandum of Agreement on Micronesian Kingfisher Recovery
This consultation is currently underway following formal reinitiation in February 2016 to include effects of the action on species listed for protection under the ESA in 2015. It involves clearing 1,021 acres of recovery habitat for kingfishers, bats, and cycads; 1,016 acres of recovery habitat for crows, and 1,145 acres of recovery habitat for rails. Through a Memorandum of Agreement between the Department of the Navy (DON) and the Service, the DON pledges to manage 5,234 acres of kingfisher habitat in northern Guam. A forest enhancement site, totaling 1,213 acres (a portion of the 5,234 acres set aside in the MOA) will be fenced and managed for native plant restoration and potentially endangered animal reintroduction.

Status of the Mariana Fruit Bat

Legal Status

The Mariana fruit bat (*Pteropus mariannus mariannus*; "fanihi" in Chamorro; hereafter, fruit bat) was listed as endangered on Guam in 1984, but was downlisted to threatened in 2005 when it was determined that all fruit bats on Guam and throughout the Commonwealth of the Northern Mariana Islands (CNMI) comprise a single subspecies (USFWS 2005b, p. 1191). In 2004 critical habitat for the fruit bat was designated at the Guam National Wildlife Refuge Ritidian Unit (USFWS 2004, p. 62944).

Species Description

The Mariana fruit bat is a medium-sized fruit bat in the family Pteropodidae that weighs 0.66 to 1.15 pounds. Males are slightly larger than females. The underside (abdomen) is black to brown with gray hair interspersed that creates a grizzled appearance. The shoulders (mantle) and sides of the neck are bright golden brown, but may be paler in some individuals. The head varies from brown to dark brown. The well-formed, rounded ears and large eyes give the face a canine appearance.

Current Known Range

The Mariana fruit bat is a subspecies endemic to the Mariana archipelago (Guam and the CNMI), where it was historically present on every island except Uracas (Wiles et al. 1989, p. 69). The fruit bat is thought to be extirpated from Tinian (USFWS 2009c, pp. 269-272; USFWS 2014d, pp. 2-3).

Life History

The diet of the fruit bat is comprised of fruits, nectar, pollen, and some leaves (Wiles and Fujita 1992, pp. 26-31; Wiles and Johnson 2004, p. 591), and it uses several forest types for foraging,

roosting, and breeding, including native primary and secondary limestone forest, volcanic (or ravine) forest, old coconut plantations, and groves of *Casuarina equisetifolia* (Glass and Taisacan 1988, pp. 6–13; Worthington et al. 2001, pp. 137–138; Wiles and Johnson 2004, pp. 589–591). Most fruit bats roost during the day in maternity colonies at sites to which they show a high level of fidelity (unless disturbed). A small proportion of fruit bats, usually males, roost alone or in small groups called bachelor colonies. Fruit bats will abandon roost sites if disturbed and have been reported to move to new locations as far as 10 kilometers (km) (or 6 miles) away (USFWS 1990b, p. 9). Any fruit bat colony can be disturbed by humans close enough to be smelled; which can be up to 200 m (656 ft) away (J. Boland, pers. obs. 2009). In addition, fruit bats have flushed from maternal roosts in response to aircraft overflights on Guam with noise levels above 90 dB (SWCA 2012, p. 23, 37). When colonies are disturbed, fruit bats may be negatively affected in a variety of ways, including but not limited to, destruction of social structures, direct injury, disruption of energetic and hormonal balance, forced relocation to lower quality habitat, abandonment of non-volant young, and disruption of breeding activities (Wingfield et al. 1998, pp. 191-204; Heideman 2000, pp. 469-499; Klose et al. 2006, p. 341; CNMI 2010, p. 7).

Data is limited for age of sexual maturity, reproductive rates, length of gestation, and lifespan of Mariana fruit bats. Female bats of the family Pteropodidae generally have a gestation period of 4.6- 6.3 months and one offspring per year (Pierson and Rainey 1992, pp. 1-17). Many *Pteropus* species typically do not give birth before 18 months of age (Pierson and Rainey 1992, pp. 1-17; McIlwee and Martin 2002, p. 76). Based on these reproductive traits, several authors have suggested that *Pteropus* bats have a low maximum population growth rate and thus a slow rate of recovery when a population is diminished (Pierson and Rainey 1992, p. 1-17; McIlwee and Martin 2002, p. 76).

Population Dynamics and Status

The total population of the Mariana fruit bat is estimated to be approximately 6,000 animals (USGS 2010, p. 36; CNMI 2011, p. 6). Surveys suggest populations are stable or declining throughout most of their range. A notable exception to the declining trend is the island of Rota, where the population has increased since 2008 (CNMI 2008, p. 11; CNMI 2011, p. 6). The fruit bat population on Rota is estimated at approximately 2,600 (CNMI 2011; p. 6). Although comprehensive surveys have not been conducted on Saipan, there have been no confirmed observations of maternity colonies in recent years, and the island-wide population is expected to be less than 50 individuals (T. Willsey, CNMI Department of Land and Natural Resources (DLNR), pers. comm. 2014).

The population of fruit bats on Guam have been estimated to be less than 30 bats (SWCA 2013, pp. 19-22). The last maternal colony to exist on Guam was at Pati Point (SWCA 2013, pp. 13). However, in December 2015, fruit bats were observed within the Habitat Management Unit (HMU), in Guam. Preliminary estimates were 30 to 50 bats present within the HMU (D. Lujan, AAFB, pers. comm. 2016). The HMU is a plot on AAFB, 136 acres in area, used for experimental habitat restoration and brown treesnake control and research. It is enclosed in a snake barrier designed to allow emigration but not immigration of brown treesnakes. In addition, it is designed to exclude ungulates to enhance forest regeneration. It partially fulfills conservation measures to mitigate effects to listed species from Northwest Field Beddown (2006-I-0281) (USFWS 2006b). The HMU is approximately 2 km from the THAAD emplacement. Additional surveys were conducted by AAFB from December through February

and on February 10, 2016, two female bats were observed within the HMU, and at least 112 bats were counted at a single time (T. Mildenstein and D. Lujan, AAFB, pers. comm. 2016). However, recent attempts to locate and count the group have proved unsuccessful, and the bats may have relocated to an unknown location (J. Horeg, AAFB, pers. comm. 2016).

Interisland movement of bats is still largely unknown, however, genetic analysis by Mildenstein and Mills (2013) showed relatively low immigration rates between island; thus, interisland migration cannot necessarily be depended on to compensate for a population decline or loss on any particular island. (USFWS in review, p. 49)

Threats

The following is adapted from USFWS 2014d, pp. 4-5

- Loss or degradation of habitat because of human development and degradation by feral ungulates on multiple islands.
- Human disturbance through illegal hunting throughout their range.
- Nonnative snake predation –Brown treesnakes prey on non-volant young left at the roost during the night, thus preventing the recruitment of young bats into the breeding population. Effective control of brown treesnakes must be achieved before fruit bat population on Guam can recover. The interdiction, control, and ultimate eradication of brown treesnakes in the archipelago are the focus of major, ongoing projects, and the fruit bat is likely to benefit from these efforts in the long term. This prognosis would change drastically if the brown treesnake were to become established widely throughout the archipelago.
- Stochastic events – Typhoons and volcanic eruptions result in mortality, reduced population viability, and habitat loss. Natural disasters can be especially damaging to the viability of smaller fruit bat populations (*e.g.*, on Guam, Saipan, Aguiguan, and Maug). The significant loss of habitat on Anatahan after the volcanic eruption in 2003 resulted in the loss of a substantial fruit bat population that has not yet recovered.

Survival and Recovery Needs

- Before the Mariana fruit bat is considered for delisting, the Service proposes that stable or increasing populations should exist on three of the five southern islands (Saipan, Tinian, Aguiguan, Rota, and Guam), and six of the northern islands where Mariana fruit bats have persisted historically (Anatahan, Sarigan, Guguan, Alamagan, Pagan, Agrihan, Asuncion, and Maug; USFWS 2009a, pp. 37-39). Since publication of the draft revised recovery plan in 2009, new information on the Mariana fruit bat has resulted in changes to how we look at recovery for the species. We now consider recovery in terms of stable or increasing subpopulations of sufficient size distributed across Guam and the Mariana Islands. To meet recovery objectives, stable or increasing fruit bat subpopulations should at a minimum be distributed on the islands that currently have extant populations (USFWS *in review*). The final version of the Mariana fruit bat recovery plan is currently in review, and recovery criteria stated here may change upon completion of the final plan.
- Of the six northern islands, the only evidence for a possibly increasing population is on Asuncion (USGS 2010, p. 33). Of the five southern islands, only Rota has achieved an increasing population. Although a conservation area containing some important habitat for fruit bats was established on Rota (USFWS 2011, pp. 1), there is

not currently enough protected fruit bat habitat on Rota, Guam, Tinian, or Saipan to support substantial population recovery on any of those islands. Even if sufficient habitat is set aside in conservation to support recovery of populations, controlling illegal hunting may continue to be a challenge that limits recovery of the species.

Status of the Guam Micronesian Kingfisher

Legal Status

The Guam Micronesian kingfisher (*Todiramphus cinnamominus cinnamominus*; "sihek" in Chamorro; hereafter, referred to as kingfisher) was listed under the ESA as endangered in 1984 (USFWS 1984, 9 pp.). A revised recovery plan for the kingfisher was completed in 2008 (USFWS 2008a, 117 pp.). On October 28, 2004, the Service designated critical habitat for the kingfisher on approximately 376 ac (152 ha) in the fee simple portion of the GNWR (USFWS 2004, 117 pp.).

Species Description and Current Known Range

The kingfisher is endemic to the island of Guam in the Mariana Islands. The Guam subspecies is a small, sexually dimorphic forest kingfisher (Baker 1951, pp. 227–228). The adult male has a cinnamon-brown head, neck, upper back, and underparts with a black line extending around the back of the neck and the eye ring is black. The adult female resembles the male except that the upper breast is paler, as are the chin and throat, with the rest of the underparts and underwing coverts white (Jenkins 1983, p. 21). Immature birds have the crown washed in greenish-blue, and a whitish chin and throat. Underparts are buffy-white in the immature male, but may be paler in the female (Jenkins 1983, p. 21).

The kingfisher is extirpated in the wild on Guam but persists in captivity at the Guam DAWR facility and 24 U.S. mainland zoos and institutions. In response to the decline of Guam's native birds in the 1980s, the Association of Zoos and Aquariums (AZA) initiated the Guam Bird Rescue Project. Between 1984 and 1986, 29 kingfishers were translocated from Guam to zoos in the U.S. mainland to start a captive breeding program. The breeding program has been managed under the auspices of the AZA's *Micronesian Kingfisher Species Survival Plan* (Bahner et al. 1998, 54 pp.).

Life History

In the wild, kingfishers nest in cavities and feed primarily in mature, second growth limestone forest, and, to a lesser degree, in scrub limestone forest (Jenkins 1983, pp. 22–23). Kingfishers are also known to use coastal strand vegetation containing coconut palm as well as riparian habitat. However, Jenkins (1983, p. 22) reported the kingfisher was probably most common along the edges of mature limestone forest. Few data exist about specific nest sites of the kingfisher in the wild, but in one study in northern Guam (Marshall 1989), 16 nest sites were correlated with closed canopy cover and dense understory vegetation. Kingfishers nest in cavities that are excavated from the soft, decaying wood of standing dead trees (Marshall 1989, p. 475).

The breeding season for this species on Guam is reported to range from December to June, however, within the managed population (in captivity) we have seen reproduction in all months of the year with January through July being the prime breeding period. During the breeding

season, it is important to minimize disturbance within the territorial range of breeding pairs. Based on experience with the managed population, Guam kingfishers are especially sensitive to stress which would likely be increased by noise and disturbance, and compounded during the breeding season (B. Bahner, Philadelphia Zoo, pers. comm. 2015). Additionally, anything that disrupts the availability of prey items in their territory would be detrimental would negatively affect kingfishers. There is no known recommended buffer around active kingfisher nests; however in captivity nesting kingfishers have sometimes been monitored by cameras to avoid disturbing breeding birds (Bahner et al. 1998).

In the wild, the kingfisher is known to feed on invertebrates and small vertebrates, including insects, segmented worms, hermit crabs, skinks, geckoes, and possibly other small vertebrates (Marshall 1989, p. 210; Baker 1951, pp. 228–229; Jenkins 1983, p. 23).

Records of kingfisher distribution and intraspecific territorial behavior suggest this species maintains exclusive year-round territories in the wild (Jenkins 1983). Pohnpei kingfishers defend their approximately 8.1 hectare (20 ac) territories from conspecifics (Kesler and Haig 2007a, pp. 386-387). Kesler and Haig (2007b, pp. 769–770) determined that kingfisher home ranges on Pohnpei consist of mixed forest and open areas and at least part of this area includes mature forest. It should be noted that Guam Micronesian kingfisher territories may differ from Pohnpei Micronesian kingfisher territories due to differences in forest structure (Mueller-Dombois and Fosberg 1998, pp. 269–275, 288–291). However, information on the related Pohnpei kingfisher as a surrogate species to the Guam Micronesian kingfisher represents the best available scientific information on kingfisher territory size and home ranges in the Pacific islands to date.

The life expectancy of the kingfisher in the wild is unknown. However, in captivity, males have a longer lifespan (23 years) than do females (15 years). Both males and females can reproduce at 1 year of age. In captivity, males have been observed to breed as old as 19 years, while females have not been observed to breed beyond the age of 12 (AZA 2014, p. 4).

Current Status

The kingfisher is currently extirpated from the wild. It was considered “fairly common” and occurred throughout forested areas on Guam in 1945 (Baker 1951, p. 229). Populations in southern and central Guam disappeared by the 1960s (Jenkins 1983, p. 25). The northern Guam population subsequently declined rapidly, and by 1985, fewer than 30 individuals were recorded on Guam (Marshall 1989, p. 474) and the taxon was considered extirpated from the wild by 1988 (Wiles et al. 2003, p. 1,354). Predation by the brown treesnake is considered the main cause of the decline of the kingfisher population on Guam (Savidge 1987, USFWS 2008a, p. iv). Currently, the captive population consists of 155 adult kingfishers (86 males and 69 females) in captive rearing facilities (GMKF Recovery Team 2015, p.3). The current captive population was founded by 16 of the 29 individuals brought into captivity. The current gene diversity is 87.74 percent; with the potential to reach 92.45 percent (AZA 2014, p. 4).

Threats

The Service intends to reintroduce the kingfisher into the wild on Guam. For that effort to be successful, the following threats need to be addressed. The following discussion is adapted from USFWS 2014a, p. 2:

- Loss or Degradation of Habitat
  - Incremental habitat loss due to fire, especially in southern Guam (Department of Agriculture 2010), and urban and agricultural development is increasingly threatening the long-term conservation of the kingfisher because of the continued loss of habitat on Guam.
  - Ongoing and proposed plans by DoD to expand training and operations on Guam are threatening much of the remaining kingfisher habitat.
  - The persistence of large, feral ungulate populations is likely to further degrade remaining forest habitats, thus lowering their value for kingfisher recovery.

- Predation
  - Predation risk from brown treesnakes currently prevents effective reintroduction of the kingfisher to Guam.

- Stochastic Events
  - Typhoons will continue to degrade forest and the affected forest areas may require several years to regenerate.
  - Although birds in the Mariana Islands have evolved with typhoons, typhoons in concert with low population numbers, habitat loss, and behavioral and genetic consequences of captive breeding could negatively affect the recovery of the Guam Micronesian kingfisher.
  - Climate models indicate that hurricanes in the northwestern Pacific are expected to increase in intensity, frequency, and duration by 2200 and continue to increase further into the future (Emmanuel et al. 2008, p. 360). These storm increases will likely have a significant effect on habitat and survival of listed species on Guam.

Survival and Recovery Needs

The recovery plan (USFWS 2008a) for the kingfisher calls for a total viable population of 2,000 adult kingfishers on Guam within two subpopulations of 1,000 adults each. One subpopulation would be located in northern Guam, and one subpopulation would be located in southern Guam to reduce the risk of a second extirpation event due to random, stochastic events. Based on acreage estimates for breeding pairs and non-breeding adults, the total habitat needed to support 1,000 adults (500 breeding pairs) is 10,462 acres.

Each subpopulation must have brown treesnakes and other predators controlled to a level where establishment of a sustainable kingfisher population is feasible and habitat to support this population level must be protected and managed. In the interim, the kingfisher also may need to be established in the wild on other islands outside their native range to reduce the detrimental consequences of long-term captivity and to spread the risk from stochastic events. Although any population(s) established on other islands outside of the kingfisher's historical range would be considered temporary and would not contribute toward the recovery goal of two subpopulations of 1,000 adults each on Guam, the ability to translocate wild birds versus captive birds to Guam would increase success of their recovery and survival on Guam. However, ultimately the recovery of the kingfisher is dependent on having adequate protected habitat free of threats on Guam to provide for the two subpopulations.

New management actions that have occurred in the last five years include:

- In 2014, the USDA-APHIS Wildlife Services, in coordination with the National Wildlife Research Center, the DoD-Environmental Security Technology Certification Program, and the Department of Interior-Office of Insular Affairs, conducted a test of aerial application of a brown treesnake toxicant (acetaminophen) over forested areas in AAFB (Dorr et al. 2014, unpublished data). The results of this study indicate that development of a scalable automatic bait application system could be used in the near future for large landscape scale brown treesnake control and suppression (Dorr et al. 2014, unpublished data).
- Brown treesnake eradication and control using an aerial automated broadcast system using acetaminophen, as a toxicant to the snake, is being planned for testing in Andersen South, Guam. The knowledge gained from this study may result in findings that would support efficient delivery of acetaminophen to snakes on Guam for a landscape level treatment.
- The Guam Micronesian kingfisher recovery team is developing a release plan on other islands outside the kingfisher's historical range to reduce the negative consequences of long-term captivity. A successful release will reduce our reliance on captive propagation for ensuring the continued existence of the kingfisher, and this population can serve as a source for translocating birds to Guam, once the threat of brown treesnakes has been sufficiently controlled.
- Construction of a 312-ac (112-ha) ungulate exclosure fence at Northwest Field on AAFB by DoD per biological opinion requirements (USFWS 2006a). However, DoD has proposed to build the proposed LFTRC within this mitigation site, which is also located on Overlay Refuge.
- Construction of the 136-ac (55-ha) Habitat Management Unit (HMU) brown treesnake and ungulate exclosure fence at Anderson Air Force base. Ungulate removal within the HMU is near completion by DoD per a section 7 consultation requirement (USFWS 2006b).
- Construction of a multi-species exclosure fence within the fee simple portion of the GNWR at Ritidian Point, Guam.
- Construction of 4,400 ft of coated chain link fence along Route 2A on the perimeter of NBG by DoD per biological opinion requirements (USFWS 2010). The fence provides an ungulate exclosure for the 3,114 ac (1,260 ha) of the main base of NBG. The fencing project is intended to effectively close off Orote peninsula from any new ungulate incursions and only entry control gates will be left unfenced. Ungulate removal within NBG is ongoing.

Recommendations for Future Actions (adapted from USFWS 2008a; USFWS 2014a, p. 3):

- Maintain or increase genetic diversity in the captive kingfisher population by implementing management strategies to exploit the potential gene diversity in the captive populations at the DAWR and AZA facilities.
- Predator Monitoring and Control
    - Continue efforts to develop and refine brown treesnake control techniques and support small-scale and large-scale control and/or eradication efforts on Guam.
- Reintroduction / Translocation

  - Develop a reintroduction plan for the kingfisher on Guam and set aside and protect recovery areas to facilitate its de-listing as soon as possible following the reintroduction of the kingfisher on Guam.

- Protection and restoration of kingfisher recovery habitat, including permanent protection as conservation areas and fencing to exclude brown treesnakes and ungulates.

Status of the Mariana Crow

Legal Status

The Mariana crow ("aga" in Chamorro) was listed as endangered throughout its range in 1984 and critical habitat was designated on Guam and Rota (USFWS 1984, pp. 33881-33885; 2004, pp. 62944-62990). On October 28, 2004, the Service designated critical habitat for the Mariana crow on approximately 376 ac (152 ha) in the fee simple portion of the GNWR (USFWS 2004, 117 pp.).

Species Description and Known Range

The Mariana crow is the only member of the genus *Corvus* occurring in Micronesia (Jenkins 1983, p. 25). This species is known historically only from the islands of Rota and Guam, but is now extirpated from Guam. Preliminary genetic studies indicate that the Rota population is most likely a genetic subset of the Guam population (Tarr and Fleischer 1999, p. 946).

Life History and Population Dynamics

Mariana crows are omnivorous, and their diet includes a wide variety of plants and animals, including insect larvae, centipedes, grasshoppers, mole crickets, praying mantis, earwigs, hermit crabs, skinks, geckos, and bird eggs (Jenkins 1983, p. 26, 31; Tomback 1986, p. 399; Ha and Ha 2010a, pp. 8-10; Faegre *in press*).

Mariana crows use forested habitats including limestone, strand, ravine, agricultural forests, and secondary forests (Jenkins 1983, p. 25, 32). However, evidence suggests they are most abundant in native limestone forests (Morton et al. 1999, p. 13, 41;) and nests are found exclusively in native trees in closed canopy forests (Morton et al. 1999, p. 13, 33; Ha et al. 2011, 2012, and 2013, pp. 32, 25, and 24-31, respectively).

Breeding likely occurs all year on Rota, while peak nesting activity generally occurs between August and February (Morton et al. 1999, p. 12; Ha et al. 2013, p. 31). A minimum of 65 days is necessary to build the nest, incubate the eggs, and rear the brood through fledging (Morton et al.1996, p. 21). Mariana crows generally produce only a single brood per year; however, nest failure and other factors lead to multiple nest attempts each breeding season.

Little is known regarding lifespan, age of sexual maturity, and length of reproductive life in Mariana crows. The oldest known wild crow was at least 18 years old when last observed on Rota in 2014 (A. Kroner and S. Faegre, University of Washington, pers. comm. 2014). This same adult male was at least 17 years old when he was last seen feeding a fledgling in 2013. Another male was 14 years old when he last produced a chick in 2009, and a 15-year-old female was observed with a fledgling in 2014 (S. Faegre, University of Washington, pers. comm. 2014).

Although it was originally thought that Mariana crows begin breeding around 3.5 years old (Morton et al. 1999, p. 2), a radio-tagged male Mariana crow built his first nest at 16 months of age and was observed feeding a fledging at 21 months of age. Two other banded crows, a female and a male, successfully fledged young in 2011 and 2013, just after they turned two years old (A. Kroner and S. Faegre, University of Washington, pers. comm. 2014).

Mariana crows are known to be highly susceptible to disturbance from human activities (Morton 1996, p. 60, 62, 72; Ha, R. 2015, pers. com.; Ha et al. 2011, p. 5). Ha et al. (2011, p. 236) found that nest sites were always greater than 300 meters from any buildings, and that actual nest sites were almost twice as far from roads and buildings as random sites.

Distribution, Status, and Threats

Guam

Although the Mariana crow was once present throughout Guam (Baker 1951, p. 246), the population has been declining since at least the 1960's (Engbring and Ramsey 1984, p. 30; Engbring et al. 1986, p. 92) and is now extirpated. The last known crow of Guam origin was observed in 2001, and the last known wild Mariana crow that was captive-reared from Rota and released on Guam was observed in 2012 (J. Quitugua, DAWR, pers. comm. 2014). Predation by brown treesnakes is the overriding factor in the extirpation of Mariana crows from Guam (USFWS 2005a).

Suitable habitat for Mariana crows is still present on Guam. As described below in the Environmental Baseline for the Mariana Crow, we estimate that 24,919 acres (10,084 ha) of Mariana crow habitat is left on Guam. More information on crow habitat is provided in the Environmental Baseline for the Mariana Crow section below.

Rota

In 1976, Mariana crows were considered relatively common and widely distributed on Rota (Pratt et al. 1979, p. 234). Reanalysis of the first island-wide survey for the species on Rota in 1982 using current density estimate methods resulted in a population estimate of 1,491 birds (815-3115 birds, 95 percent confidence interval) (Engbring et al. 1986, pp. 92-95; F. Amidon, Service, pers. comm. 2014). The most recent island-wide pair survey on Rota was conducted during the 2013 breeding season and documented 46 breeding pairs; an approximate 94 percent decrease in the population since 1982 (Kroner 2014, p. 3). The primary threats to the Mariana crow on Rota are suspected to be predation by cats, human persecution, and habitat destruction (USFWS 2014b, p. 3), but evidence is limited and substantially more research is needed.

Mariana crow telemetry studies were conducted from 2009-2013 and will begin again in the 2014-2015 nesting season. Before telemetry studies began on Rota there was no evidence available to suggest feral cats (*Felis silvestris*) were predating crows. The lack of evidence was likely due to high scavenging and decomposition rates, and the extreme unlikelihood of finding a fresh carcass in time to retrieve any useful information regarding cause of death. Since telemetry efforts began, nine recently-deceased, radio-tagged Mariana crows have been found with evidence suggesting cat predation, and one untagged adult was taken in for care and later died after receiving what a veterinarian confirmed as an infected cat bite (Ha et al. 2013, pp. 5-6).

Recovery Criteria for the Mariana Crow

The following criteria are taken from the Draft Revised Recovery Plan for the Mariana Crow (USFWS 2005a).

- The Mariana crow may be considered for downlisting from endangered to threatened status when all of the following criteria are met:
    - Mariana crow occur in two populations, one on Rota consisting of a minimum of 75 territorial pairs, and 1 in northern Guam consisting of a minimum of 75 territorial pairs;
    - Both populations are stable or increasing based on quantitative surveys or demographic monitoring that demonstrates an average intrinsic growth rate (λ) not less than 1.0 over a period of at least 10 consecutive years;
    - Sufficient Mariana crow habitat, based on quantitative estimates of territory and home range size, is protected and managed to achieve criteria 1 and 2 above;
    - Brown treesnakes and other introduced predators found to be a threat to Mariana crow are controlled at a sufficient level to achieve criteria 1 and 2 above;
    - Brown treesnake interdiction efforts are in place to prevent the establishment of brown treesnakes on Rota; and
    - Efforts to resolve Mariana crow and landowner conflicts have been implemented.

- The Mariana crow may be removed from the Federal list of threatened and endangered species when all of the following criteria are met:
    - Mariana crow occur in three populations, one on Rota consisting of a minimum of 75 territorial pairs, one on northern Guam consisting of a minimum of 75 territorial pairs, and one in southern Guam consisting of a minimum of 75 territorial pairs;
    - All three populations are stable or increasing based on quantitative surveys or demographic monitoring that demonstrates an average intrinsic growth rate (λ) not less than 1.0 over a period of at least 10 consecutive years;
    - Sufficient Mariana crow habitat, based on quantitative estimates of territory and home range size, is protected and managed to achieve criteria 1 and 2 above;
    - Brown treesnakes and other introduced predators are controlled at a sufficient level to achieve criteria 1 and 2 above;
    - Brown treesnake interdiction efforts are in place to prevent the establishment of brown treesnakes on Rota;
    - Efforts to resolve Mariana crow and landowner conflicts have been implemented; and
    - A monitoring plan has been developed and is ready for implementation, to cover a minimum of five years post-delisting, to ensure the ongoing recovery of the species and the continuing effectiveness of management actions.

Since the draft revised recovery plan was published in 2005, additional work on population viability of the Mariana crow has occurred. This recent assessment of population viability indicated that 75 territorial breeding pairs may not be viable over the long-term and that 100 territorial breeding pairs may be a more appropriate recovery target (Amidon 2012, unpubl. data).

Survival and Recovery Needs on Guam

Management and recovery actions that have occurred in the last five years include:

- Construction of a 312-ac (112-ha) ungulate exclosure fence at Northwest Field on AAFB by DoD per biological opinion requirements (USFWS 2006b). However, the DON has proposed to build the proposed LFTRC within this mitigation site, which is also located on Overlay Refuge.
- Construction of the 136-ac (55-ha) Habitat Management Unit (HMU) brown treesnake and ungulate exclosure fence at AAFB. Ungulate removal within the HMU is near completion by DoD per a section 7 consultation requirement (USFWS 2006b).
- Construction of a multi-species exclosure fence within the fee simple portion of the GNWR at Ritidian Point.
- Construction of 4,400 ft of coated chain link fence along Route 2A on the perimeter of NBG by DoD per biological opinion requirements (USFWS 2010). The fence provides an ungulate exclosure for the 3,114 ac (1,260 ha) of the main base of NBG. The fencing project is intended to effectively close off Orote peninsula from any new ungulate incursions and only entry control gates will be left unfenced. Ungulate removal within NBG is ongoing.
- In 2014, the USDA-APHIS Wildlife Services, in coordination with the National Wildlife Research Center, the DoD-Environmental Security Technology Certification Program, and the Department of Interior-Office of Insular Affairs, conducted a test of aerial application of a brown treesnake toxicant (acetaminophen) over forested areas in AAFB (Dorr et al. 2014, unpublished data). The results of this study indicate that development of a scalable automatic bait application system could be used in the near future for large landscape scale brown treesnake control and suppression (Dorr et al. 2014, unpublished data).

Recovery actions still needed to allow the reintroduction of the Mariana crow to Guam

- Development and implementation of large-scale, long-term methods for brown treesnake control that will reduce the brown treesnake population on a landscape level.
- Protection and restoration of Mariana crow habitat in northern and southern Guam including in-perpetuity protection as conservation areas and fencing to exclude brown treesnakes and ungulates.
- Continued management of the fenced exclosures at Northwest Field, the HMU, and NBG as described above.

Status of the Guam Rail

Legal Status

The Guam rail (*Gallirallus owstoni*; ko'ko' in Chamorro; hereafter, rail) was listed as endangered on Guam in 1984 (USFWS 1984, pp. 2485-2488). An experimental, nonessential population of rails occurs on Rota. The rails on Rota are treated as threatened species, rather than as endangered species, for the purposes of sections 4(d) and 9 of the ESA (USFWS 1989, pp. 43966-43970). Critical habitat for the rail has not been designated on Guam.

Species Description and Current Known Range

The Guam rail is endemic to the island of Guam in the Mariana Islands. The species is derived from the closely related barred rail (*Gallirallus torquatus*) of the Philippines and Indonesia (Ripley 1977). No closely related species occur in Micronesia. The rail is medium-sized and capable of short burst of flight (1 to 2 m), but is seldom observed in flight (Jenkins 1979, p. 404). Rails are about 28 cm (11 in) in total length (Taylor 1998, p. 258). Guam rails have elongated and laterally compressed, particularly in the neck and breast regions, bodies allowing the birds to move rapidly through dense vegetation.

The rail is extirpated in the wild on Guam but persists in captivity at the Guam DAWR facility and twelve U.S. mainland zoos (AZA 2014, p. 1). Efforts to establish a nonessential experimental population on the island of Rota has been underway since 1989. The establishment of a wild population on Rota will ensure that a source wild population is available for future repatriation of rails to Guam when brown treesnakes have been controlled or eradicated on Guam (USFWS 1989, p. 43967). On Cocos Island (a small islet approximately 1.6 km (1 mi) off the southern coast of Guam), breeding pairs of rails have become established in a predator-controlled habitat through efforts associated with a Safe Harbor Agreement and activities permitted under section 10(a)(1)(A) of the ESA (USFWS 2008b; USFWS 2008c, p. 1-2). This agreement, signed in 2008, has allowed for the establishment of Guam rails on private land owned and managed by Cocos Island Resort and public land owned by the Government of Guam and managed by the Guam Department of Parks and Recreation. The rails are monitored to learn more about survivorship, breeding behavior, habitat preference and nesting success.

Life History

The Guam rail formally occurred in most habitat types on Guam, including forest, savanna, secondary grassland, agricultural areas, mown grass bordering scrub communities, mixed woodland and scrub, and fern thickets (Jenkins 1979, p. 405-406; Taylor 1998, p. 259). Guam rails were predominantly observed using scrubby secondary growth area and the edges of mixed forest areas (Jenkins 1979, Engbring and Ramsey 1984). Jenkins (1979) reports that they were seldom observed in the interior of mature limestone forests or savanna areas and did not occur in wetlands. As Guam was probably mostly limestone forest before the arrival of humans (Forsberg 1960), the rail may have become more common after much of the mature forest had been converted to scrubby second-grown or mixed forest (Engbring and Ramsey 1984).

The diet of the Guam rail is comprised of snails, slugs, lizards, insects, and vegetable matter such as seeds and palm leaves; the rail feeds on food items from the surface of the ground, especially snails and slugs after rain showers (Jenkins 1979, pp. 405-406). They are able to forage at night, but are most active during the dawn and dusk (Jenkins 1979, p. 404-406; Taylor 1998, p. 259).

Guam rails are monogamous and breed throughout the year (Jenkins 1979, p. 406; USFWS 1990a, p. 9), with a possible peak breeding period during the rainy season (May-October) (Perez 1969 as cited in the USFWS 1990a, p. 9). They can lay two to four eggs per clutch and both parents share in the construction of the nest. Nests are located on dry ground in dense grass, are a shallow cup of interwoven loose and rooted grass, and are built by both sexes (Jenkins 1979, p. 406; Taylor 1998, p. 260).

In captivity, Guam rails can live up to 17 years, while females can reach 16 years old. Median life expectancy for captive males is 9.5 years; captive female median life expectancy is slightly lower at 5.7 years (AZA 2014, p. 5). The median life expectancy of Guam rails in the wild is unknown. Both males and females can begin reproducing at approximately 5 months old. Males have bred until the age of 11, and females as old as 9 years old have successfully reproduced. Breeding in captivity is complex, as males can be extremely aggressive and have at times injured or killed females. In captivity, clutch sizes range from one to six eggs, averaging 2.1 eggs, with an incubation period of 19 days.

Population Dynamics and Status

Guam rails were once distributed throughout Guam (USFWS 1990a, p.7). They first disappeared from southern Guam in the early 1970's (Jenkins 1979). In 1981, the population was reduced to approximately 2,300 individuals and only existed in northern Guam (Engbring and Ramsey 1984, p. 28). In 1983, estimates of the population size indicated that fewer than 100 individuals remained on Guam and 22 individuals were moved to captive propagation facilities (Haig and Ballou 1995, p. 446). The rail was extirpated on Guam by 1987 (Wiles et. al. 1995, p. 38).

There have been two releases of rails on Guam since this species has been listed as endangered. In 1998, 16 rails were released in "Area 50" at AAFB in northern Guam (Beauprez and Brock 1999). A temporary brown treesnake barrier was constructed around Area 50 and snake populations in the barrier were reduced through snake control. Breeding was documented, although the small population was extirpated by predators, mainly feral cats. In 2003, a second release of 44 rails occurred in a brown treesnake-reduced area of the Munitions Storage Area on AAFB (P. Wenninger, DAWR, pers. comm. 2008). Efforts to reduce cat predation on the rails were limited due to difficulty in obtaining approval to control cats in the area. By 2008, rails no longer were present in the Munitions Storage Area (P. Wenninger, DAWR, pers. comm. 2008; USFWS 2009b, p. 5).

On Rota, over 800 captive-bred Guam rails have been released between 1989 and 2008 in an effort to establish an experimental wild population (Beck 1991, Brock and Beck 1995, Beauprez and Brock 1996-1999a, P. Wenninger, DAWR, pers. comm. 2008). The introduction to the island of Rota, which is outside the historical range of the species, was justified because primary habitat on Guam had been altered through the establishment of the introduced, predatory brown treesnake (USFWS 1989, p. 43966). Improvements in managing the captive flock have increased the number of rails available for each release and the larger release cohorts have increased the likelihood of population establishment. Population estimates in 2002 indicated 100 rails were present on the northeast end of Rota near two release sites, Duge and Saguagaga. Based on surveys conducted in July 2013, there are approximately 125 rails on Rota (S. Medina, DAWR, pers. comm. 2013). However, released birds still suffer mortality primarily due to feral cat predation, which slows population establishment. Current release strategies include intensive cat trapping and a review and update of monitoring protocol for rails on Rota.

On Cocos Island, sixteen captive bred rails were released in November 2010. Prior to the release, rats (*Rattus* spp.) were eradicated on Cocos Island. Guam rails are successfully breeding (16 nests and 12 chicks have been observed) on Cocos Island. Sightings of unbanded adults have been documented, which suggests that chicks are surviving into adulthood (S. Medina, DAWR, pers. comm. 2013).

As of December 30, 2014, the Guam rail captive population is distributed among 14 institutions, with the Guam DAWR facility holding 116 birds and the 13 Association of Zoos and Aquariums (AZA) facilities housing 46 birds. At that time, current gene diversity was 88 percent in the DAWR facility and 83 percent at the AZA facilities (AZA 2014, p. 4). When gene diversity falls below 90 percent in a founding population, it is expected that reproduction will be compromised by, among other factors, lower hatch rates, small clutch sizes, and greater neonatal mortality (Ross et al. 2006). However, there still remains the potential to increase the gene diversity in DAWR and AZA facilities over the long term (AZA 2014, p. 6). The DAWR and AZA work cooperatively and closely coordinate on the transfer of birds to facilities, as needed, in order to manage the genetic diversity within the captive Guam rail population (AZA 2014, p. 4). These facilities also support the releases of individuals into the wild on Rota.

Threats (adapted from USFWS 2014c, p. 2-5):

- Loss or degradation of habitat –
    - Agricultural and urban development is a factor in habitat loss and degradation on Guam.
    - Nonnative snake predation. The brown treesnake continues to limit efforts to reestablish rails on Guam.
    - Cat predation. Feral cats continue to limit efforts to reestablish rails on Guam and impact the rail experimental population on Rota.
    - Rodent predation. Because rats have been eradicated and are absent from Cocos Island, there is continued efforts to prevent the reintroduction of rats to this island. Rats can negatively impact rails by consuming eggs and preying on chicks.
    - Stochastic events – Although birds in the Mariana Islands have evolved with typhoons, typhoons in concert with low population numbers, habitat loss, and behavioral and genetic consequences of captive breeding could negatively affect the recovery of the Guam rail.

Survival and Recovery Needs

Before the Guam rail is considered for downlisting from endangered to threatened, the repatriation of 1,000 birds to northern Guam and 1,000 birds to southern Guam (total = 2,000 individuals; USFWS 1990a, p. 33) would need to occur and brown treesnakes would need to be controlled on Guam (USFWS 1990a, p. 33-34). No criteria were defined for delisting. Traill et al. (2009) proposed a minimum population target of 5,000 individuals as an appropriate target for species conservation.

New management actions that have occurred in the last five years include:

- Brown treesnake eradication and control using acetaminophen, as a toxicant to the snake, is being conducted within the approximately 136-acre (55-hectare) Habitat Management Unit on AAFB. The project may result in the reduction of snake numbers to a low enough level to allow for rails to survive and reproduce within this snake-proofed area on Guam.
- Management unit planning – On Guam, a management plan is currently being developed for the HMU on AAFB. The plan will consider the reintroduction of Guam rails to this site.
- Predator control – Cat control is conducted on Rota and will continue with increased efforts from additional funding by the Service in fiscal year 2015.

Recommendations for Future Actions (adapted from USFWS 2014c, p. 3):

- Maintain or increase genetic diversity in captive rail population – Implement management strategies to exploit the potential gene diversity in the captive populations at the DAWR and AZA facilities.
- Predator monitoring and control
    - Continue efforts to develop and refine brown treesnake control techniques and support small-scale and large-scale control and/or eradication efforts on Guam.
    - Continue and increase efforts to control and eradicate brown treesnakes on Guam and prevent introduction of brown treesnakes on other Mariana Islands.
    - Implement large-scale cat control and/or eradication.
- Reintroduction / translocation
    - Consider alternative sites for establishing other experimental populations.
    - Develop reintroduction plan for Guam rails on Guam and set aside and protect recovery areas for these rails on Guam.
- Revise recovery objectives and criteria – Revise recovery plan.
- Population monitoring and viability analysis – Continue population and demographic monitoring on Rota and Cocos Island.

Protection and restoration of Guam rail recovery habitat including in-perpetuity protection as conservation areas and fencing to exclude brown treesnakes and ungulates.

Status of *Cycas micronesica*

Legal Status

Cycas micronesica (or "fadang" in Chamorro) occurring within the Mariana Islands was listed as threatened under the ESA in 2015 (USFWS 2015b, 73 pp.). No critical habitat has been designated for this species. A recovery plan for *C. micronesica* has not been completed.

Species Description and Current Known Range

Cycas micronesica is a palm-like, usually unbranched tree in the Cycadaceae family (Raulerson and Rinehart 1991). Adult trees can reach heights of 6 meters and fronds can reach 1 to 2.5-m long (Stone 1970, p. 65; Raulerson and Rinehart 1991, p. 4). It is known from Guam, Rota, Tinian, and Pagan (Mariana Islands); as well as Palau (politically the independent Republic of Palau) and Yap (geographically part of the Caroline Islands; politically part of the Federated States of Micronesia, in the forest ecosystem (Hill et al. 2004, p. 280; Keppel et al. 2008, p. 1,006; Cibrian-Jaramillo et al. 2010, pp. 2,372-2,375; Marler 2013, in litt.; DON 2015 pp. 3-140).

Currently, there are 15 to 20 occurrences of *C. micronesica* totaling 900,000 to 950,000 individuals on the Micronesian Islands of Guam, Rota, Yap, and Palau. There are a small number of individuals on Pagan (DON 2015, pp. 3-136 – 3-137) and 1,000 individuals present on Tinian (DON 2014, in litt.). On Guam and Rota, there are fewer than 630,000 (T. Marler, UOG, pers. comm. 2013). This number does not distinguish between successfully reproducing adults and juveniles (T. Marler, UOG, pers. comm. 2013), which, because of the effects of the cycad aulacaspis scale (*Aulacaspis yasumatsui*), implies that the number of extant individuals that can successfully reproduce is much lower. On Guam, there are four fragmented occurrences, totaling fewer than 516,000 individuals: one occurrence along the shoreline to the base of the limestone

cliffs on the north side; a second occurrence beginning at the forest edge along the cliffs and continuing into the forest on the north side; a third occurrence on the northern plateau; and a fourth occurrence along the ravines and rock outcrops on the southern side, with a few individuals occurring across the savanna.

On Rota, there are four known occurrences within the forest ecosystem, totaling fewer than 111,500 individuals (Marler 2013, in litt.). On the northeast shore the first occurrence totals fewer than 25,500 individuals; the second occurrence, on the northwest shore, totals fewer than 21,600 individuals; the third occurrence on the south shore totals fewer than 63,600 individuals; and the fourth occurrence on Wedding Cake peninsula totals fewer than 300 individuals.

Life History and Ecology

Cycas micronesica is the only native gymnosperm in the Mariana Islands. Cycads are dioecious, and both sexes bear reproductive structures that are relatively massive amongst gymnosperms (*e.g*. conifers). Approximately 300 cycad species and subspecies exist across much of the tropics and subtropics, but cycads remain the most threatened group of plant species on earth (Donaldson 2003, p. 1). *C. micronesica* (sometimes considered *Cycas circinalis* in early references) occurs in limestone forests in Guam and Rota, with a smaller number of occurrences in volcanic soils typical of southern Guam (Stone 1970, p. 65). Few studies exist that describe cycad natural history and ecology in the Mariana Islands, and much of the current literature is focused on its decline and effects from introduced pests. However, *C. micronesica* is a food source for fanihi (*Pteropus mariannus mariannus*), which feed on its fruits (Wiles and Fujita 1992, p. 27), as well as for the Chamorro people, who process the fruits to rid the naturally-occurring toxins (Safford 1905, p. 71). Most cycads have historically been assumed to be wind pollinated, but recent research on a number of species has revealed that insects play in important role in pollination (Hall et al. 2004, p. 334; Kono and Tobe 2007, p. 853), even emitting chemical cues to attract pollinator insects (Schneider et al. 2002, p. 285). *C. micronesica* cones emit strong smells when pollen is mature (Raulerson and Rinehart 1991, p. 4), and evidence indicates pollination by both insects and wind (Terry et al. 2009, p. 96).

Population Dynamics and Current Status

Just 10 years ago, *Cycas micronesica* was ubiquitous on the island of Guam, and similarly common on Rota. It was the most abundant tree in Guam forest inventory surveys in 2002 (Donnegan et al. 2004, p. 16). *C. micronesica* is currently under attack by a nonnative insect, the cycad aulacaspis scale (*Aulacaspis yasumatsui*) is causing rapid mortality of all life stages of the plant (Marler 2014, in litt.). As of January 2013, *C. micronesica* mortality reached 92 percent on Guam, and cycads on Rota are experiencing a similar fate from the cycad aulacaspis scale (Marler 2013, in litt.; USFWS 2015b, p. 59435). All seedlings of *C. micronesica* in a study area were observed to die within 9 months of infestation by *A. yasumatsui* (Marler and Muniappan 2006, p. 3; Marler and Lawrence 2012, p. 233; Western Pacific Tropical Research Center (WPTRC) 2012, p. 4; Marler 2013, pers. comm.).

As mentioned above, there are fewer than 630,000 on Guam and Rota. However, this number does not distinguish between successfully reproducing adults and juveniles (T. Marler, UOG, pers. comm. 2013). Because the scale causes mortality of all life stages of *Cycas micronesica*, it prevents reproduction and recruitment into the population on Guam and Rota (USFWS 2015b, p. 59435). The cycad aulacaspis scale is not present on Tinian and Pagan. Overall, the population of *C. micronesica* is in declining because of the scale and other threats (see below).

Threats

Adapted from USFWS 2015b (p. 59435).

- *Cycas micronesica* is affected by multiple pest species, with *Aulacapsis yasumatsui*, an introduced cycad specialist armored scale insect, being the most significant threat (Marler and Muniappan 2006, p. 3). A specialist scale predator beetle, *Rhyzobius lophanthae*, was introduced purposefully to treat the *A. yasumatsui* outbreak with some positive results (Marler and Lawrence 2012, pp. 234-238). However, a number of other insects, including cycad blue butterfly (*Chilades pandava*) and a native longhorn beetle that bores cycad stems (*Dihammus marianarum*), also contribute to declining health and mortality in Guam cycad populations (Marler and Muniappan 2006, p. 3; Marler and Lawrence 2012, pp. 238-240).
- Loss and degradation of habitat from development, military training, urbanization, nonnative plants and agriculture.
- Feral pigs and introduced deer are also threats through herbivory and physical damage.
- Stochastic events such as typhoons will continue to degrade forest and the affected forest areas may require several years to regenerate.
- Drought and climate change will exacerbate many of these threats.

Survival and Recovery Needs

In order to recover *Cycas micronesica*, individuals of this species need to be protected on Guam, Rota, Tinian, and Pagan. *C. micronesica* populations should have age structures consisting of seedlings, juveniles, and adult plants. Expanded trials with biocontrol, especially targeting *Aulacapsis yasumatsui*, should be considered to help stabilize the population (Marler and Lawrence 2012; p. 240). In addition, future invasions from other pests must be prevented (Marler and Lawrence 2012; p. 240). Feral pigs and introduced deer are also threats through herbivory and physical damage, further compounding effects from insects (Marler and Lawrence 2012; p. 238); therefore, ungulate control and fencing restoration sites are also crucial steps in managing cycad populations.

Management actions that have occurred in the last five years:

- Since 2007, DON has been maintaining an outplanted population of *C. micronesica* in fenced areas on the island of Tinian, which were selected to represent a broad genetic diversity. These outplantings number about 1,000 mature individuals in each of five fenced exclosures, are maintained to ensure health and survival, and funding for this maintenance is ensured through 2020.

- Five one-acre fenced cycad plots that have been established on AAFB are being maintained as part of a conservation measure from the 2006 ISR Strike biological opinion (USFWS 2006a p. 13, AAFB 2015 p. 8). In addition, monitoring is being conducted within these plots to help inform future management actions (JRM 2015, p. 2-1).

Status of *Tabernaemontana rotensis*

Legal Status

Tabernaemontana rotensis was listed as threatened under the ESA in 2015 (USFWS 2015b, 73 pp.). No critical habitat has been designated for this species. The Service has not completed a recovery plan for *T. rotensis*.

Species Description and Current Known Range

Tabernaemontana rotensis occurs on Guam and Rota, in the forest ecosystem (UOG 2007, p. 6). *T. rotensis* is a small to medium-sized (8-10 m tall) tree in the dogbane family (Apocynaceae). Its leaves are thin, light green, opposite, and 15-30 cm long. Flowers are white, elongate, slender, and branch from the tree. *T. rotensis* produce conspicuous orange fruit that are twinned or single and beaked (UOG 2007, p. 6).

Life History

Tabernaemontana rotensis occurs in forests with crevices of rough limestone (Raulerson and Rinehart 1991, p. 94) and are able to colonize sites that occur in full sun or in deep shade (UOG 2007, p. 16). On Guam, the population structure includes emerging seedlings, young juveniles, and reproductive mature individuals with an immense range in canopy size. Because of the loss of frugivorous bird species on Guam, seed dispersal is very limited and spatial distribution of individuals are clumped within specific areas (UOG 2007; pp. 4, 28). Seedling establishment frequently occurs within the vicinity of mature individuals. These seedlings develop in extreme competition with each other, and many of them become stunted and some die (UOG 2007; pp. 14, 22).

In the absence of typhoons, one study showed that the *Tabernaemontana rotensis* population exhibited an increase in the number of trees flowering in August to October, withthe greatest percentage of trees bearing immature or orange fruit in the following months (UOG 2007, p.23). It also was determined that 40 to 80 percent of trees had a least some flowering occur every month. In typhoon conditions, *T. rotensis* develops a synchronized pulse of flowering about one month after the typhoon. This pulse of flowering leads to a mast seeding event about four months after the typhoon (UOG 2007, p. 29).

The fruit of *T. rotensis* reaches full size approximately 30 to 35 days after flowering. Fruit color changes from bright green to dull green in subsequent months, and a dull orange color break occurs in 50 to 60 days after flowering (UOG 2007, p. 24).

Current Status

In 2007, more than 21,000 *Tabernaemontana rotensis* individuals, comprising of seedlings, juveniles and mature trees, were observed throughout AAFB on Guam. Individuals were located in forest areas: Ritidian Point, Pati Point, HMU, and central and southeast edge of AAFB (JRM 2016, p. 5; UOG 2007, pp. 32-42). *T. rotensis* are present in an area north of route 3A (or northwest of the HMU) on AAFB (AAFB 2014, p. 23). At least five individuals of *T. rotensis* also occur within the GNWR. In addition, 12 saplings of *T. rotensis* have been outplanted on the GNWR (L. Gutierrez, Service, pers. comm. 2016). Multiple *T. rotensis* saplings naturally occur

in the forest on the east or north side of the road, close to the cliffline, which is located outside the GNWR boundary near the old gate (A. Gawel, Service, personal observation. 2016).

In 2014, the CNMI DLNR observed nine individuals on Rota. These individuals were spread across the western, southern, and eastern parts of the island (CNMI DLNR 2014, in litt.). Additionally, there are 30 surviving outplanted individuals, ranging in size from 4 to 23 ft (1.3 to 7 m), spread out across the island (J. Manglona, T. Reyes, R. Ulloa, pers. comm. 2014 cited in CNMI DLNR 2014, in litt.).

Threats
(UOG 2007, p. 28-30; USFWS 2015b, p. 59436)

- Loss and degradation of habitat from agriculture, urban development, military training, nonnative animals and plants, and fires
- Forest fragmentation
- Limited dispersal and recruitment in new habitat.
- Stochastic events - Typhoons will continue to degrade forest and the affected forest areas may require several years to regenerate.
- Climate change will further exacerbate many of the above threats in the future.

Survival and Recovery Needs

In order to recover *Tabernaemontana rotensis*, the remaining individuals of this species need to be protected on Guam and Rota. *T. rotensis* populations should have age structures consisting of seedlings, juveniles, and adult plants. Ungulate and invasive species control should be implemented throughout its range. On Guam, restoring areas with this species' natural dispersers (*e.g.*, native frugivorous birds) would expand the distribution of *T. rotensis* population into new habitat niches, niches that would have likely been naturally occupied by the *T. rotensis* population prior to the loss of seed dispersal on Guam. Outplanting and/or relocation of wild seedlings within protect areas in needed to increase their abundance and distribution on Guam and Rota.

Management actions that have occurred in the last five years:

- From 2014-2015, the Service funded the Guam Plant Extinction Prevention Program (GPEPP) to work on the propagation of *Tabernaemontana rotensis*. GPEPP's mission is to prevent the extinction of Guam's rarest plant species that have fewer than 200 individuals in the wild on Guam. GPEPP works with conservation partners to protect wild populations and reintroduce plants to their natural habitat. The Service is working with GPEPP in efforts to outplant *T. rotensis* within protected areas on Guam.

- GPEPP is building a relational database and geodatabase to connect all plant handling activities. Records from the different GPEPP projects and activities will be stored in this database. The database will house ex situ (wild populations and outplanted population records) and in situ (seed storage, in vitro propagation and Rare Plant Nursery) data.This work is conducted under a U.S. Forest Service grant.

Recommendations for Future Actions:

- Continue monitoring and survey efforts for *Tabernaemontana rotensis*.
- Collect seeds from fruiting trees and develop a nursery of seedlings for outplanting in protected areas throughout its range.
  - *T. rotensis* responds to typhoons with a synchronized flowering pulse (UOG 2007, p. 6). Conservation efforts should ensure harvest of the mast seeding that occurs about four months after the passage of a typhoon (UOG 2007, pp. 22, 29).
- Outplant or relocate wild seedlings to increase their distribution.
  - *T. rotensis* seedlings typically occur in a cluster near the parent tree. The seedlings compete with one another for light and other resources, and not all seedlings survive. Resource managers would benefit from transplanting some of these seedlings prior to their death (UOG 2007, p. 22). This approach also would thin out crowded seedlings and possibly ensure more of them remain alive (UOG 2007, p. 23).
- Eradicate or control ungulates and invasive plants.
- Prevent establishment of introduced invasive species (*e.g.*, insect pests).

Status of *Bulbophyllum guamense*

Legal Status

Bulbophyllum guamense (or siboyas hålum tåno in Chamorro) was listed as threatened under the ESA in 2015 (USFWS 2015, 73 pp.). No critical habitat has been designated for this species. The Service has not completed a recovery plan for *B. guamense*.

Species Description and Current Known Range

Bulbophyllum guamense, an epiphyte in the orchid family (Orchidaceae), occurs in large mat-like formations high on branches of trees. *B. guamense* have leaves that are oblong, elliptic and 10 to 15 cm long (Stone 1970, p. 155), and flowers that are single, fleshy, and greenish-yellow in color (Raulerson and Rinehart 1992, p. 90). The sepals are the most conspicuous part of the flower, while the yellow-green lip with its wine markings is hinged and extremely mobile.

Bulbophyllum guamense is known from widely-distributed occurrences on the southern Mariana Islands of Guam and Rota, in the forest ecosystem (Ames 1914, p. 13; Raulerson and Rinehart 1992, p. 90; Costion and Lorence 2012, pp. 54, 66; Global Biodiversity Information Facility (GBIF) 2012−*Online Herbarium Database*; Zarones et al. 2015a, in litt.). *B. guamense* was recorded historically on Guam from clifflines encircling the island, and on the slopes of Mt. Lamlam and Mt. Almagosa. In 1992, this species was reported to occur in large mat-like formations on trees "all over the island," (Guam) (Raulerson and Rinehart 1992, p. 90). However, *B. guamense* has declined in number and populations on Guam, which represents half its known range. On Rota, *B. guamense* can occur along the Sabana tableland and slopes above 980 ft (300 m) (USFWS 2015, p. 59434).

Life History

Little is known about the life history of *Bulbophyllum guamense*. Members of the genus *Bulbophyllum* are epiphytes (growing on other plants), or have some species are lithophytic (growing on rocks). *B. guamense* is epiphytic and grows on trees within limestone forest type

ecosystems. On AAFB on Guam, this orchid can be observed in limestone forest dominated by the introduced *Vitex*, and in primary limestone forest dominated by *Arctocarpus* and *Ficus* in the lower canopy of closed forest about 10 feet or less above ground. On the Naval Magazine on Guam, this orchid is observed in humid areas in lower elevation, on Areca palms (*Dypsis* sp.) or *Pandanus tetorius* (JRM 2016, pp. 4-9). On Rota, *B. guamense* occurs within the *Hernandia-Eleocarpus* limestone forest ecosystem (USFWS 2015, p. 59434).

Typical to orchids in this genus, *Bulbophyllum guamense* has a carrion-like scent (Raulerson and Rinehart 1992, p. 90). *B. guamense* is almost ever-blooming, as one flower drops, another replaces it until one is pollinated. The ovary then enlarges to form a ribbed capsule about 5-by-1 cm, where the dust-like seeds develop (Raulerson and Rinehart 1992, p. 90). *B. guamense* has a sympodial growth habit which form sequential pseudobulbs (with determinate growth). Research is currently being conducted to determine if we could potentially increase the number of this orchid vegetatively by division within a nursery environment (J. McConnell, UOG, pers comm. 2016).

Current Status

There are approximately 844 individuals on Guam and at least 261 individuals on Rota (USFWS 2015, p. 59434; Joint Region Marianas [JRM] 2016, p. 5). The Naval Magazine contains approximately 753 individuals, which is the majority of known individuals on Guam (JRM 2016, p. 5). Other areas on Guam contain few individuals. Eight *B. guamense* were found during those surveys within the HMU in a limestone forest dominated by non-native *Vitex* (Naval Facilities Marianas 2016, p. 172 as cited in 94th AAMDC 2016). The University of Guam surveys resulted in an observation of one occurrence of *B. guamense* at the Ritidian area (JRM 2016, p. 5).

On Rota, there are at least 261 individuals of *Bulbophyllum guamense* with a population structure consisting of seedlings, juveniles, and flowering adults (Zarones et al. 2015a, in litt). The number of individuals was suggested to be as high as 16,000 individuals on Rota, however this estimate is based on the assumption that *B. guamense* is uniformly distributed across its habitat (Zarones et al. 2015a, in litt).

Bulbophyllum guamense has declined in number of populations and individuals, especially on Guam which represents half of its known range. The remaining individuals are vulnerable to effects of continued habitat loss and other threats as detailed below (USFWS 2015, p. 59434).

Threats (USFWS, p. 59343; see also General Environmental section of this Opinion)

- Loss and degradation of habitat – Development from agriculture, construction, and military training has decreased the recovery habitat for this species. *B. guamense* habitat continues to be degraded by ungulates, nonnative plants, and fires.
- Predation by nonnative slugs.
- Stochastic events - Typhoons will continue to degrade forest and the affected forest areas may require several years to regenerate.
- Climate change will exacerbate many of these threats.

Survival and Recovery Needs

In order to recover and ensure the survival of *Bulbophyllum guamense*, wild populations of this species and its habitat need to be protected and maintained on Guam and Rota. The populations of *B. guamense* should have age structures consisting of seedlings, juveniles, and adult plants. The presence of large, feral ungulate populations on Guam is likely to further degrade remaining forest habitats, thus lowering their value for *B. guamense* recovery. Ungulate control needs to be implemented throughout the range of this species. Similarly, control of nonnative plants and slugs is critical for the conservation of *B. guamense*.

Management actions that have occurred in the last five years:

- For fiscal years 2014-2015, the Service funded the Guam Plant Extinction Prevention Program (GPEPP) to work on the seed germination and propagation of *B. guamense*. GPEPP is working on cultivation of *B. guamense* in their plant nursery.

- GPEPP is building a relational database and geodatabase to connect all plant handling activities. Records from the different GPEPP projects and activities will be stored in this database. The database will house ex situ (wild populations and outplanted population records) and in situ (seed storage, in vitro propagation and Rare Plant Nursery) data. This work is conducted under a U.S. Forest Service grant.

Recommendations for Future Actions:

- Monitor the status of *B. guamense*.
- Determine life history and habitat preferences.
- Identify areas that are needed to be protected for the conservation of *B. guamense*.
- Eradicate or control ungulates within *B. guamense* habitat.
- Determine the best methods in augmenting populations and relocating and/or reintroducing *B. guamense* into protected areas within its historic range.
- Prevent and treat insect infestation on trees.

Status of the *Dendrobium guamense*

Legal Status

Dendrobium guamense was listed under the ESA as threatened in 2015 (USFWS 2015, 73 pp.). No critical habitat has been designated for this species. The Service has not completed a recovery plan for *D. guamense*.

Species Description and Current Known Range

Dendrobium guamense (no common name) is an epiphyte in the orchid family (Orchidaceae). This orchid usually occurs on tree branches in forests in filtered sunlight. Stems are crowded and can be one-meter long. Two small white flowers emerge between two leaves, and are open only one day, appearing as balls on the second day.

Dendrobium guamense occurs in the forest ecosystem on Guam, Rota, Saipan (historically), and Tinian, and recently recorded for the first time on Aguiguan (Ames 1914, p. 14; Raulerson and

Rinehart 1992, p. 98; Raulerson 2006, in litt.; Costion and Lorence 2012, p. 66; Zarones et al. 2015a, in litt.; Zarones et al. 2015b, in litt.). As recently as the 1980s, this species was common in trees on Guam and Rota, with more than 12 occurrences on Guam and 17 occurrences on Rota (Raulerson and Rinehart 1992, p. 98; Consortium Pacific Herbarium 2012a—*Online Herbarium Database,* 5 pp.).

Life History

Little is known about the life history of *Dendrobium guamense.* As an epiphytic orchid, *D. guamense* are supported by trunk and thick lower branches, sometimes in small twigs in the top of the canopy of trees. They cling strongly onto their hosts with a developed root system and use the moisture and organic debris caught in the crevices and bark of the host for nourishment. The humid tropical air is absorbed for additional moisture. In northern Guam, individuals of *D. guamense* were observed mostly on *Ficus prolixa* about 10 to 25 ft high in the canopy (JRM 2016, p. 7). *Dendrobium* species take advantage of the microclimate, which are found on the trunk, lower branches, under the canopy, and can prefer shade or moderate light (Landscape and Garden 2015, in litt). However, *D. guamense* individuals have been observed within forest edges, where there is more than moderate light (A. Gawel, Service, pers. obs. 2016). In the Naval Magazine in southern Guam, *D. guamense* was observed at all elevations along rivers and on ridges and plateaus, and on numerous tree species (JRM 2016, p. 9).

Current Status

There are at least 23 occurrences totaling at least 2,690 individuals distributed on the islands of Guam, Rota, Tinian, and Aguiguan. In 2012, *Dendrobium guamense* was reported present at 4 occurrences totaling fewer than 250 individuals on Guam (Harrington et al. 2012, in litt). During surveys in 2014 to 2015 in DoD areas on Guam, *D. guamense* was observed within habitat surrounded by the Ritidian Ungulate Fence at NWF and over 1,200 were observed in the Naval Magazine (JRM 2016, pp. 4-9). In addition, 29 clumps of approximately 340 individuals are present within the Finegayan area on Guam (DON 2016c). On Rota, at least 15 occurrences of *D. guamense* are present, and a recent survey team reported more than 700 individuals of *D. guamense* on the western third of Rota, represented by seedlings, juveniles, and flowering adults (Harrington et al. 2012, in litt; Zarones et al. 2015a, in litt.). The presence of multiple generations in a healthy population structure indicates that the status of *D. guamense* on Rota is better than previously known. There are two reported occurrences on the island of Tinian, with an unknown number of individuals (Raulerson 2006, in litt.; CPH 2012a—*Online Herbarium Database,* 5 pp.). Zarones et al. (2015b, in litt.) discovered three individuals of *D. guamense* on the island of Aguiguan, a new island record for this species.

The populations of *D. guamense* on Guam, which comprise more than 50 percent of its known range, have declined due to threats predominantly associated with habitat destruction and modification (*i.e.*, development, military training, nonnative plants and animals, fire, typhoons, and climate change) (Harrington et al. 2012, in litt.).

Threats (adapted from USFWS 2015a, pp. 59431, 59453, 59454-5, 59457, 59459, and 59467):

- Loss or Degradation of Habitat
  - Incremental habitat loss due to wild fire, urbanization, and agricultural development is increasingly threatening the availability of habitat.

  - The ongoing and proposed expansion plans of DoD training and operations on Guam are threatening the remaining *D. guamense* habitat and potential future conservation efforts from the activities associated with the expansion.
  - As numbers of cattle and ranchers increase on Tinian, there may be a greater risk of cattle potentially escaping and becoming feral. Both feral and domestic cattle can drastically alter the landscape (Wiles et al. 1990, pp. 176–177), and depending on the location and amount of land designated as pasture land for domestic cattle, negative impacts to the forest ecosystem may be observed in the future, minimizing the available habitat.
  - The presence of nonnative plants and other nonnative ungulates (pigs, goats, and water buffalo), and Philippine deer, is likely to further degrade remaining forest habitats, thus impeding their ability to survive.

- Predation
  - Nonnative slugs have been observed to cause mechanical damage to plants and destruction of plant parts (branches, fruits, and seeds), including orchids, and are considered.

- Stochastic Events
  - Typhoons will continue to degrade forest and the affected forest areas may require several years to recover.
  - On a global scale, sea level is rising as a result of thermal expansion of warming ocean water; the melting of ice sheets, glaciers, and ice caps; and the addition of water from terrestrial systems (Church et al. 2013). Individuals that occur close to the coast in the adjacent forest ecosystem at or near sea-level and may be negatively impacted by sea-level rise and coastal inundation due to climate change.

- Climate Change
  - We anticipate the effects of climate change will further exacerbate many of the above threats in the future (USFWS 2015b, pp. 59435-6)

Survival and Recovery Needs

In order to recover *Dendrobium guamense*, individuals of this species in the wild and their habitat need to be protected on Guam, Rota, Tinian, and Aguiguan. *D. guamense* populations should have age structures consisting of seedlings, juveniles, and adult plants. The presence of large, feral ungulate populations on islands is likely to further degrade remaining forest habitats, thus lowering their value for *D. guamense* recovery. Ungulate control needs to be implemented throughout the range of this species. Similarly, control of nonnative plants and slugs is critical for their recovery.

Management actions that have occurred in the last five years:

- From fiscal years 2014-2015, the Service funded GPEPP to work on the propagation of *D. guamense*. GPEPP's mission is to prevent the extinction of Guam's rarest plant species that have fewer than 200 individuals in the wild on Guam. GPEPP works with conservation partners to protect wild populations and reintroduce plants to their natural habitat. The Service is working with GPEPP in efforts to outplant *D. guamense* within protected areas on Guam.

- GPEPP is building a relational database and geodatabase to connect all plant handling activities. Records from the different GPEPP projects and activities will be stored in this database. The database will house ex situ (wild populations and outplanted population records) and in situ (seed storage, in vitro propagation and Rare Plant Nursery) data. This work is conducted under a U.S. Forest Service grant.

- A conservation project on Rota, administered through the Water and Environmental Research Institute of the Western Pacific at the University of Guam, is aimed to analyze the island's hydrology, with the ultimate goal of protection of the Sabana Watershed and Talakhaya Springs (Keel et al. 2007, pp. 5, 22–23). Erosion control, revegetation, and water source preservation conducted as part of this project may provide protection to *D. guamense* (USFWS 2015b, p. 59460).

Recommendations for Future Actions:

- Monitor the status of *D. guamense*.
- Determine life history and habitat preferences.
- Identify areas that are needed to be protected for the conservation of *D. guamense*.
- Eradicate or control ungulates within *D. guamense* habitat.
- Determine the best methods in augmenting populations and relocating and/or reintroducing *D. guamense* into protected areas within its historic range.
- Prevent and treat insect infestation on trees.

Status of *Tuberolabium guamense*

Legal Status

Tuberolabium guamense (no common name) was listed under the ESA as threatened in 2015 (USFWS 2015, 73 pp.). No critical habitat has been designated for this species. The Service has not completed a recovery plan for *T. guamense*.

Species Description and Known Range

Tuberolabium guamense is an epiphytic orchid with roots that elevate the leaves and flowers away from the tree trunk. Leaves are leathery, oblong, about 13 cm long and 1.5 cm wide. Small white flowers are on a rachis about 3.5 cm long (Raulerson and Rinehart 1992, p. 127). *T. guamense* occurs in forest ecosystems on Guam and Rota (Raulerson and Rinehart 1992, p. 127; USFWS 2015), with a few scattered historical occurrences on Tinian and Aguiguan (CPH 2012b - *Online Herbarium Database*; USFWS 2015b).

There is limited information on the distribution of *Tuberolabium guamense*. However, most orchids are narrowly distributed in specific habitats (Lozano et al. 1996, Cribb et al. 2003, Zang et al. 2015). Accordingly, *T. guamense* are not distributed uniformly throughout the forests; and where they occur, they are present in clusters. For example, at least 145 individuals were located on four trees adjacent to one another in the forest within the Finegayan area on Guam (USFWS 2016).

Life History

Similar to other epiphytic orchids, *Tuberolabium guamense* grows slowly and requires specific microclimates, which are found on the trunk, lower branches, and under the forest canopy. *T. guamense* clings onto their host trees with a strong developed root system and uses the moisture in the air and organic debris caught in the crevices and bark of the host for nourishment.

Orchids are known to have long lifespans (Dressler 1993, p. 226) and seedlings can require 2 to 10 years or more, depending on the species, before they are large enough to flower, with most common orchid species taking 2 or 3 years. Epiphytic orchids may need 30 years to reach maturity (Zotz 1995). The age of maturity and the lifespan of *Tuberolabium guamense* are unknown. However, McConnell (2016) indicated *T. guamense* grows slowly and is a long-lived plant. In addition, *T. guamense* exhibits a monopodial growth habit in which the stem may continue to grow indefinitely (McConnell 2016).

There is limited information on the life history and habitat preferences of *Tuberolabium guamense*. However, observations of *T. guamense* indicated this species is associated with *Taeniophyllum mariannense* (worm orchid) and moss on host trees. *T. guamense* is generally located in high humid areas that are protected from wind within the forest (USFWS 2016). On Guam, biologists have observed *T. guamense* present in areas with low to moderate sunlight within the forest, and no individuals were observed in moderately shaded areas (USFWS 2016). *Tuberolabium guamense* also was observed growing on bark of *Vitex parvifloara* at a height of 3 to 20 ft and some individuals were observed on *Guamia mariannae* (JRM 2016, p. 6). *T. guamense* occurs in forest habitat adjacent to rivers on Guam, mostly on *Areca catechu* and *Cocos nucifera*. They were occasional present on *Vitex* and *Pandanus* (JRM 2016, p. 8).

On Rota, the *Tuberolabium guamense* population occurs within a specialized niche of limestone forest within the Sabana region, a raised plateau unique in the Marianas (USFWS 2015b). Forests located within the Sabana are often shrouded in clouds and mist, and some areas include healthy growths of epiphytes (USDA 1989, p. 6). Zarones et al. (2015a) indicated that *T. guamense* occurs in native canopy trees, with the majority of individuals found on *Hernandia labyrinthica*, *Premna obtusifolia*, and *Elaeocarpus joga* (Zarones *et al.* 2015a, in litt.).

Current Status of Tuberolabium guamense

Tuberolabium guamense is present in discrete, restricted populations on the islands of Rota and Guam. In 1992, Raulerson and Rinehart (p. 87) stated that although *T. guamense* may appear abundant on the limestone ridges, the habitats are limited and in reality these orchids are very rare on Rota and Guam. For example, the Rota *T. guamense* population occurs in clusters within limestone forest within a specialized niche in the Sabana region, and the Guam *T. guamense* population occurs in clusters at only four known locations with one site harboring over 90 percent of the known population rangewide (DON 2016, Table 1; JRM 2016 p. 5). *T. guamense* populations are vulnerable to ongoing threats posed by the continued habitat loss and destruction from agricultuare, urban development, nonnative animals and plants, fires, typhoons, and herbivory by slugs. We anticipate the effects of climate change will further exacerbate many of these threats in the future (USFWS 2015b, p. 59424).

Table 1. Known *Tuberolabium guamense* Populations on Guam and Rota.

Known Populations	Number of *T. guamense* [a]	Landownership	Conservation Status
HMU, Guam	251	DoD	None
Ritidian Point, Guam	105	DoD	None
Naval Magazine, Guam	188	DoD	None
Finegayan, Guam	6,576	DoD	None
Sabana, Rota[a]	239	CNMI	Conservation Area

HMU – Habitat Management Unit, DoD – Department of Defense, CNMI – U.S. Commonwealth of the Northern Mariana Islands [a] Number of *T. guamense* includes seedlings, juveniles, and flowering adults.

Currently, the Sabana Region is the only area where *Tuberolabium guamense* is present that has a formal conservation area designation. The Sabana Region, a high plateau area in the southwestern portion of Rota, was established as a protected area in 1994 under Rota Local Law 9-1. The HMU on AAFB was developed as a conservation measure under the 2006, informal consultation on the Beddown of Training and Support Initiative at the Northwest Field (USFWS 2006c, p. 2), and currently serves as an experimental site for brown treesnake research and control.

Threats (adapted from USFWS 2015a, pp. 59431, 59452, 59454-5, 59457, 59459, and 59467):

- Loss or Degradation of Habitat
  - Incremental habitat loss due to wild fire, urbanization, and agricultural development is increasingly threatening the availability of habitat.
  - The ongoing and proposed expansion plans of DoD training and operations on Guam are threatening the remaining *T. guamense* habitat and potential future conservation efforts from the activities associated with the expansion.
  - The presence of nonnative plants and nonnative ungulates (pigs, goats, and water buffalo), and Philippine deer that degrade forest habitats.
- Predation
  - Nonnative slugs have been observed to cause mechanical damage to plants and destruction of plant parts (branches, fruits, and seeds), including orchids, and are considered a threat.
- Stochastic Events
  - Typhoons will continue to degrade forest and the affected forest areas may require several years to propagate. In addition, the presence of nonnative vertebrates can exacerbate the impact of storms by impeding regeneration and seral development.
- Climate Change
  - We anticipate the effects of climate change will further exacerbate many of the above threats in the future (USFWS 2015b, pp. 59435-6).

Survival and Recovery Needs

Tuberolabium guamense does not occur uniformly within forest habitat. It grows in more humid areas where moss is present on trees and other epiphytic growth including ferns and other native orchids occur. Local site conditions may have a large impact on population dynamics of orchid species, and differences in populations may be due to variables such as seed germination or the availability of suitable fungi to promote seed germination (Perkins and McGee 1995, pp. 565–

575; Jersakova and Malinova 2007, pp. 237-241; Jacquemyn 2010, pp. 119-129). Therefore, it is important to conserve habitats in which the remaining large population of rare orchids occurs, in order to save them from extirpation (Cozzolino et al. 2003, pp. 1684-1686). Furthermore, habitat size is important for orchids because larger habitats will support higher numbers of orchids, and will likely provide greater opportunity for orchids to survive changing environmental conditions by providing orchids suitable areas to colonize if current habitat becomes unsuitable. Larger habitats are also more likely to support greater levels of natural disturbances, and thus more patch disturbance for orchid seedling establishment and potential for orchid colonization. The Finegayan area contains the largest and most robust population of *T. guamense*; the majority (over 90 percent) of the known population on Guam occurs as clusters in this area. Therefore, protection and management of this area is essential to the conservation of this species on Guam.

Because epiphytic orchids are restricted to microclimates and thus sensitive to changes in climate conditions, as well as often slow growing, they are more vulnerable to disturbance than other plants (Hietz 1999). *Tuberolabium guamense* is geographically restricted and requires a specific microclimate to survive. Thus, *T. guamense* grows and reproduces best where they grow naturally in the wild (Raulerson and Rinehart 1992, p.87). The likelihood of this species surviving and recovering is dependent on maintaining the microclimate requirements of *T. guamense* where they occur in forests on Guam and Rota.

As discussed above, *Tuberolabium guamense* populations are geographically restricted, and are subject to further decline due to continued habitat loss and destruction from agriculture, urban development, nonnative animals and plants, and typhoons. Because *T. guamense* grows slowly and may need several years to mature, current population growth rates may not be sufficient to maintain a stable population. In general, species with slow growth rates are less able to compensate for increased mortality (Huston 2004, p. 169). In addition, epiphytes depend on host plants or trees and any conversion or loss of their host will result in a complete loss of epiphytes in the affected area (Hietz 1999, p. 2). Therefore, given the current status of *T. guamense* and their specific habitat requirements and life history, protecting and maintaining all five known populations are essential for the survival and recovery of this species.

More specifically, the conservation needs of the *T. guamense* are as follows:

1. Protect, maintain, and enhance the habitat of the five known *T. guamense* populations. Because *T. guamense* is restricted to microclimates and thus sensitive to changes in climate conditions, as well as often slow growing, they are more vulnerable to disturbance. Restoration and management activities should focus on reducing threats to *T. guamense* populations to insure their long-term persistence and viability. Habitat should be managed to support stable or increasing populations of the orchid.

2. Restore populations of *T. guamense* (i.e. HMU, Naval Magazine, Ritidian, and Sabana) to higher numbers of plants capable of withstanding random genetic or demographic events or environmental catastrophes that might otherwise cause population extirpation.

3. Research should be conducted on methods for reestablishing and augmenting *T. guamense* populations within its historic range. In order to build resiliency, additional populations are needed that are protected and managed to insure survival and recovery of the species.

4. The occurrence of large, feral ungulate populations in the Mariana Islands further degrades the remaining forest habitats, thus lowering their value for *T. guamense* recovery. Ungulate control

needs to be implemented throughout the range of this species. Similarly, control of nonnative plants and slugs is critical for their recovery.

Management actions that have occurred in the last five years:

- For fiscal years 2014-2015, the Service funded the Guam Plant Extinction Prevention Program (GPEPP) to work on the seed germination and propagation of *T. guamense*. GPEPP is working on cultivation of *T. guamense* in their plant nursery.

- GPEPP is building a relational database and geodatabase to connect all plant handling activities. Records from the different GPEPP projects and activities will be stored in this database. The database will house ex situ (wild populations) and in situ (seed storage, in vitro propagation and Rare Plant Nursery) data. This work is conducted under a U.S. Forest Service grant.

Future Conservation Actions Needed for *Tuberolabium guamense*:

- Monitor the status of *T. guamense*.
- Determine life history and habitat requirements and preferences.
- Identify core areas critical to the conservation and long-term survival and recovery of *T. guamense* and institute appropriate measures to protect and conserve those habitats.
- Eradicate or control ungulates within *T. guamense* habitat.
- Determine the best methods in augmenting populations and relocating and/or reintroducing *T. guamense* into protected areas within its historic range.
- Prevent and treat insect and other invertebrate infestation on host trees.

Mitigation framework

In consideration of the on-going and increased habitat loss and degradation on Guam (as detailed in the General Environmental Baseline section) the Service has endeavored to finalize the draft Mitigation Framework (USFWS 2014e), including the mitigation ratio for habitat loss, to address future habitat conservation needs for the Guam Micronesian kingfisher (USFWS 2015c). As land management actions are proposed that will affect habitat needed for the recovery and survival of the kingfisher, it will be necessary to offset these effects by assuring that durable habitat will be protected and available for species reintroduction. This can be accomplished by ensuring that any habitat that is lost is offset with permanent habitat conservation at rates that ensure an adequate amount of habitat is needed to support the survival and recovery of the kingfisher on Guam.

The mitigation ratio took into account kingfisher habitat that was already protected in northern and southern Guam. For northern Guam, approximately 571 acres of kingfisher habitat was protected before the Memorandum of Agreement with DoN was signed. There is no kingfisher habitat protected in southern Guam. Kingfisher habitat should be protected to the maximum extent possible until restoration and management practices for kingfisher habitat are proven to work.

The Mitigation Framework provides guidance to ensuring that adequate amounts of the habitat will be available for species reintroduction in the future. We have recommended to the DON that they should assure that any habitat that is lost as a result of proposed projects is offset with permanent habitat conservation at a rate that ensures the minimum amount of habitat needed to

support kingfisher conservation will ultimately be available to support the recovery and survival of the species in the wild on Guam.

EFFECTS OF THE ACTION

The vegetation clearing and construction for the placement of the THAAD and CDZ, supporting infrastructure, operation of the THAAD (including EMR), movement of personnel, avoidance and minimization measures, and conservation measures are considered in this effects analysis. The CDZ training activities are analyzed and considered in a previous biological opinion (2001-F-0001).

Habitat loss and degradation

The proposed action has resulted (and will result) in habitat loss, degradation, and fragmentation (including edge effects) from clearing, as well as light and noise disturbance. The habitat loss, degradation, and fragmentation will decrease the amount of suitable habitat for recovery of listed species on Guam. The loss of limestone forest and listed species habitats increases time to recovery as a result of small acreages of remaining native forested habitat on Guam, and threatens future recovery of listed species on Guam. Given the small amount of habitat left on Guam, off-setting measures to protect remaining limestone forest and listed species habitats are needed.

Habitat suitable for the survival and recovery of the Guam Micronesian kingfisher, Guam rail, Mariana crow, and Mariana fruit bat has been delineated on Guam (Amidon 2012, in litt.). Because *Cycas micronesica* has been considered one of the dominant trees within the forests on Guam, we used the number of acres for the kingfisher and bat, to estimate the amount of habitat loss for *C. micronesica*. More information on *Tabernaemontana rotensis* and the listed orchids is needed to estimate the amount of habitat loss for these species.

Table 2. Amount of recovery habitat affected by proposed action.

Species	**Recovery Habitat Available in Guam (acres)**	**Cleared/Disturbed for THAAD/CDZ Action (acres)**	**Recovery Habitat Remaining After Action (acres)**	**Proposed Conservation Area**
Mariana Fruit Bat	26,075	87.1	25,987.9	334.7
Guam Micronesian Kingfisher	26,977	85.8	26,891.2	334.7
Mariana Crow	23,587	85.2	23,501.8	334.7
Guam Rail	48,422	140.6	48,281.4	334.7*
Cycas micronesica	26,977	85.8	26,889.9	334.7

*Rails utilize edge habitat and ecotones, and therefore, are less likely to benefit from dense forest areas that other listed species would utilize.

Effects to the Mariana fruit bat

A total of 87.1 acres of bat recovery habitat will be disturbed (cleared or physically modified) for this action. Of the 26,075 acres of recovery habitat available for bats in Guam, this constitutes a loss of less than 0.4%. Although most components of this action are located in previously disturbed areas, placement and operation of the THAAD and shift in CDZ activities will further

degrade areas of Northwest Field that were either potential habitat or developed areas that could be used as corridors or pathways to roosting and foraging habitat at Ritidian and Anao. Based on calculations made for fruit bat habitat loss from the Marine relocation and military build-up consultation (USFWS 2015a), 100 acres of fruit bat habitat could potentially contain 96 bats. Therefore, the loss of 87.1 acres for this project decreases the carrying capacity of remaining fruit bat habitat in Guam by approximately 84 bats, and results in the permanent loss of 87.1 acres of potential breeding, foraging, and sheltering habitat

The Mariana fruit bat has high energetic demands associated with flight and year-round breeding, and as such depends on a steady and ample supply of fruiting and flowering plants that are supplied patchily through space and time (Wiles and Fujita 1992, pp. 26-31; USFWS 2009a p. vi). To meet requirements for breeding, feeding, and sheltering, a self-sustaining population of Mariana fruit bats will rely on threat-managed, native limestone forest habitat containing diverse food resources that are available throughout the year. Because of this patchy distribution through space and time, extensive amounts of habitat need to be available in order to meet recovery needs.

Re-establishing and maintaining a widely-distributed, robust metapopulation of fanihi in the Mariana Islands is critical to long-term persistence of the species (USFWS in review, p. 45). Distribution in both the northern and southern islands of the Marianas is essential (USFWS in review, p. 45), and delisting criteria calls for stable or increasing populations on three of the five southern Marianas Islands (Saipan, Rota, Tinian, Aguiguan, and Guam) (USFWS 2009, p. 37-39). Much of the forests in Saipan and Tinian have been degraded historically, and Aguiguan is very small in size. Guam is the largest island in the Mariana Island chain with the largest potential habitat for bats, and therefore, the habitats on Guam are essential to recovery because they can provide enough habitat containing diverse food resources that are available throughout the year . That being said, Guam's forests continue to be subject to loss and degradation, and the rate of habitat conservation does not keep sufficient pace with the proposed rate of habitat loss (USFWS 2014e p. 2). Therefore, even a habitat loss of 87.1 acres presents adverse effects to the Mariana fruit bat because of the importance of habitat in Guam to recovery of the species, and because this important habitat continues to decline island-wide. However, because the habitat loss is still relatively small, the loss of this habitat due to the proposed action is not likely to result in jeopardy to the species.

The operation of the THAAD involves use of EMR, which has the capability of negatively impacting animals such as birds and bats when exposed for extended periods of time to the radar beam. However, the chances of adverse effects to bats are extremely low due to the following factors:

- All land within 2,000 feet of the radar system has been cleared of trees. Since bats tend to roost and forage in forested areas, crossing open areas only to get between areas of foraging and roosting, it is unlikely that any bats in the area would remain within a radar beam for long enough for any dangerous levels of exposure.
- Bats in forested areas near the radar beam would not likely be exposed because the lowest elevation of the radar beam is at least 170 ft. above ground level at the nearest forest edge.
- The THAAD system most often operates in search/surveillance mode, and bats flying past or towards the radar system would be exposed to EMR for a very short duration (less

than 0.2 seconds), which would not result in adverse physical, physiological, social, or ecological, consequences.

- While tracking a target, a cross section of the radar beam at 350 meters away from the device is an ellipse that measures 19.6 meters vertically and 9.8 meters horizontally, but is narrower closer to the radar, at heights that fruit bats would be more likely to be flying (Hubbs 2016, in litt.). The chances that a bat will move in the same direction and at the same speed as the constant beam while tracking a target, and therefore be exposed to potentially damaging levels of radiation, are extremely small.
- Because of the human activity at the location of the THAAD stationing, namely noise, human smells, man-made structures, vehicles, and lights, it is unlikely that bats will fly over these areas, as bats in the Marianas are known to avoid human-caused stressors (see Status of the Species above).

The Department of Defense proposes to set aside 334.7 acres of habitat for conservation (described above). This will help mitigate the loss of about 87 acres of recovery habitat for bats.

In conclusion, this action, although presenting adverse effects to bats through habitat loss, is not likely to result in jeopardy of this species. In addition, the commitment to conserve 334.7 acres of habitat for restoration and conservation will help to offset adverse effects. At the time of this consultation, limited information was available about the effects of EMR on wildlife, especially with regards to repeated exposure. If new information becomes available that could potentially contradict these results, this analysis will be revisited.

Effects to the Guam Micronesian kingfisher

A total of 85.8 acres of kingfisher recovery habitat will be disturbed (cleared or physically modified) permanently for this action. This constitutes less than 0.4% of the specie's remaining habitat in Guam. Because the kingfisher does not currently exist in the wild, no direct adverse impacts are expected except through habitat loss and disturbance. The Department of Defense proposes to set aside 334.7 acres of habitat for conservation (described above). This will help mitigate the loss of 85.8 acres. In the event that extirpated birds are reintroduced to northern Guam, this analysis will be revisited.

Maintaining an adequate amount of habitat for recovery is of utmost concern for the Guam Micronesian kingfisher. The kingfisher recovery plan sets a goal of 1,000 adult kingfishers in Guam – 500 in northern and 500 in southern Guam – for delisting (USFWS 2008a). Mating pairs of kingfishers are estimated to require approximately 20 acres of habitat each (Kesler and Haig 2007a, pp. 386-387). This would require about 11,500 acres each in northern and southern Guam. About 71% of the kingfisher's remaining recovery habitat in northern Guam is located on DoD property. With the current rate of development both on and off DoD properties, the degraded state of much of this habitat due to lack of management and the presence of ungulates, and the continued presence of the brown treesnake throughout Guam, the recovery prospects for this island-endemic bird is tenuous. This project will result in the loss of 85.8 acres of habitat, which could potentially support 4 mating pairs of kingfishers. The recovery habitat remaining in northern Guam amounts to approximately 15,000 acres, or only about 3,500 acres left above recovery thresholds available before recovery is compromised (USFWS 2014e, pp. 1-6). The habitat loss from the proposed action is a small fraction of the total habitat remaining for kingfisher recovery on Guam. However, because of the tenuous situation for recovery described above, the Service continues to closely track loss of habitat and encourage project proponents to

ensure conservation of habitat for the kingfisher. Because so little habitat remains above the threshold, even small losses can result in adverse effects to the recovery of kingfishers.

In conclusion, this action, although presenting adverse effects to kingfishers through habitat loss and degradation, is not likely to result in jeopardy of this species. In addition, the commitment to conserve 334.7 acres of habitat for restoration and conservation will help to offset adverse effects. At the time of this consultation, limited information was available about the effects of EMR on wildlife, especially with regards to repeated exposure. If new information becomes available that could potentially contradict these results, this analysis will be revisited. In addition, in the event that extirpated kingfishers are reintroduced to northern Guam, this analysis will be revisited.

Effects to the Mariana crow

A total of 85.2 acres of Mariana crow recovery habitat will be disturbed (cleared or physically modified) permanently for this action. This constitutes less than 0.4% of the remaining habitat for this species in the wild in Guam. Because the crow does not currently exist in the wild in Guam, no direct adverse impacts are expected except through habitat loss and disturbance. The Department of Defense proposes to set aside 334.7 acres of habitat for conservation (described above) to mitigate the loss of 85.2 acres.

The Mariana crow recovery plan sets a goal of three populations, one in Rota, one in northern Guam, and one in southern Guam, each with 75 mating pairs (USFWS 2005a, p. v). However, as mentioned in the Status of the Species above, new information and analyses recommend 100 mating pairs in each of these populations are more likely to maintain sustainable populations (Amidon 2012, unpubl. data). There are currently 13,962 acres of potential crow habitat in northern Guam (USFWS 2015a p. 125). However, to achieve recovery goals, a minimum of approximately 5,500 acres of recovery habitat needs to be maintained in northern Guam. With the current rate of development both on and off DoD properties, the degraded state of much of this habitat due to lack of management and the presence of ungulates, and the continued presence of the brown treesnake throughout Guam, the recovery prospects for this island-endemic bird is tenuous. Unlike the kingfisher, however, the crow still exists in the wild on the island of Rota, and while recovery criteria call for a small number (100 breeding pairs rather than 500 for kingfisher), each crow pair requires a larger number of habitat for territory. Therefore, while habitat is certainly a limiting factor in crow recovery due to its limited native range and relatively large territory requirements, the loss of crow habitat due to this action will cause limited adverse effects, especially with the commitment to conserve and restore habitat to mitigate this loss.

In conclusion, this action, although presenting adverse effects to crows through habitat loss and degradation, is not likely to result in jeopardy of this species. In addition, the commitment to conserve 334.7 acres of habitat for restoration and conservation will help to offset adverse effects. At the time of this consultation, limited information was available about the effects of EMR on wildlife, especially with regards to repeated exposure. If new information becomes available that could potentially contradict these results, this analysis will be revisited. In addition, in the event that crows are reintroduced to northern Guam, this analysis will be revisited.

Effects to the Guam rail

A total of 140.6 acres of rail recovery habitat will be disturbed (cleared or physically modified) for this action. This constitutes less than 0.3% of this species' remaining habitat in Guam. Because rails are extirpated in the wild in Guam, no direct adverse impacts are expected to individual birds except through habitat loss and disturbance.

While the Guam rail is also a single island endemic, because of its ability to use edge and disturbed habitat as well as savannah and forests, the rail's recovery prospects in Guam are less limited by habitat availability. There are approximately 24,698 acres and 24,886 acres of recovery habitat in northern and southern Guam, respectively, for the Guam rail (USFWS 2015a, p. 128). This action will result in the loss of 140.6 acres of rail recovery habitat. Although a higher number of acreage lost than for other avian species, this is a smaller proportion of the total recovery habitat remaining for this species. Therefore, while the rail is still absent in the wild in Guam, and the presence of the snake and continued degradation or development of recovery habitat continues, the adverse effects to recovery habitat from this project are small in scale and unlikely to hinder the recovery prospects for this species.

In conclusion, the this action, although presenting adverse effects to rails through habitat loss, is not likely to result in jeopardy of this species. The Army, with collaboration from the Navy and Air Force, proposes to set aside 334.7 acres of habitat for conservation (described above). While this will be of help mainly to crows, kingfishers, bats, and listed plants, restoration activities that help to control or exclude brown treesnakes in these areas will have benefits to rails. Since rails are flightless, it is unlikely any new information about the effects of EMR will pertain to rails. However, in the event that extirpated rails are reintroduced to northern Guam, the Service and project proponent may decide to revisit this analysis.

Effects to *Cycas micronesica* and *Tabernaemontana rotensis*

Recovery habitat layers for the two listed plants *Cycas micronesica* and *Tabernaemontana rotensis* have yet to be developed. However, based on current knowledge of *C. micronesica*, it is evenly distributed through most types of forest habitat in Guam, similar to habitat suitable for birds, bats, and kingfishers. Therefore, it is reasonable to assume that habitat lost for these species would be habitat that could be suitable for cycads. We chose to use kingfisher numbers because of the nature of the habitat utilized by this species – limestone forest, but with potential for use of secondary growth such as coconut plantations. Since cycads occur in multiple types of forest habitat, even in secondary growth and previously disturbed areas, we assume the number of recovery habitat available in Guam, as well as the amount of recovery habitat to be cleared and set aside for restoration, will be similar. We anticipate that cycads, being more widely and regularly distributed in forests of northern Guam, are more likely to be found in larger numbers. However, over 20 acres be cleared consists of secondary forests with heavy monotypic stands of *Casuarina equisetifolia*, with about 42 acres consisting of mixed limestone forest-plateau/secondary (94th AAMDC 2016). The proposed clearing for a fiber-optics line will be an additional 2.4 acres of forest or perennial scrub. Based on the estimated density of approximately 1.5 cycads per acre on AAFB (based on Marler 2014), the proposed action has the potential to clear or disturb up to 110 cycads because of clearing for the CDZ (72.6 acres of forest or scrub cleared). This number may be lower because the flexibility allowed for placement of the fiber-optics line.

Tabernaemontana rotensis, in contrast, is patchily distributed in limestone forest areas of northern Guam. In addition, and ecological information about this species is still very limited. However, *T. rotensis* has been recorded near the action area, as well as in similar habitat types in northern Guam (UOG 2007, p. 9; 94th AAMDC 2016, p. 1-25). When it occurs, it tends to occur in clusters or high-density clumps (UOG 2007, p. 9, 14), with very few exceptions of 1-2 individuals more than 100m from other *T. rotensis* individuals. Because the action area, while not thoroughly surveyed, has been observed on multiple occasions by biologists and botanists, we believe that since this species occurs in high-density clumps, it will be unlikely to find any high-density clusters of this species within the action area of this project. Therefore, we anticipate no more than five individuals will be impacted by the proposed action. If individuals are found, they can either be avoided, or they will be occurrences that are not a part of a large cluster.

A large cluster of *T. rotensis* occurs within and near the proposed conservation mitigation area (the largest contiguous portion of the proposed conservation area, 330.1 acres) on the eastern side of AAFB. Therefore, we anticipate the conservation area to be particularly beneficial to *T. rotensis* by long-term protection from development and human disturbance, and by conservation actions, especially ungulate control and exclusion. Cycads also occur within the proposed conservation areas, and we anticipate that conservation actions such as ungulate control and exclusion may prove beneficial to cycads in the area. However, we also recommend research and pest control for cycads since based on the onslaught of threats to this species, especially from arthropod pests, ungulates are only one of many factors contributing to their decline (USFWS 2015b, 73 pp.).

Effects to Listed Orchids

In the revised Biological Analysis (94th AAMDC 2016), the Army indicated that it was possible that several individuals of the following species, three orchid species and one tree species, not analyzed above, may have been found in the footprint of the emergency placement of the THAAD:

Bulbophyllum guamense
Dendrobium guamense
Tuberolabium guamense

At the time of the emergency placement, these species were not listed, and there is no way to confirm their presence in the project footprint that has already been cleared. Based on the description of the areas yet to be cleared, we believe it is unlikely but possible that a small number of these orchids occur and therefore will be impacted in the proposed project footprint.

Effects to *Bulbophyllum guamense*

B. guamense, like many forest orchids in the Marianas, occurs in forested areas with high humidity. While the Guam Plant Extinction Prevention Program (GPEPP) documented two individuals of *B. guamense* in the Habitat Management Unit (HMU) in AAFB in northern Guam, they documented much higher numbers in the river valleys of southern Guam – 62 along the Atmasogu River and 214 along the Maulap River, which were surveyed within the Naval Munitions Storage installation (JRM 2016 p. 5). River valleys, because of their topography and more consistent presence of water, retain more moisture and experience less air movement,

creating ideal conditions for *B. guamense*. Most of the vegetation types that are planned for clearing for this project are previously disturbed areas dominated by *Casuarina equisetifolia* and are located on the edges of roads or runways with little to no understory, allowing for more air movement, and therefore, dryer conditions. The proposed placement of the underground fiber-optic cable largely follows along roads, runways, or fenclines that have already been cleared or disturbed. However, a long, narrow, rectangular area, about 30 acres in size, northwest of the North Runway is planned for clearing for the Cargo Drop Zone activities (Figure 3). This rectangular area contains some patches of dense native canopy including large *Tristiropsis obtusangula* trees (Figure 5) and more rugged karst substrate distinct from the *C. equisetifolia* strands alongside the runways at Northwest Field. Other native trees such as *Psychotria mariana*, *Aglaia mariannensis*, *Hibiscus tiliaceus*, *Pandanus* sp., and *Ficus prolixa* were recorded here, as well as non-native trees such as *Vitex parviflora* (A. Gawel, USFWS, 2016 pers. obs.). *B. guamense*, while not observed at the time these species were recorded, has been recorded at other sites on both native trees such as *Ficus prolixa* and on the invasive tree *Vitex parviflora*, which occurs in high numbers. Therefore, while the exact number of *B. guamense* that would be disturbed by this action is unknown, we do not anticipate more than 5 individuals would be impacted by this action. It is also possible that no individuals will be impacted.

Effects to *Tuberolabium guamense*

Tuberolabium guamense is also an epiphytic orchid that can be found in multiple forest types. While patchily distributed across its range, it can occur in dense clusters where it is found, as evidenced by the presence of over 5,000 individuals within a 1,213-acre area of Finegayan in northern Guam (USFWS 2015b, p. 16; DON 2016, 11 pp.). The majority of the Finegayan area is mixed secondary limestone forest dominated by *Vitex parviflora*, *Hibiscus tiliaceus*, *Pandanus dubius*, *Pandanus tectorius*, *Guamia mariannae*, *Morinda citrifolia*, and *Triphasia trifolia* (DON 2016, p. 1). This habitat is similar in species composition to the 30-acre area of the Cargo Drop Zone (CDZ) clearing described above for the effects to *Bulbophyllum guamense*, which also contains some *Eugenia* forest (Figure 4) However, the Finegayan area is comprised of a larger area of contiguous forest while the area to be cleared for the CDZ occurs in a narrow strip of forest fragment abutting roads and helicopter landing pads. The pockets of high density of *T. guamense* within the Finegayan area were marked by limited air movement and high humidity (USFWS 2016, Field Notes), which contrasts with the 30-acre area of the proposed CDZ clearing, which has more air movement,

While clumped and not evenly distributed, the density of *T. guamense* in the 1,213-acre area of Finegayan amounts to approximately 4 orchids per acre. Based on the vegetation characteristics described above, and the limited knowledge we have about *T. guamense* habitat and occurrences, we anticipate that this action may adversely affect up to 120 *T. guamense* individuals. However, it is possible that fewer or even no orchids will be present because of the exposure of more of the project footprint to air movement, being adjacent to large runways and helicopter-landing pads.

Effects to *Dendrobium guamense*

In contrast to the orchid species analyzed above, *Dendrobium guamense* occurs across multiple habitat types, including at all elevations along rivers and on ridges and plateaus, co-occuring with other species of orchids, but also occurring on ridges, plateaus, on trees that are within or near savannah, and on trees on forest edges (JRM 2016, p. 9; A. Gawel, Service, pers. obs. 2016). They are epiphytes on multiple species. While they occur across a variety of habitat types,

recent surveys suggest that they are more abundant in the forests of southern Guam. Surveys done on DON lands found higher numbers in the river valleys of southern Guam as compared to limestone forest areas adjacent to the action area in northern Guam (JRM 2016, 95 pp.). The Habitat Management Unit and the Finegayan area were both surveyed for this species. None were found in the HMU (JRM 2016, p. 5), while 29 were recorded from the area of 1,213-acre area of Finegayan described in the analysis for *Bulbophyllum guamense*, above. These areas of northern Guam contain mixed habitat types, some of which are similar to the habitat types that occur within the proposed areas to be cleared for the Cargo Drope Zone portion of this action – namely, mixed secondary limestone forest with overlap of species composition. In southern Guam, this species was commonly found as an epiphyte on Pandanus tectorius (JRM 2016, p. 9), which does occur within the proposed project footprint.

While no formal surveys have been done within the project footprint, based on the information above, and the vegetation characteristics of the action area, it is possible that a small number of *D. guamense* individuals may occur within the action area. Therefore, while the exact number of *D. guamense* that would be disturbed by this action is unknown, we do not anticipate more than 5 individuals would be impacted by this action. It is also possible that no individuals will be impacted.

Note on *Psychotria malaspinae*

While the Army requested to consult formally on *Psychotria malaspinae*, little information was available at the time to determine whether this species was likely to be present in the action area. The Service agreed to consult based on information in the Biological Assessment suggesting that this species may be present, despite no surveys of the action area (94th AAMDC 2016). However, recent information gained from discussions with local botanists, as well as reconnaissance surveys by the Service, strongly suggest that this species does not occur within the action area. *P. malaspinae* is a rare species of shrub currently known from "cockpit karst" habitats of native limestone forest (JRM 2016; pp. 6-7). In fact, only seven individuals are known from the deep karst areas, away from forest edges, on the Ritidian clifflines (E. Demeulenare, 2016, pers. comm.), in addition to two occurrences in native limestone forest elsewhere in northern Guam. This habitat type does not exist in the action area, and the small pockets of less disturbed vegetation to be impacted by this project (more detailed vegetation and habitat descriptions of the action area found in the analyses for orchids above), while they contain native tree and shrub species, do not have the topographic and ecological characteristics that typify the very small range of known habitat for this species. Therefore, we do not, at this time, analyze effects from the proposed action to *P. malaspinae*.



Figure 5. Photos of forested area proposed for clearing. *Tristiropsis obtusangula* tree in right panel.

CUMULATIVE EFFECTS

Cumulative effects include the effects of future non-Federal actions that are reasonably certain to occur within the area of action subject to consultation. Future Federal action will be subject to the consultation requirements established in section 7 of the ESA and, therefore, are not considered cumulative for the proposed action.

Although there are no proposed development projects that we are aware of, it is reasonable to assume development on Guam will continue to increase. This may increase habitat loss and degradation of suitable recovery habitat for listed species. The action area is completely within a military base, so non-Federal actions are extremely unlikely to occur within or near the action area. The staffing necessary for construction and operation of the THAAD have already caused a small increase in the number of personnel on AAFB and workers necessary for construction of the proposed portions of this actions may also contribute a small increase in population. However, a total staff of 225 mostly military personnel, with a potential 168 dependents is unlikely to result in noticeable increases in development or strains on natural resources.

CONCLUSION

In conclusion, this action is not likely to result in jeopardy to listed species analyzed above because of the amount of habitat to be cleared or disturbed constitutes a very small portion of the recovery habitat needed for recovery of these listed species. Adverse effects will be minimized by adhering to the avoidance and minimization measures detailed above. Adverse effects will also be mitigated by conservation actions detailed in the conservation measures, especially the habitat conservation and enhancement planned for 334.7 acres of potential listed species habitat on AAFB.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act and Federal regulations pursuant to section 4(d) of the Act prohibit the take of endangered or threatened species, respectively, without special exemption. Take is defined as harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct. Harm is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioural patterns, including, breeding, feeding, or sheltering. Harass is defined by the Service as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behaviour patterns which include, but are not limited to, breeding, feeding or sheltering.

Incidental take is defined as take that is incidental to, and not the purpose of, carrying out an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered a prohibited taking under the Act provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The measures described below are non-discretionary, and must be undertaken by the U.S. Army so that they become binding conditions to the applicant for the exemption in section 7(o)(2) to apply. The Army has a continuing duty to regulate the activity covered by this incidental take statement. If the Army (1) fails to assume and implement the terms and conditions or (2) fails to require contractors to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to contract documents, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the Army must report the progress of the action and its impact on the species to the Service as specified in this incidental take statement [50 CFR 402.14(i)(3)].

Amount or Extent of Take Anticipated

Based on the analysis presented in this biological opinion, while adverse effects to Mariana fruit bats, Guam kingfisher, Guam rail, and Marianas crow are anticipated through loss of acres of recovery habitat, the Service does not anticipate any take in the form of mortality, harassment, or harm over the duration of the proposed action.

REINITIATION – CLOSING STATEMENT

This concludes formal consultation on this action. As required in 50 CFR §402.16, reinitiation of consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is met, any operation causing such take must cease pending reinitiation.
If you have questions regarding this letter, please contact Jacqueline Flores, Biologist, (phone: 671-989-6744).

Sincerely,

for Mary M. Abrams, Ph.D.
Field Supervisor

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Endangered Species Act – Section 7 Consultation

Biological Opinion

Action Agency:	United States Navy, Joint Guam Program Office (JGPO)
Activity:	The U.S. Navy's proposed Guam and Commonwealth of the Northern Mariana Islands (CNMI) Military Relocation
Consulting Agency:	National Marine Fisheries Service, Pacific Islands Region, Protected Resources Division
NMFS File No. (PCTS):	F/PIR/2008/07326
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Acronyms

ANF	Annual Nesting Females
ATF	Amphibious Taskforce
BA	Biological Assessment
BMP	Best Management Practices
CFR	Code of Federal Regulations
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
cm	Centimeter
cy	Cubic Yard
CNMI	Commonwealth of the Northern Mariana Islands
CSG	Carrier Strike Group
CVN	Carrier Vessel Nuclear (Nuclear-powered aircraft carrier)
DAWR	Division of Aquatic Wildlife Resources, Guam
dB	Decibel
DEIS/OEIS	Draft Environmental Impact Statement/Overseas Environmental Impact Statement
DFW	Division of Fish and Wildlife, CNMI
EEZ	Exclusive Economic Zone
ESA	Endangered Species Act
FR	Federal Register
FSM	Federated States of Micronesia
GBR	Great Barrier Reef (Australia)
Hz	Hertz (a measurement of frequency equivalent to cycles per second)
ITS	Incidental Take Statement
km	Kilometer
MHI	Main Hawaiian Islands
MIRC	Mariana Islands Range Complex
NA	Nesting Aggregation
NDWTP	Northern District Wastewater Treatment Plant
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service (also NOAA Fisheries)
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
ODMDS	Ocean Dredged Material Disposal Site
PIFSC	Pacific Islands Fisheries Science Center
PIRO	Pacific Islands Regional Office
PNG	Papua New Guinea
PRD	Protected Resources Division
PTS	Permanent Threshold Shift
RL	Received Level
rms	Root-Mean-Square
SL	Source Level
SPL	Sound Pressure Level
TTS	Temporary Threshold Shift
US	United States
USEPA	US Environmental Protection Agency
USFWS	US Fish and Wildlife Service
USN	US Navy
UV	Ultraviolet

Introduction

Section 7(a)(2) of the Endangered Species Act of 1973, as amended (ESA; 16 U.S.C. 1539(a)(2)) requires each Federal agency to insure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of critical habitat of such species. To "jeopardize the continued existence" means "to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species" (50 CFR 402.02). A Federal agency is required to consult formally with the National Marine Fisheries Service (NMFS) for marine species or their designated critical habitat or with the United States Fish and Wildlife Service (USFWS) for terrestrial and freshwater species or their designated critical habitat when that agency's action "may affect" an ESA-listed species. Federal agencies are exempt from the requirement for formal consultation if they have received from NMFS or USFWS written concurrence with a determination that an action "may affect, but is not likely to adversely affect" ESA-listed species or their designated critical habitat (see ESA Section 7 Implementing Regulations; 50 CFR 402).

This document represents NMFS' biological opinion (Opinion) of the effects on marine species protected under the ESA that may result from the Guam and CNMI Military Relocation. This Opinion is based on: the review of the U.S. Navy's November 2009 Draft Environmental Impact Statement/Overseas Environmental Impact Statement - Guam and CNMI Military Relocation - Relocating Marines from Okinawa, Visiting Aircraft Carrier Berthing, and Army Air and Missile Defense Task Force (DEIS/OEIS); the U.S. Navy's March 12, 2010 Biological Assessment for Carrier Vessel Nuclear (CVN) Wharf Construction and Navy Waterfront Improvement, Apra Harbor, Guam (BA); the U.S. Navy's April 14, 2010 response to NMFS/PRD's request for additional information; recovery plans for U.S. Pacific populations of listed sea turtles; published and unpublished scientific information on the biology and ecology of threatened and endangered marine species, as well as of other species of concern in the action area; monitoring reports and research in the region; biological opinions on similar actions; and relevant scientific and gray literature (see Literature Cited).

1 Consultation History

On October 30, 2008, NMFS Pacific Islands Regional Office (PIRO) Protected Resources Division (PRD) received the Navy's October 27, 2008, request for informal consultation and concurrence with their species list, green sea turtles (*Chelonia mydas*) and hawksbill sea turtles (*Eretmochelys imbricata*), for proposed construction of berthing for nuclear-powered aircraft carriers (CVN) in Apra Harbor, Guam. On November 4, 2008, NMFS PRD conditionally concurred with the species list, based on the understanding that the proposed action area was limited to Apra Harbor, and requested additional information. Numerous interagency meetings and document reviews transpired between that date and July 29, 2009, when the Navy released the early release DEIS/OEIS for the proposed action. Among other comments, NMFS responded that we would not concur with the Navy's intended determination that the proposed action was not likely to adversely affect ESA-listed marine species, and recommended that the Navy enter into formal consultation for the proposed action for impacts on green and hawksbill sea turtles. On November 9, 2009, NMFS received the Navy's November 5, 2009 request for informal consultation. NMFS transmitted our letter of non-concurrence on December 2, 2009, stating our

rationale and again recommending the Navy request formal consultation. On March 12, 2010, the Navy hand-delivered its request for formal consultation along with its BA, both dated that same day. NMFS transmitted to the Navy our comments on the BA and a request for additional information on March 26, 2010. The requested information arrived on April 14, 2010, and a formal consultation was initiated on that date for green and hawksbill turtles. A draft Opinion was presented to the Navy on June 5, 2010. Comments on the draft Opinion were received from the Navy on July 1, 2010. The Navy's Final EIS (FEIS) for the proposed action was received on July 26, 2010. The Navy's comments and FEIS were both considered in finalizing this Opinion.

2 Description of the Proposed Action and Action Area

The proposed action is described in the Navy's March 12, 2010 BA (USN 2010a), in the April 14, 2010 additional information (USN 2010b), and in the July 2010 FEIS/OEIS (USN 2010e). In summary, the proposed action includes three primary components: 1) Relocating US Marines from Okinawa to Guam; 2) Increasing and upgrading vessel berthing and related facilities in Apra Harbor to accommodate increased visits by aircraft carriers and their accompanying ships, collectively referred to as a Carrier Strike Group (CSG), as well as supporting increased visits by Amphibious Taskforce (ATF) ships; and 3) Stationing an Army Air and Missile Defense Task Force on Guam. The proposed action includes substantial new upland construction and infrastructure improvements to support the incoming Marine and Army forces. That construction is not expected to directly affect ESA-listed species under NMFS jurisdiction. However, work done to increase and upgrade vessel berthing and related facilities in Apra Harbor is likely to directly affect ESA-listed marine species. The proposed action is expected have indirect impacts on ESA-listed marine species through increased wastewater discharge and increased commercial and recreational vessel traffic that are expected result from the proposed population increase on Guam. As such those actions are the components of the proposed action that are the subject of this consultation.

Accommodating a proposed increase in the number of military vessels visiting Apra Harbor is the prime reason for increasing and upgrading vessel berthing and related facilities in Apra Harbor. The Navy expects that visits by CSGs (typically 5-7 surface vessels and 2 submarines) would increase from the current two 7-day visits per year, to three 21-day visits per year (total of 63 days). The Navy also expects that visits by ATFs (typically 7 vessels) would increase from two 21-day visits per year, to between four and six 21-day visits per year (a maximum total of 126 days). ATFs embark numerous landing craft, which are expected to be kept at the amphibious craft laydown area at Polaris Point.

Increasing and upgrading vessel berthing and related facilities in Apra Harbor can be divided into two primary components: 1) CVN Wharf Construction and 2) Inner Harbor Waterfront Improvements. The Navy expects that work would begin in 2010. The Navy reported in their comments on the draft Opinion and their FEIS that they are deferring finalizing the decision about locating the CVN Wharf until additional marine surveys are completed. They also reported that construction of the CVN wharf would begin no earlier than FY 2013. However, they also restated that constructing the CVN Wharf at Polaris Point remains the preferred alternative. As such, construction of the CVN wharf at Polaris Point, along with its associated dredging, remains part of the proposed action, and consequently, must be analyzed in this Opinion.

The expected project-specific durations for work in Apra Harbor are given below. A great deal of overlapping work is expected, so those duration estimates are not necessarily additive in nature. No Apra Harbor-specific project completion date was given, and the DEIS/OEIS indicated that construction for the whole proposed action would be completed by 2020. Thus, although it seems likely that much of the proposed work would be done as soon as possible, some level of project-related construction may be ongoing in Apra Harbor for up to 10 years. Construction, pile driving, and dredging would be done by land-based and barge mounted heavy equipment, as appropriate, throughout the duration of the proposed project. Small support craft and divers are also expected to be used to perform construction-related tasks and repairs to equipment as needed. It is expected that pile driving and dredging, and much of the other work would be done around the clock, 7 days per week until the proposed action is completed.

2.1 CVN Wharf Construction

The primary requirements to accommodate a visiting CVN include appropriately wide channels with adequate water depth and a 1,325-foot long concrete decked wharf. To meet the required widths, the existing Navy operation channel would be widened from its current 400 feet (ft) (122 m) to 600 ft (183 m), and a 2,184-ft (666 m) diameter turning basin would be established adjacent to the proposed CVN Wharf at Polaris Point. Work to widen the channel and establish the turning basin would consist of relocating several existing channel markers, two sets of range lights, and a mooring buoy. The minimum required water depth for CVN movement is -49.5 ft (-15.1 m) mean lower low water (MLLW) plus 2 ft overdredge. The current minimum channel depth is -35 ft (-10.7 m), and the location for the proposed CVN pier is also too shallow. Consequently, the channel, turning basin, and the proposed wharf area would be mechanically dredged to -51.5 ft MLLW. The current minimum channel depth is reportedly -35 ft (-10.7 m) MLLW. However, the FEIS reports that throughout most of the project area the substrate is between 1.6 and 3.3 ft (0.5 to 1.0 m) shallower than the required -51.5 ft.

The Navy proposes to use barge-mounted equipment to dredge shallow areas within the channel, the turning basin, and at the proposed CVN wharf. The dredging footprint encompasses a total planar area of about 53 acres, including up to a maximum of 33 acres of coral reef habitat. The Navy anticipates using a several-ton steel spike chisel to fracture hard reef substrates, and a clamshell drop bucket, also several tons, to remove hard and soft substrate material. Dredging is expected to require up to 18 months of round-the-clock work to complete. Total volume of fill to be removed is about 608,000 cubic yards (yd^3) (465,000 m^3). The Navy estimates that up to 2 barge loads of dredged material would be removed per day. Dredged material would be disposed of via beneficial use options, upland dewatering and disposal, or at the US Environmental Protection Agency's (USEPA) proposed Ocean Dredged Material Disposal Site (ODMDS), which is expected to be located about 12 miles (20 km) northwest of the entrance to Apra Harbor.

The CVN wharf would be constructed at Polaris Point, at the north side of the entrance to the inner harbor. In addition to the dredging mentioned above, the shoreline along the proposed wharf alignment would be sloped to accommodate the project design. About 410 24-inch (61 cm) diameter vertical steel pipe pilings would be impact driven to about 150 ft below the mud line to support a concrete-decked wharf. Pile driving is expected to take about 2,050 hours of work to complete. Assuming 24-hour work days, it would take a minimum of about 85 days of

pile-driving. The Navy intends to underlay the length of wharf with a 3 to 1 sloped riprap structure that would extend from the shoreline under the wharf and outward to about 20 ft beyond the outermost pilings at about -50 ft. Other work would include over- and near-water work to construct the concrete decking; to install mooring structures such as bollards, cleats, and fenders; and to construct the facilities, structures, and utilities needed to support a visiting CVN.

2.2 Inner Harbor Waterfront Improvements

Proposed inner harbor waterfront improvements include: repairs and upgrades at numerous wharves; maintenance dredging; construction of an amphibious craft laydown area with ramps for launching and recovering amphibious craft and small boats; and the relocation of certain existing facilities such as the Military Working Dog Kennel and US Coast Guard facilities to make room for ATF-related facilities. Proposed improvements common to all of the wharves include: over- and near-water work to repair or replace concrete decking, ladders, and handrails; filling of voids, repair or replacement of mooring structures; the repair or replacement of wharf-side structures and utilities; and the pier-side construction of a new cargo staging area and a new equipment wash down area.

Sierra, Tango, Uniform, and Victor Wharves require significant in-water work to repair and reinforce them. All four wharves would have new sheet piling bulkheads driven-in about 10 ft seaward along the entire length of their existing bulkheads (Table 1). The new piling bulkheads would consist of 23.6-inch by 0.35-inch sheet pilings impact driven to about 66 ft below the mud line. The sheet pilings would be supported by 3-ft by 1.5-ft H-pilings that would be spaced about 10 ft apart and driven to 75 ft below the mud line. The new bulkheads would be tied-back to the existing wharf bulkheads and additional H-pilings driven between the existing and new bulkheads. Pile driving is expected to take about 18 months of 24-hour work days to complete. The voids between the new and old bulkheads would be filled, and new concrete decking would be constructed out to the new bulkheads.

Table 1. Details for work at S, T, U, & V Wharves, including the number of pilings and expected duration of work.

Wharf	Length	Sheet Piles	Support H Piles	Tie-back H Piles	Pile Drive Duration	Total Project Duration
Sierra	660 yards	360	170	390	3 to 6 months	9 months
Tango	520 yards	370	180	400	3 to 6 months	9 months
Uniform	220 yards	185	80	190	3 months	6 months
Victor	220 yards	200	98	186	3 months	6 months

In order to accommodate the operational requirements of the ATF vessels that would berth in the inner harbor, the harbor floor in front of S and T wharves must be dredged from the current depth of -35 ft (-10.7 m), down to -40 ft (-12.2 m) MLLW. The Navy proposes to use barge-mounted equipment with a clamshell bucket to mechanically remove about 327,000 yd^3 (250,000 m^3) of accumulated fine sediments. The dredging footprint encompasses about 114 acres. The Navy estimates that up to 12 months of dredging would be required, and that up to 2 barge loads of dredged material would be removed per day. As with the CVN-related dredging, material dredged from the inner harbor would be disposed of via beneficial use, upland disposal, or at the ODMDS.

2.3 ODMDS Disposal Option

About 935,000 yd^3 of dredged material is expected to be produced over about 21 months for inner and outer harbor dredging projects combined. Assuming that the USEPA designates its proposed Guam ODMDS in 2010, as planned, it is likely that a significant volume of that dredged material would be disposed of at the ODMDS, requiring up to 234 round trips by tugs and scows to deliver the dredged material to the ODMDS.

2.4 Best Management Practices (BMPs)

The BMPs enumerated in Navy's Biological Assessment are intended to ensure that constant vigilance shall be kept for the presence of ESA-listed sea turtles during all aspects of the proposed construction action, particularly during in-water activities such as pile driving, dredging, boat operations, or diving. They are also intended to minimize contamination of the marine environment from project-related activities. Such measures include, but are not limited to, protected species safety zones, ramp up protocols, vessel speed limits, construction debris control, and the use of turbidity and siltation minimization devices. In their April 14, 2010 response to NMFS/PRD's request for additional information, the Navy committed to incorporate a list of BMPs intended to further reduce or eliminate project-related impacts on ESA-listed marine species.

2.5 Interrelated/Interdependent Actions

For the purposes of this consultation, interrelated and interdependent actions due to the overall proposed action are actions related to supplying the construction and supporting the increased population that may be expected to impact the marine environment. As such interrelated and interdependent actions are expected to include: 1) increased commercial shipping traffic; and 2) increased discharge of wastewater effluent.

The other major components of the proposed action, relocating US Marines to Guam and stationing a US Army Air and Missile Defense Task Force on Guam would increase the human population on Guam, which is currently about 180,000 people (CIA 2010). Personnel would be permanently relocated to Guam, and temporary construction works would move to the island to support the related construction, but are expected to leave when work is no longer available. As described in the DEIS, the maximum additional population is expected to peak at about 79,000 people in 2014 during the height of construction (a 43.9 % increase over the current population). Following the peak, the additional population is expected to decline and level off at about 33,600 additional people by 2019 (an 18.7 % increase over the current population). Additionally, CSG and ATF visits are expected to periodically bring about 7,200 and 6,200 more personnel to Guam, respectively (USN 2010e).

In their comments on the Draft Opinion, and in the FEIS, the Navy described the potential implementation of Force Flow Reduction (FFR) and an Adaptive Program Management (APM) approach that could be used in conjunction with each other to avoid the growing population's exceedance of infrastructure capability. The Navy could adjust the arrival of the majority of the relocated military personnel (FFR) until much of the construction was completed and the number of on-island temporary construction workers was in decline. The APM, through its advisory body the Civil-Military Coordination Council, would be used monitor environmental impacts and infrastructure capacities so that construction tempo and sequencing could be adjusted to

minimize environmental impacts. The Navy suggests that the combination of FFR and APM could reduce the peak population increase from 79,000 in 2014, to something close to 41,000 across the 2014 to 2018 time frame, but they are clear that the numbers given are only notional, and they make no commitments to any specific levels or dates. The post-construction population increase would remain as described in the FEIS, but the additional population may not drop to that level until 2020. Implementation of FFR and APM could reduce environmental impacts as compared to those expected to result from the proposed action, as described in the DEIS. However, without a commitment from the Navy to achieve/maintain particular population levels, or to complete specific infrastructure upgrades, NMFS must assume that potential impacts due to the expected population increase would occur based on a population growth curve that is somewhere between that described in the FEIS (79,000 peak) and the one described in their FFR/APM plan (41,000 peak). As such, NMFS assessed potential impacts based on the 79,000 population peak described in the DEIS, under the assumption that that level would be a worst case scenario, and that this approach would allow an appropriately conservative analysis.

1. The FEIS reports that total annual commercial shipping (containerships and breakbulk/Roll-On-Roll-Off (RORO) ships, and barges) has steadily declined from a high of 763 vessels in 1995 to a low of 436 vessels in 2008. Although breakbulk/RORO and barge arrivals declined during that period, containership arrivals increased, particularly during 2007 and 2008. Barge traffic has fallen off dramatically, to about 20 trips annually since 2006, and the FEIS did not predict any increase in that traffic. However, the FEIS predicts that breakbulk/RORO and containership arrivals would increase at the onset of construction. It is likely that the increase has already begun, but this consultation can only address components of the action that are yet to occur. The 14-year averages (1995-2008) for breakbulk/RORO ships and containership arrivals are 290 and 124, respectively. The combined average is 414 annual trips. The FEIS reports that, due to construction, annual commercial traffic is expected to rise to 58 additional arrivals in 2010, peak at 362 additional arrivals in 2015, and then taper-off, back down to the 14-year average toward the completion of construction in 2018. Although recent shipping trends seem to be downward and the FEIS suggests that commercial shipping would fall back down to pre-action levels, NMFS expects post-construction commercial shipping to level-off at a rate commensurate with the expected permanent population increase (19%). Thus, about 79 additional commercial ships (breakbulk/RORO ships and containerships combined) are expected to arrive annually following the end of construction.

2. Wastewater effluent discharged into the waters of Guam is expected to increase proportionally to the population increase. Based on expected population changes, as described in the FEIS, the population could increase by about 45% above 2010 levels in 2014, during the construction peak, then taper off to about 19% above 2010 levels in 2019 and beyond (factoring in increases due to CSG and ATF visits). Wastewater effluent discharged by the Northern District Wastewater Treatment Plant (NDWTP) is expected to increase by 5.6 million gallons per day (MGD); a 46.7% increase (USN 2010e). Effluent discharged by the Hagatna WTP is also expected to increase due to the proposed action but not as much as the NDWTP.

2.6 Action Area

With regard to ESA-listed marine species under NMFS jurisdiction, the action area for the Guam and CNMI Military Relocation is defined as the marine waters around the Island of Guam out to about 5 nautical miles (nm) where the direct and indirect impacts from harbor construction, increased shipping, effluent outflow, and recreational use of marine waters are expected to be contained (Figure 1).

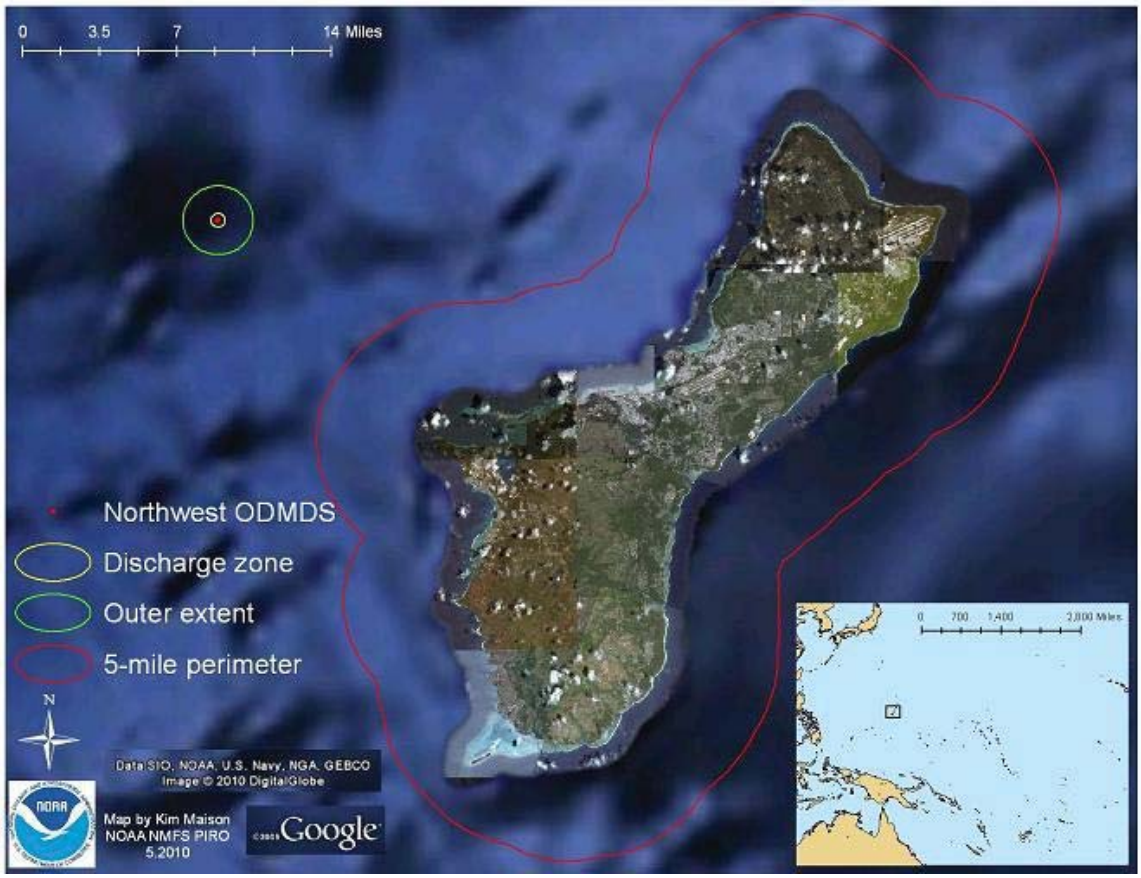

Figure 1. Action Area - Guam with the 5-mile nearshore area outlined in red, and the proposed USEPA Ocean Dredge Material Disposal Site (ODMDS) outlined in green.

Should the Guam ODMDS option be exercised for the disposal of dredged material during the proposed action, the action area is further extended to include the in-water area approximately 110 yards around the tugs and scows as they transit to and from the ODMDS, as well as the area around and under the tug and scow when disposal takes place. Also, due to the increased commercial shipping and military vessel traffic that would not approach Guam if it were not for the proposed action, the action area must also include the in-water area around those additional vessels. For the additional commercial vessels, the action area includes the in-water area approximately 110 yards around those ships as they transit to and from Apra Harbor once inside the 200 nm boundary of the Guam Exclusive Economic Zone (EEZ) (NMFS 2010b).

The movement of additional military vessels in and out of Apra Harbor is more complicated. Military vessels typically conduct training while enroute. With the exception of some land based small arms fire and other strictly land based training, military training in the Marianas is intentionally excluded from the proposed action. All other significant military training in the Marianas, such as naval exercises and amphibious landings is covered under the EIS/OEIS for the Mariana Islands Range Complex (MIRC) and the potential impacts of that training are considered in a separate ESA consultation. Thus, the action area around additional military vessels includes the in-water area approximately 110 yards around those ships, but begins only when training covered under the MIRC is complete and those vessels are headed for port in Apra Harbor. Similarly, the action area around outbound military vessels is considered terminated upon the initiation of training that is covered under the MIRC.

3 Status of the Species

The US Navy determined that the proposed action is likely to adversely affect green and hawksbill turtles, but that the action would have no effect on blue, fin, humpback, sei, and sperm whales, as well as leatherback, loggerhead and olive ridley sea turtles (USN 2010c). However, due to expected actions that are interrelated and interdependent to the proposed action, particularly the expected increased vessel traffic to and from the Marianas, NMFS has determined that the proposed action may affect, but is not likely to adversely affect blue, fin, humpback, sei, and sperm whales, as well as leatherback, loggerhead and olive ridley sea turtles (Table 2). Green and hawksbill turtles are the subject of this Opinion.

Table 2. ESA-listed marine species that may be affected by proposed action.

Species	Scientific Name	ESA Status	Listed	Federal Register
Species not likely to be adversely affected by the proposed action.				
Blue Whale	*Balaenoptera musculus*	Endangered	12/02/1970	35 FR 18319
Fin Whale	*Balaenoptera physalus*	Endangered	12/02/1970	35 FR 18319
Humpback Whale	*Megaptera novaeangliae*	Endangered	12/02/1970	35 FR 18319
Sei Whale	*Balaenoptera borealis*	Endangered	12/02/1970	35 FR 18319
Sperm Whale	*Physeter macrocephalus*	Endangered	12/02/1970	35 FR 18319
Leatherback Sea Turtle	*Dermochelys coriacea*	Endangered	06/02/1970	35 FR 8491
Loggerhead Sea Turtle	*Caretta caretta*	Threatened	07/28/1978	43 FR 32800
Olive Ridley Sea Turtle	*Lepidochelys olivacea*			
Nesting aggregations on west coast of Mexico		Endangered	07/28/1978	43 FR 32800
All other Olive Ridley Sea Turtles		Threatened	07/28/1978	43 FR 32800
Species likely to be adversely affected by the proposed action.				
Green Sea Turtle	*Chelonia mydas*			
Nesting aggregations in Florida and Mexico		Endangered	07/28/1978	43 FR 32800
All other Green Sea Turtles		Threatened	07/28/1978	43 FR 32800
Hawksbill Sea Turtle	*Eretmochelys imbricata*	Endangered	07/28/1978	43 FR 32800

This section presents biological or ecological information for green and hawksbill sea turtles affected by the proposed action relevant to formulating the Opinion. Subsections 3.1 and 3.2 provide species-specific descriptions of distribution and abundance, life history characteristics (especially those affecting vulnerability to the proposed action), threats to the species, major conservation efforts, and other relevant information. Factors affecting those species within the action area are described in more detail in the Environmental Baseline (Section 4). No critical habitat has been designated for either of these species in the Pacific Ocean. Therefore, this project would have no effect on designated critical habitat under NMFS jurisdiction.

3.1 Green Sea Turtles

Green turtles are distributed circum-globally, and can be found in the Pacific, Indian, and Atlantic Oceans as well as the Mediterranean Sea, as described in the most recent green turtle 5-year status review (NMFS & USFWS 2007a). As shown above in Table 2, in 1978, all green turtles were listed as threatened under the ESA, except for the breeding populations in Florida and on the Pacific coast of Mexico, which were listed as endangered. Following are descriptions of the distribution and abundance, life history characteristics (especially those affecting vulnerability to the proposed action), threats to the species, and major conservation efforts for green sea turtles.

3.1.1 Distribution and Abundance

Globally, most green sea turtle nesting populations declined substantially during the 20th century. Conservation efforts over the past 25 years or more appear to have had some positive results, as indicated below. However, threats and impacts persist for many green sea turtle populations (NMFS & USFWS 2007a). Following are brief descriptions of distribution and abundance of green turtles in the three major ocean basins, with more detail provided for Oceania in the Pacific Basin where the action area is located. These descriptions are based on the numbers of nesting females, or their nests, because those are the best available methods for confirming sea turtle distribution or for estimating density and population trends.

Indian Ocean

There are numerous nesting sites for green sea turtles in the Indian Ocean. One of the largest nesting sites for green sea turtles worldwide occurs on the beaches of Oman where an estimated 20,000 green sea turtles nest annually. Based on a review of 32 index sites, declines in green turtle nesting were evident for many of the Indian Ocean index sites (Seminoff 2004). While several of these had not demonstrated further declines in the more recent past, Comoros Island and the Seychelles are the only index sites in the western Indian Ocean that showed evidence of increased nesting (NMFS & USFWS 2007a).

Atlantic Ocean / Mediterranean Sea

The 5-year status review for the species identified nine geographic areas considered to be primary sites for green sea turtle nesting in the Atlantic/Caribbean, and four in the Mediterranean and reviewed the trend in nest count data for each (NMFS and USFWS 2007a). Atlantic areas include: (1) Florida, USA; (2) Yucatán Peninsula, Mexico; (3) Tortuguero, Costa Rica; (4) Aves Island, Venezuela; (5) Galibi Reserve, Suriname; (6) Isla Trindade, Brazil; (7) Ascension Island, United Kingdom; (8) Bioko Island, Equatorial Guinea; and (9) Bijagos Archipelago (Guinea-Bissau). Mediterranean sites include: (1) Turkey; (2) Cyprus; (3) Israel/Palestine; and (4) Syria. Nesting at all of the Atlantic sites was considered to be stable or increasing with the exception of Bioko Island and the Bijagos Archipelago where the lack of sufficient data precluded a meaningful trend assessment for either site. Lack of sufficient data also precluded meaningful trend assessments for the Mediterranean sites. The most important nesting concentration for green turtles in the Atlantic is at Tortuguero, Costa Rica, where nesting has increased since the 1970s. Nest count data from 1999-2003 suggest nesting by 17,402- 37,290 females per year. These sites are not inclusive of all green sea turtle nesting in the Atlantic or Mediterranean. However, other sites support lower levels of nesting and contribute a much smaller proportion to the total number of green turtles in these areas (NMFS and USFWS 2007a).

Pacific Ocean

Green turtles occur in the eastern, central, and western Pacific. Foraging areas are found throughout the Pacific, including along the southwestern U.S. coast (NMFS and USFWS 1998a). Nesting is known to occur at hundreds of sites throughout the Pacific, with major nesting occurring in Indonesia, Malaysia, the Philippines, Australia, Micronesia, Hawaii, New Caledonia, Mexico, the Galapagos Islands, and other sites (NMFS & USFWS 2007a). Oceania is a subset of the Pacific, and includes Micronesia (where the action area is located), Melanesia, and Polynesia. In this opinion, Oceania is defined as also including Australia's Great Barrier Reef (GBR), because a high proportion of green turtles occurring in Oceania nest on the GBR. Based on the best information currently available, about 18,000 to 38,000 green turtles nest annually in Oceania (Figure 2) (NMFS 2010a).

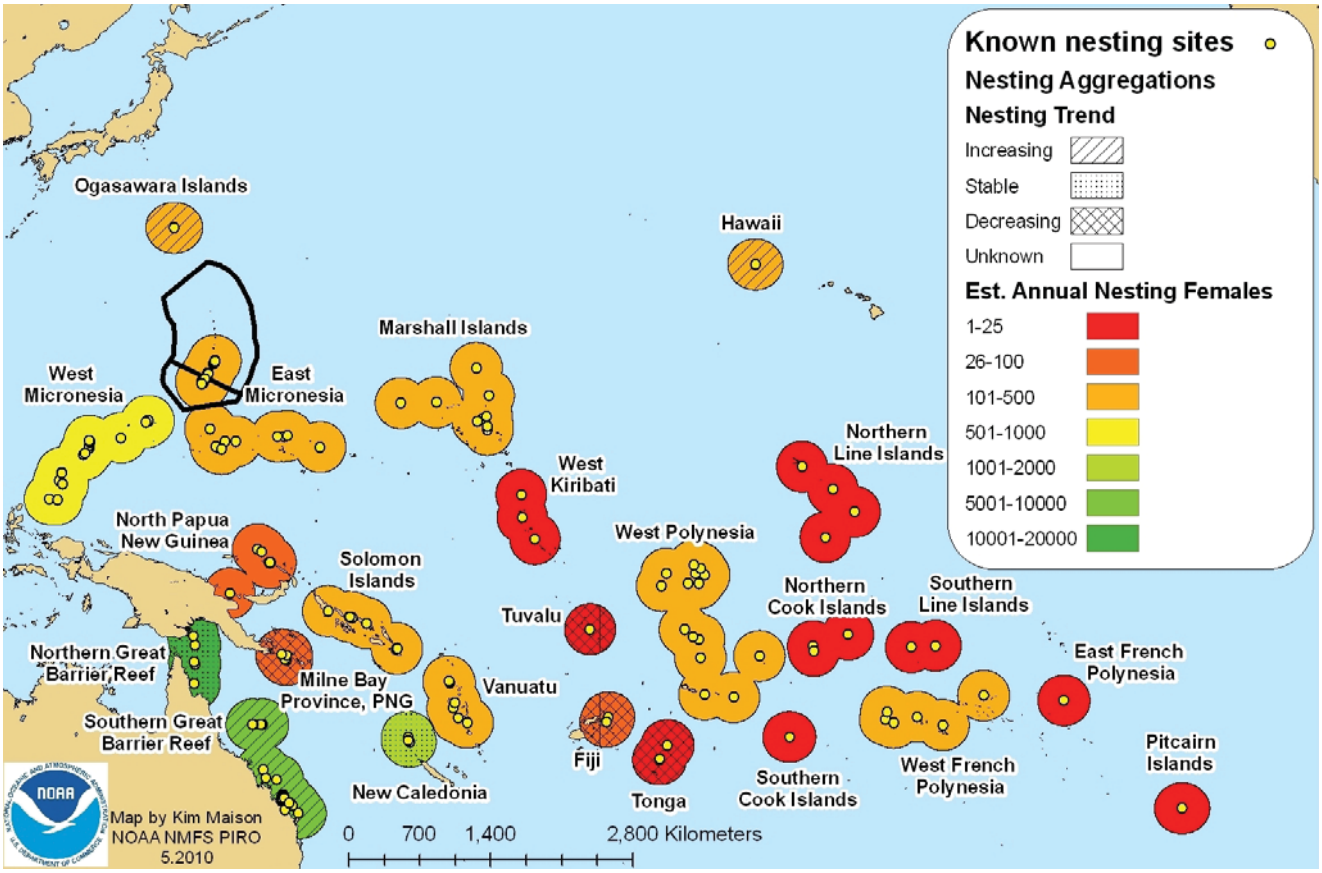

Figure 2. Green turtle nesting aggregations in Oceania. Mariana EEZs are outlined in black.

However, about 90% of nesting takes place among two Australian nesting aggregations (NAs) (Northern GBR and Southern GBR which includes the Coral Sea Platform), with over half of all the nesting occurring on a single island; Raine Island in the Northern GBR (Chaloupka *et al*. 2008a, Limpus 2009). Nesting trends appear stable at Raine Island, and are increasing at Heron Island in the Southern GBR, as well as at Chichi-jima in the Ogasawara Islands (Chaloupka *et al*. 2008a). However, these trends do not necessarily correlate with a stable or increasing total number of turtles because of low nesting success and hatchling production at Raine Island, where the majority of nesting for Oceania occurs (Limpus *et al*. 2003; Limpus 2009). Also, NAs with small numbers of nesting females, like those throughout the islands and atolls of central and

south Pacific, may be of greater importance than their proportional numbers indicate. Many of these NAs are geographically isolated, and likely harbor unique genetic diversity, which may be lost if these small NAs or their components become extirpated (Avise & Bowen 1994).

Mariana Archipelago

Sub-adult and adult green turtles occur in low abundance in nearshore waters around the Mariana Islands. Although it is likely that they occur around all of the Mariana Islands, nesting is thought to occur only in the southern islands of the CNMI and on Guam. There are no reports of turtles nesting at northern island locations. Genetic samples from nesting rookeries in the western Pacific Islands suggest that nesting greens in Guam and the CNMI are indistinguishable from each other, but distinct from those in Palau, Yap and the Marshall Islands (Dutton 2009).

Kolinski *et al*. (2004) estimated 1,000 to 2,000 turtles inhabit reef areas in the southern CNMI (Rota, Tinian, Aguiguan, Saipan, and Farallon de Mendillia). Information on nesting trend is currently insufficient for the CNMI. However, anecdotal information from residents suggests that nesting activity has decreased over time, likely as a direct result of illegal harvest (NMFS and USFWS 2007a). Since 1999, the CNMI Division of Fish and Wildlife (DFW) has monitored nesting at a minimum of five beaches on Saipan (CNMI DFW 2009), where between 4 and 18 nests are laid annually (CNMI DFW unpublished annual reports). Monitoring on Saipan, between March 4 and August 31, 2009, confirmed 16 green turtle nests, but also confirmed that three nesting turtles and three nests were poached during the same time (CNMI DFW 2009). On Tinian, nesting likely occurs on all or most of the accessible beaches (Pultz *et al*. 1999), and a July 22-31, 2009 rapid assessment yielded 35 nests at 5 beaches (CNMI DFW 2009). Eleven beaches on Rota are known to support nesting (Ilo *et al*. 2005), and a rapid assessment on July 12, 2009 yielded 13 nests (CNMI DFW 2009).

On Guam, the 5-year status review for green sea turtles reports that nesting was stable between 1990 and 2001 with the number of annual nesters fluctuating between 2 and 60 females, with nearly constant near shore abundance 150 to 250 turtles (NMFS and USFWS 2007a). Foraging and resting green turtles are often seen in close proximity to seagrass beds and reef flats, including Cocos Lagoon, Apra Harbor, Tarague Beach and several other locations around the island (Wiles *et al.* 1995). Guam's Division of Aquatic Wildlife Resources (DAWR) has maintained a bimonthly aerial survey program to monitor near shore fisheries and record opportunistic animal sightings, including marine turtles. These surveys confirm the year-round presence of a resident population of green sea turtles in Guam's nearshore waters. A total of 351 sea turtles were observed during aerial surveys between 1998 and 2008, with an annual mean of 32 turtles. Sightings include low numbers of turtles observed in the area of the proposed CVN turning basin and in inner Apra Harbor (DAWR unpublished data).

Information is currently inadequate to identify or define in any comprehensive manner green turtle in-water habitat resources around Guam, or to describe its utilization in more than general terms. However, for the purposes of this consultation, NMFS has defined potential green turtle habitat as the in-water marine areas around Guam from the shoreline to a depth of 100 feet (30.5 m), including Apra Harbor and Cocos Island lagoon. This was done with the intention of including habitat areas most likely to possess features beneficial to green turtles for foraging and refugia, such as: hard reef areas that support algal growth; shallow sandy areas that support

seagrass growth; vertical structures with fissures, caves, and over-hangs that would provide shelter; and the overlying waters necessary for turtles to transit between their various habitats. Although green turtles are rarely seen inside the shore break around Guam, this does not exclude that area as potential turtle habitat that may be utilized as the population recovers into the future. For example, high numbers of the recovering green turtle population in Hawaii are regularly observed in nearshore reef habitats inside of the shore break, including basking on the beach. Based on bathymetric information, the area around Guam between the shoreline and the 100-ft depth curve encompasses about 36 square miles (23,000 acres, 93 km2).

Opportunistic nesting surveys counted 55 green turtle nests at various beaches around Guam between October 1, 2006 and July 31, 2008 (GDAWR 2009). Known nesting beaches on Guam include: Ritidian National Wildlife Refuge, Haputo, Urunao, Tumon Bay, Cabras Island, Spanish Steps (Dangkolo and Dikiki), Cocos Island, Acho Bay, Nomña Bay, Jinapsan, and Tarague Beach (GDAWR 2004; Grimm and Farley 2008). Of these beaches, two locations are on Navy lands: Haputo, and Spanish Steps, with an additional 6 to 8 unmonitored beaches occurring on Navy lands (Grimm and Farley 2008). Nesting activity peaks from April to July on Guam but often appears to continue throughout the entire year (Grimm and Farley 2008).

Little data exists regarding the number of green turtles that nest on the beaches at Spanish Steps (Dikiki and Dangkolo), although it is considered one of the primary nesting locations in Guam. During 2007 and 2008, Naval Facilities Engineering Command Marianas (NAVFACMAR) monitored nesting sites 3 times per week between May and July. In 2007, 5 green turtle nests were identified at Dangkolo, and in 2008, 18 green turtle nests or nest attempts were identified at the same site (Grimm and Farley 2008). Based on this limited information and assuming that a female may lay 5 to 6 clutches per season (Grimm and Farley 2008), about 1 to 4 green turtles may nest per season at Spanish Steps. Emergence success data from Raine Island, Australia and French Frigate Shoals, Hawaii suggest the mean number of eggs per clutch is 104 eggs. Emergence success rates ranged from 74-83% in Australia (Limpus *et al*. 2003) and 70% in Hawaii (Balazs 1980). Based on this information, the number of green turtle hatchlings that hatched from 18 nests at Dangkolo in 2008 may have ranged between 1,310 and 1,557 (18 nests x 104 eggs = 1872 eggs/nest x 0.70 emergence success = 1,310 hatchlings; or 1872 eggs/nest x 0.83 emergence success = 1,557 hatchlings). Using similar population parameters, the 5 green turtle nests in 2007 may have produced between 364 and 432 hatchlings.

3.1.2 Life History Characteristics Affecting Vulnerability to Proposed Action

Following hatching at their natal beaches, green turtle hatchlings spend several years of early development in the oceanic (pelagic) zone followed by recruitment to coastal areas where post-recruitment juveniles and adults forage and mature in shallow coastal areas, feeding primarily on algae and seagrass. When on their foraging grounds, post-recruitment green turtles are often referred to as “residents”. The majority of sea turtles in coastal areas spend their time at depths <5 m below the surface (Schofield *et al.* 2010, Hazel *et al.* 2009), and most resident green turtles show strong long-term site fidelity (over years) to preferred nearshore foraging and sheltering habitats, often until the habitat can no longer support their increasing size (Balazs and Chaloupka, 2004; Balazs *et al*. 1987 and 1998; Chaloupka and Limpus 2001; Godley *et al*. 2003; Grant *et al*. 1997; Seminoff *et al*. 2003). Upon reaching sexual maturity, adult greens typically undertake long migrations between their resident foraging grounds and their natal nesting areas,

where they mate and females nest. Nesting females are referred to as “nesters”, which distinguishes them from “resident” turtles that regularly forage in that area. Although males also make mating migrations, because they do not crawl out on the beach as the females do, those males are nearly impossible to distinguish from the resident males.

Green turtle forage grounds and natal nesting areas are frequently located in different island groups, and residents at a given island group may originate from multiple natal nesting areas. Between 1971 and 1996, 46 adult female greens were flipper tagged after they nested at Rose Atoll, American Samoa. Three were recaptured, two in Fiji, and one in Vanuatu (Balazs *et al*. 1994). Between 1993 and 1995 seven post-nesting green turtles were satellite tagged at Rose Atoll. Most migrated 1,600 km to foraging areas in Fiji, and one migrated to French Polynesia (Craig *et al*. 2004). Of 513 greens tagged in French Polynesia between 1972 and 1991, six were recovered in Fiji, three in Vanuatu, two in New Caledonia, and one each were recovered in Tonga, and in the Cook Islands. Five post-nesting green turtles were satellite tracked in the Republic of the Marshall Islands (RMI) in 2007-2008, one turtle migrated to Bikini Atoll, RMI, another to Tarawa Atoll in Kiribati, one traveled to the Philippines passing through the CNMI, while two turtles circled for long periods of time in the open ocean with one having a final transmitted location in the FSM EEZ and the other in RMI (PIRO and PIFSC unpublished data). The last two turtles may have been exhibiting oceanic foraging strategies (Kabua *et al.* 2009). Seven post-nesting green turtles were satellite tracked from Yap, Federated States of Micronesia (FSM) during 2005-2006. Five migrated to the Philippines, one to Malaysia, and one turtle’s transmitter ceased sending signals while still in the FSM (Kolinski *et al.* Draft manuscript 2007). An additional seven post-nesting greens were tracked from Yap in 2007: four migrated to the Ryukyu Islands of Japan and three went to the Philippines (PIRO and PIFSC unpublished data).

While information for the Marianas is limited, there is every reason to believe that turtles in the Marianas display similar life history characteristics as other green turtle populations; migrating great distances between resident forage habitats and their natal beaches were they mate and nest. Three post-nesting green turtles have been satellite tracked from Guam. One was tagged at Pati Point in 2000, and tracked to the Philippines. Two others were tracked from Cocos Island in 2007; one migrated to Japan and the other to the Philippines (S. Wusstig, pers. comm.). Because green turtles found around Guam likely migrate widely between their preferred forage and nesting areas, the proposed action may affect green turtles from multiple NAs across a broad area of the south and western Pacific (Figure 2).

Turtle hearing research is limited, but available information suggests that they are low frequency specialists, with greens thought to be most acoustically sensitive between 200 and 700 hertz (Hz) (Ridgway *et al.* 1969). Because the hearing range of green turtles overlaps with the expected frequency range of the pile driving signals, NMFS considers it likely that greens can hear and respond to pile driving noise. Existing information about sea turtle sensory biology also suggests that sea turtles rely more heavily on visual cues, rather than auditory, to initiate threat avoidance, and that they can not be expected to consistently notice and avoid vessels that are traveling faster than 2 knots (kts) (Hazel *et al*. 2007). Consequently, it is likely that green turtles would be at increased risk of vessel collision due to the expected increased vessel activity.

As described above, post-recruitment juvenile and adult green turtles forage primarily on macroalgae and seagrasses. Carrion-Cortez *et al.* (2010) found that green sea turtles in the Galapagos Islands fed mainly on algae, but also on mangrove, and possibly animal matter. Lopez-Mendilaharsu *et al.* (2005) examined green sea turtle stomach contents from turtles collected in Bahia Magdalena, Mexico and found primarily algae and sea grass species, but also invertebrate and mangrove species. Seminoff *et al.* (2006) studied green sea turtle foraging and resting behavior in the Gulf of California and found that forage species included marine algae, tube worms, and black coral polyps. The study also found that green sea turtles rested within patches of black coral, marine algae pastures, and insular boulder habitats. This suggests that reef features can be an important component of sea turtle resting microsites. Seminoff *et al.* (2002) report that green sea turtles consumed diverse marine algae, but augmented their diet with food items such as sponges. Balazs *et al.* (1987) sampled stomach contents of green sea turtles in the main Hawaiian Islands and found algae was a primary component of this species diet.

The FEIS reports that several algal species found within the proposed dredging area are known forage for green turtles, and that green turtles have been observed on the reefs adjacent to the proposed dredging area, in Sasa Bay, and in the inner harbor. The FEIS also provides survey photographs of areas in the proposed dredging area that have reef structures that may serve as turtle sheltering habitat, such as undercuts and overhanging structures. Aerial survey data from Guam DAWR reports the presence of green turtles on the surface in the proposed dredging area (DAWR unpublished). Thus, green turtles have been seen underwater and on the surface in areas adjacent to the proposed outer harbor dredging area as well as on the surface in that dredging area. Also, potential sheltering habitat and known forage resources occur in the proposed outer harbor dredging area. Based on this, NMFS considers it likely that, at a minimum, greens utilize the area as a transit corridor, and that they may yet utilize the area to some degree for sheltering and forage resources found there.

Studies show that sea turtles are adapted for bright light vision and they can see ultraviolet (UV) wavelengths (Fritsches and Warrant 2006). Although sea turtle and human vision overlaps in the visible light spectrum, violet and near-UV light sources appear brighter to turtles than to humans (Witherington & Martin 1996). Consequently, sea turtles are most attracted to shorter wavelength lights such as UV, violet, blue, and green, and less attracted to longer wavelength lights, such as yellow, amber, and red (Witherington & Martin 1996). However, it is important to add that intensity is also important; the higher the intensity, the more attractive the light. So, even longer wavelengths can be attractive when at high intensity. Sea turtle hatchlings possess an inborn tendency to move in the direction of the brightest light. Under natural conditions, starlight and moonlight brightens the sky and ocean, drawing the newly emerged hatchlings toward the sea. However, if artificial light sources are present, hatchlings often crawl toward those lights and are led away from the ocean (Witherington and Martin 1996). Artificial light on the beach may also discourage adult females from nesting (Mortimer 1983).

Based on the description of the proposed action and on green turtle life history characteristics, post-recruitment juvenile and adult green turtles sheltering and foraging in Apra Harbor are the life stages most likely to be affected by the expected high intensity noise (pile driving) and loss of forage and sheltering habitat (dredging). Post-recruitment juveniles and adults in the nearshore waters in Apra Harbor and are the life stages most likely to be affected by the increased boating

activity around Guam. Because the green turtles found around Guam are likely to migrate widely between their preferred forage and nesting areas, the proposed action may affect greens from multiple NAs across a broad area of the south and western Pacific (Figure 2).

3.1.3 Threat to the Species

Global threats to green turtles are described in the 5-year review (NMFS & USFWS 2007a). The major threats to the species are alteration of nesting and foraging habitat, fishing bycatch, and direct harvest, which are briefly described below. Climate change also appears to be a growing threat to this species, and is also mentioned below.

Destruction and alteration of green turtle nesting and foraging habitats is occurring throughout the species' global range, especially through coastal development, beach armoring, beachfront lighting, vehicular/ pedestrian traffic, invasive species, and pollution from discharges and runoff. Under natural conditions, beaches can move landward or seaward with fluctuations in sea level. However, extensive shoreline hardening (e.g., seawalls) inhibits this natural process. Beach armoring is typically done to protect the coastal development from erosion during storms, but armoring blocks turtle nesting and often leads to beach loss. Coastal development also increases artificial lighting, which may disorient emerging hatchlings, causing them to crawl inland towards the lights instead of seaward. Coastal development also improves beach access for humans, resulting in more vehicular and foot traffic on beaches, causing compaction of nests and thereby reducing emergence success. Adult green turtles are opportunistic feeders, but are considered primarily herbivores that forage on seagrass and algae in shallow nearshore areas and coral reefs. Contamination from effluent discharges and runoff has degraded these habitats, and invasive species may reduce native algae species preferred by green turtles or could exacerbate susceptibility to, or development of disease (NMFS & USFWS 2007a; Guimaraes dos Santos 2010).

Green turtles are susceptible to fisheries bycatch, particularly in nearshore artisanal fisheries. These fisheries use a vast diversity of gears, including long-lining, drift gillnets, set-nets, pound-nets, trawls, and others. Despite operating in the areas with the greatest density of adult green turtles, artisanal fisheries are typically the least regulated of all fisheries (NMFS & USFWS 2007a). Industrial fisheries such as the Hawaii-based deep-set and American Samoa longline fisheries also interact with green turtles, especially juveniles. Harvest of green turtles for their meat, shells, and eggs has been a major factor in the past declines of green turtles. Although reduced from previous levels, legal and illegal harvest of adults and eggs continues in most of the NAs described above, and remains a major factor in some parts of the species' range, including in the Marianas.

Although green turtles are probably already being affected by impacts associated with anthropogenic climate change in several ways (described in more detail in the Environmental Baseline section below), no significant climate change-related impacts to green turtle populations have been observed to date. However, over the long-term, climate change-related impacts will likely influence biological trajectories in the future on a century scale (Paremsan and Yohe 2003). For example, increasing temperatures at nesting beaches may impact sex ratios of hatchlings (many rookeries already exhibit strong female bias [Binckley *et al*. 1998; Chan and Liew 1995; Godfrey *et al*. 1996; Godfrey *et al*. 1999; Godley *et al*. 2001; Kaska *et al*. 2006;

Marcovaldi *et al*. 1997; Oz *et al*. 2004]) and/or increase embryonic mortality (Matsuzawa *et al*. 2002). Increased nest mortality has also been linked to erosion due to increased typhoon frequency (VanHoutan and Bass 2007) and intensity; predicted consequences of climate change (Webster *et al*. 2005). Seagrasses are a major food source for green turtles worldwide. Seagrass habitats may suffer from decreased productivity and/or increased stress due to sea level rise and salinity and temperature changes (Short and Neckles 1999; Duarte 2002). Climate change induced shifts in ocean productivity linked to temperature changes (Harwood 2001; Edwards & Richardson 2004; Hays *et al*. 2005) may affect foraging strategies and therefore reproductive capacity for green turtles (Solow *et al*. 2002) similar to what has been observed during El Nino events in the western Pacific (Limpus and Nicholls 1994; Chaloupka 2001). While there is some available data on past trends, this data is limited, and current scientific methods are not able to reliably predict the future magnitude of climate change and associated impacts or the adaptive capacity of this species. Due to a lack of scientific data, the specific effects climate change will have on this species in the future are not predictable or quantifiable to any degree that would allow for more detailed analysis in this consultation (Hawkes *et al*. 2009). Because of this uncertainty, climate change-related impacts are not considered significant within the context of the temporal scale of this action, as discussed further in the Environmental Baseline and Cumulative Effects sections below.

3.1.4 Conservation of the Species

Green turtles nesting in the US have benefited from both State and Federal laws passed in the early 1970s banning the harvest of turtles and their eggs. Protection and management activities since 1974 throughout the Hawaiian Archipelago and habitat protection at the French Frigate Shoals nesting area since the 1950's have resulted in increased population trends of both nesting and foraging turtles (Balazs and Chaloupka 2004). Elsewhere, the protection of nesting beaches against large-scale egg harvest appears to have reversed some downward nesting trends. Using long-term data sets, encouraging trends in green turtle nester or nest abundance over the past 25 years has become apparent in at least six locations including Hawaii, Australia, Japan, Costa Rica and Florida (Chaloupka *et al*. 2008a).

Efforts to reduce fisheries bycatch, such as the improvements made in the Hawaii-based longline fishery since the 1990s, has reduced green turtle interactions (NMFS & USFWS 2007a). Internationally, the conservation and recovery of green turtles is facilitated by a number of regulatory mechanisms at international, regional, national and local levels, such as the FAO Technical Consultation on Sea Turtle-Fishery Interactions, the Inter-American Convention for the Protection and Conservation of Sea Turtles, the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), and others. As a result of these designations and agreements, many of the intentional impacts on sea turtles have been reduced: harvest of eggs and adults have been slowed at several nesting areas through nesting beach conservation efforts and an increasing number of community-based initiatives are in place to slow the take of turtles in foraging areas (Gilman *et al*. 2007; NMFS & USFWS 2007a).

3.2 Hawksbill Sea Turtles

Hawksbill turtles are distributed circumglobally, and can be found in the Pacific, Indian, and Atlantic Oceans, but not in the Mediterranean Sea, as described in the most recent hawksbill turtle 5-year status review (NMFS & USFWS 2007b). As shown above in Table 2, in 1978, all

hawksbill turtles are listed as endangered under the ESA. Hawksbills are the most tropical sea turtle species, ranging from approximately 30° N latitude to 30° S latitude. They are closely associated with coral reefs and other hard-bottom habitats, but are also found in other habitats including inlets, bays, and coastal lagoons. There are only five remaining nesting aggregations with more than 1,000 females nesting annually. These nesting aggregations are in the Seychelles, Mexico, Indonesia, and two in Australia (NMFS and USFWS 2007b). The global population has declined by more than 80 percent over the last three generations. Hawksbills face many of the same threats affecting green sea turtles. In addition, there continues to be a commercial market for hawksbill shell products, despite protections afforded to the species under U.S. law and international conventions (NMFS and USFWS 2007b). Following are descriptions of the distribution and abundance, life history characteristics (especially those affecting vulnerability to the proposed action), threats to the species, major conservation efforts for the hawksbill sea turtle.

3.2.1 Distribution and Abundance

Globally, most of the important hawksbill sea turtle nesting populations declined substantially during the 20th century. Following are brief descriptions of distribution and abundance of hawksbill turtles in the three major ocean basins, with more detail provided for Oceania in the Pacific Basin where the action area is located.

Atlantic Ocean

In the western Atlantic, the largest hawksbill nesting population occurs on the Yucatán Peninsula of Mexico. Nesting also occurs in Antigua, Barbados, Costa Rica, Cuba, and Jamaica. Within the U.S., nesting occurs in Puerto Rico, the U.S. Virgin Islands, and along the southeast coast of Florida. At the two principal nesting beaches in the U.S. Caribbean where long-term monitoring has been carried out, populations appear to be increasing (Mona Island, Puerto Rico) or stable (Buck Island Reef National Monument, St. Croix, USVI) (NMFS and USFWS 2007b).

Indian Ocean

Of the approximately 83 nesting rookeries that have been identified for hawksbill sea turtles, 31 occur in the Indian Ocean. Many of those nesting areas are relatively small hosting 100 or fewer nesting females annually. However, some nesting rookeries in Madagascar, Iran, and Western Australia may have as many as 1,000 to 2,000 nesting females annually. Based on the number of nesting females the population trends at the 31 nesting rookeries over the recent past (last 20 years) have remained stable in two locations, declined at five, and are unknown for 24. Historically (20 to 100 years ago), population trends at these nesting rookeries were in decline at 17 sites and are unknown for 14 (NMFS and USFWS 2007b).

Pacific Ocean

Hawksbill turtles nest broadly in the Pacific, including on the islands and mainland of Southeast Asia, from China to Japan, and throughout the Philippines, Malaysia, Indonesia, Papua New Guinea (PNG), the Solomon Islands, and Australia, with the largest nesting concentration occurring on remote islands in the GBR area. However, along the eastern Pacific Rim where nesting was common in the 1930s, hawksbills are now rare or absent (NMFS and USFWS 2007b). Unlike green turtles, hawksbills are solitary nesters, hampering data collection on nesting female numbers, thus all nesting numbers cited below are rough estimates. Hawksbill

nesting information is available for eight locations within Oceania: GBR, PNG, Solomon Islands, Vanuatu, Fiji, Micronesia (Federated States of Micronesia (FSM) and Palau), the Samoan Islands (Western Samoa and American Samoa), and the Mariana Islands. Hawksbill nesting may occur elsewhere within the range of this population, but little to no information is available, and nesting activity at those sites is thought to be very low. Based on the best information currently available, about 5,400 to 6,100 hawksbill turtles nest annually in Oceania, (NMFS 2010a) and the overall trend is downward (NMFS & USFWS 2007b).

Mariana Archipelago

Sub-adult and adult hawksbill turtles occur in low abundance in nearshore waters around the Mariana Islands (NMFS & USFWS 2007b). In CNMI, they have been sighted as far north as Anatahan (Ilo *et al.* 2005) and sporadically around Farallon de Medinilla (Kolinski *et al*. 2004; Ilo and Manglona 2001). They are occasionally observed by divers in the waters of Saipan, and two hawksbills were captured there in 2009 during the in-water monitoring program (CNMI DFW 2009). Hawksbills are also infrequently sighted around Rota (Kolinski *et al*. 2004; Ilo *et al.* 2005). No nesting trend data are available for the CNMI. Although anecdotal information suggests that hawksbill nesting occurred in the CNMI in the past, no nesting activity has been documented in recent years (CNMI DFW unpublished annual reports to PIRO).

Grimm and Farley (2008) report that hawksbills are frequently sighted in the nearshore waters surrounding Guam. However, they are less common than green sea turtles (NMFS and USFWS 2007b). According to Wiles *et al.* (1995), as reported in the BA, hawksbills represent about 13% of turtles sighted around Guam. Based on this and the estimated 150 to 250 green turtles present, NMFS estimates that about 22 to 37 hawksbills reside year-round in the nearshore waters around Guam. Between 5 and 10 hawksbills are estimated to nest annually at Guam, and although trend data are lacking, the population is thought to be declining (NMFS & USFWS 2007b). The first reported hawksbill turtle nest on Guam was in November 1991 (NMFS-USFWS 1998) and in 1997 a possible hawksbill nest was reported from a beach at Sumay Cove (Grimm and Farley 2008). In 2008, four nesting attempts at Adotgan Dikiki (Spanish Steps) were attributed to a hawksbill turtle (Grimm and Farley 2008).

As described above for green sea turtles, information is currently inadequate to comprehensively identify hawksbill turtle in-water habitat around Guam. Although hawksbill habitat needs are somewhat different than greens, significantly in that hawksbills forage heavily on sponges, whereas greens forage primarily on algae and seagrass, it is believed that hawksbill habitat would be similarly included within the area described above as green turtle in-water habitat. As such, hawksbill turtle in-water habitat would be found within the same area outlined above. Thus, for the purposes of this consultation, NMFS is defining hawksbill turtle in-water habitat as that area around Guam found between the shoreline and the 100-foot depth curve including Apra Harbor and the Cocos Island lagoon, an area of 23,000 acres.

3.2.2 Life History Characteristics Affecting Vulnerability to Proposed Action

As with green turtles, hawksbills hatch at their natal beaches, hatchlings spend several years of early development in the oceanic (pelagic) zone. At about 35 cm carapace length, juveniles recruit to coastal areas where post-recruitment juveniles and adults forage and mature in shallow coastal areas, feeding primarily on sponges, but also on other benthic invertebrates, coral, and

algae. When on their foraging grounds, post-recruitment hawksbill turtles are often referred to as "residents". The majority of sea turtles in coastal areas spend their time at depths <5 m below the surface (Schofield *et al.* 2010, Hazel *et al.* 2009). Upon reaching sexual maturity, adult hawksbills typically undertake long migrations between their resident foraging grounds and their natal nesting areas, where they mate and females nest. As with greens, nesting females are referred to as "nesters", which distinguishes them from "resident" turtles that regularly forage in that area. Although males also make mating migrations, because they do not crawl out on the beach as the females do, those males are nearly impossible to distinguish from the resident males.

As with green turtles, hawksbill forage grounds and natal nesting areas are frequently located in different island groups, and residents at a given island group may originate from multiple natal nesting areas. Thus, upon maturation, adult hawksbills undertake long migrations between their resident foraging grounds and their natal nesting areas (NMFS & USFWS 2007b). Two post-nesting hawksbills were fitted with satellite tags on Tutuila; one migrated several hundred km to Western Samoa, and the other migrated more than 1,000 km to the Cook Islands (Tagarino *et al*. 2008). Post-nesting hawksbills on the GBR are reported to migrate more than 2,000 km (Miller *et al*. 1998).

Research into turtle hearing is limited, and no specific information is available for hawksbills. However, based on the similarity in hearing between greens and loggerheads, and the hawksbill's close taxonomic relationship to these species, NMFS considers it likely that hawksbill hearing is also similarly specialized for low frequencies. As described above, green turtles are thought to be most acoustically sensitive between 200 and 700 Hz (Ridgway *et al* 1969). Loggerhead (*Caretta carreta*) hearing is very similar to that of greens, being most sensitive between 250 and 1,000 Hz (Bartol *et al*. 1999). Because the hearing range of hawksbill sea turtles likely overlaps with the expected frequency range of the pile driving signals, NMFS considers it likely that hawksbills can hear, and respond to pile driving noise. Existing information about sea turtle sensory biology also suggests that sea turtles rely more heavily on visual cues, rather than auditory, to initiate threat avoidance, and that they can not be expected to consistently notice and avoid vessels that are traveling faster than 2 knots (kts) (Hazel *et al*. 2007). Consequently, it is likely that hawksbill turtles would be at increased risk of vessel collision due to the expected increased vessel activity.

Hawksbills are thought to occupy a range of habitats including coral reefs or other hard-bottom habitats, sea grass, algal beds, mangrove bays and creeks, or mud flats (NMFS and USFWS 2007b). Post-recruitment juvenile and adult hawksbill turtles were originally thought to forage almost exclusively on sponges (Meylan 1988), however they are known to have a broader diet, consuming zooanthids, soft corals, corallimorphs, ascidians, mobile invertebrates, and polyps of hard corals (Leon and Bjorndal 2002, Obura *et al.* 2010). Survey data for the proposed dredging area in the outer harbor confirm the presence of this habitat as well as numerous species of sponge and coral that may be potential forage resources for hawksbill turtles. Thus, it is reasonable to assume that hawksbills may utilize the area to some degree.

Studies show that sea turtles are adapted for bright light vision and they can see UV wavelengths (Fritsches and Warrant 2006). Although sea turtle and human vision overlaps in the visible light

spectrum, violet and near-UV light sources appear brighter to turtles than to humans (Witherington & Martin 1996). Consequently, sea turtles are most attracted to shorter wavelength lights such as UV, violet, blue, and green (Witherington & Martin 1996), and less attracted to longer wavelength lights, such as yellow, amber, and red. However, it is important to add that intensity is also important; the higher the intensity, the more attractive the light. So, even longer wavelengths can be attractive when at high intensity. Sea turtle hatchlings possess an inborn tendency to move in the direction of the brightest light. Under natural conditions, starlight and moonlight brightens the sky and ocean, drawing the newly emerged hatchlings toward the sea. However, if artificial light sources are present, hatchlings often crawl toward those lights and are led away from the ocean (Witherington and Martin 1996). Artificial light on the beach may also discourage adult females from nesting (Mortimer 1983).

Based on the description of the proposed action and on hawksbill turtle life history characteristics, post-recruitment juvenile and adult hawksbill turtles sheltering and foraging in Apra Harbor are the life stages most likely to be affected by the expected high intensity noise (pile driving) and loss of forage and sheltering habitat (dredging). Post-recruitment juveniles and adults in the nearshore waters in Apra Harbor and are the life stages most likely to be affected by the increased boating activity around Guam. Because the hawksbill turtles found around Guam are likely to migrate widely between their preferred forage and nesting areas, the proposed action may affect hawksbills from multiple NAs across a broad area of the south and western Pacific.

3.2.3 Threats to the Species

Global threats to turtles are described in the 5-year review. As discussed for green turtles (Section 3.1.3), destruction and alteration of habitat, as well as direct harvest are considered the major threats to hawksbills. Climate change also appears to be a growing threat. Destruction and alteration of hawksbill nesting and foraging habitats is occurring throughout the species' global range, especially through coastal development, beach armoring, beachfront lighting, vehicular/ pedestrian traffic, invasive species, and pollution from discharges and runoff. The adverse impacts of these threats described for greens, are virtually the same for hawksbills (NMFS & USFWS 2007b), so they are not repeated here. Although hawksbills interact with some fisheries, their bycatch rates are much lower than for the other sea turtle species, particularly with industrial fisheries.

Harvest of hawksbill shells and eggs continues to be a major threat. Due to the beauty of their shells, hawksbill adults may be harvested more heavily than other sea turtle species. Despite protections under CITES, the "tortoiseshell" trade continues in many areas. As with other sea turtle species, egg harvest continues unabated in parts of the Pacific, including Southeast Asia, Melanesia, and Polynesia (NMFS & USFWS 2007b). Kinch (2007) estimates that approximately 250 hawksbill turtles are sold annually in Port Moresby, but this may represent only a small fraction of the overall subsistence and semi-commercial take of hawksbills in PNG. It is estimated that large numbers of hawksbill turtles from Australian rookeries are being harvested in neighboring countries including Indonesia, PNG, Solomon Islands and Fiji to supply meat and/or tortoiseshell for use locally or for export.

Although hawksbill turtles are probably already being affected by impacts associated with anthropogenic climate change in several ways (described in more detail in the Environmental

Baseline section below), no significant climate change-related impacts to hawksbill turtle populations have been observed to date. However, over the long-term, climate change-related impacts will likely influence biological trajectories in the future on a century scale (Paremsan and Yohe 2003). In the future, climate change-related increasing temperatures, sea level rise, changes in ocean productivity, and increased frequency of storms events are all potential threats to hawksbills for the same reasons described above for green turtles. Additionally, because hawksbills typically inhabit coral reef communities, they are vulnerable to changes that affect these communities, such as increased bleaching events, increased occurrence of disease, and weakening of coral skeletons that may result from global climate change (McWilliams *et al* 2005; Langdon *et al* 2000; Ohde and Hossain 2004). As with green turtles, only limited data are available on past trends, and current scientific methods are not able to reliably predict the future magnitude of climate change and associated impacts or the adaptive capacity of this species. Due to a lack of scientific data, the specific future effects climate change will have on this species are not predictable or quantifiable to any degree that would allow for more detailed analysis in this consultation (Hawkes *et al* 2009). Because of this uncertainty, climate change-related impacts are not considered significant within the context of the temporal scale of this action, as discussed further in the Environmental Baseline and Cumulative Effects sections below.

3.2.4 Conservation of the Species

Numerous conservation programs are being implemented around the world to protect nesting habitat and reduce harvesting and fisheries bycatch of all sea turtle species, and numerous regulatory mechanisms are in place at international, regional, national and local levels to protect sea turtles (Section 3.1.4 above). Many of these programs likely benefit hawksbills. However, hawksbills continue to decline rapidly in the Pacific and Indian Ocean areas (NMFS & USFWS 2007b).

4 Environmental Baseline

The environmental baseline for a biological opinion includes: past and present impacts of all State, Federal, or private actions and activities in the action area; the anticipated impacts of all proposed Federal projects in the action area that have already undergone Section 7 consultation; and the impact of State or private actions which are contemporaneous with the consultation in process (50 CFR 402.02). The Consultation Handbook further clarifies that the environmental baseline is an analysis of the effects of past and ongoing human and natural factors leading to the current status of the species, its habitat (including designated critical habitat), and ecosystem, within the action area (USFWS & NMFS 1998). The purpose of describing the environmental baseline in this manner within a biological opinion is to provide the context for the effects of the proposed action on the listed species. The past and present impacts of human and natural factors leading to the status of green and hawksbill sea turtles within the action area include coastal development, fishing interactions, vessel strikes, direct take, pollution, entanglement in marine debris, and climate change. As described in Section 2 above, the action area for this consultation consist of the nearshore waters within 5 miles around Guam, including Apra Harbor; the USEPA ODMDS if used, including the in-water around tugs and scows as they transit between Apra Harbor and the ODMDS (Figure 1); and the marine waters around military and commercial vessels traveling to and from Apra Harbor due to the proposed action.

Guam is a small tropical island of volcanic origin that is surrounded by coral reefs. It is the southernmost island in the Marianas, and with a land area of 210 miles^2 (544 km^2), it is also the largest. The island is about 30 miles (48 km) long, with about 78 miles (125.5 km) of shoreline. The northern third of the island consists of a relatively flat coralline limestone plateau with steep coastal cliffs and narrow coastal plains. Low hills in the center, give way to mountains in south, where the highest point, 1,332 ft (406 m) Mt Lamlam is located. The island's population was estimated at 178,430 in 2009, and based on an expected growth rate of 1.365% (CIA 2010) is now likely to be about 181,000.

Portions of the nearshore marine environment around Guam have been degraded by impacts from: intense combat during World War II (WWII); shoreline development; sediment-laden runoff; and pollution from run-off and years of poorly treated wastewater effluent. Apra Harbor is a natural deep-water harbor, which has been heavily modified, particularly since World War II (Figure 3).

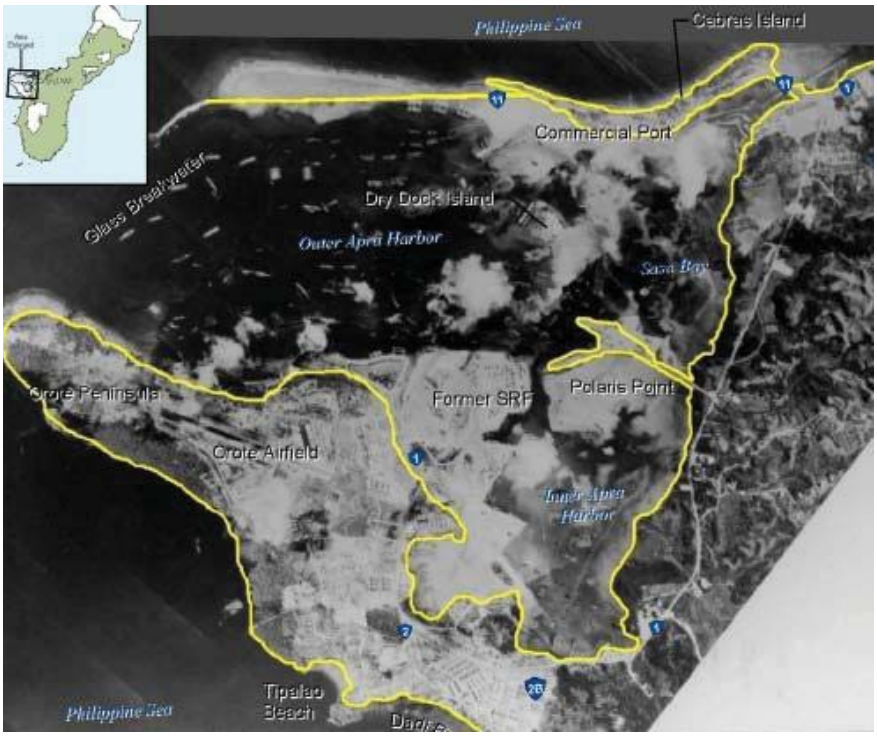

Figure 3. Apra Harbor July 1945. The yellow line indicates the approximate shoreline prior to the dredging and fill projects of the 1940s (USN 2010a).

Much of the harbor's current topography and bathymetry is manmade; the result of work begun by the US Government in 1943. Extensive dredging and fill projects resulted in the creation of Inner Apra Harbor and its channel. Other fill projects resulted in the creation of Dry Dock Peninsula, Polaris Point, and the manmade northeastern and southeastern shorelines, and the Glass Breakwater, which extends from Cabras Island, out and across Luminau Reef to provide increased protection for the harbor. Other impacts include the knolls (hard bottom sites that protrude at least 25 ft (7.6 m) above the harbor bottom) that were explosively cleared during WWII, because they were considered navigational hazards. Some of the shallower knolls have been used as anchorage sites since WWII, and some are still used by military and commercial vessels. Sunken ships rest on the sea floor at several locations throughout the harbor, as does metallic wreckage and other debris. The east end of Apra Harbor is highly developed and brightly illuminated at night. As viewed from Spanish Steps, which is located approximately 4,600 meters west of Polaris Point, industrial facilities light-up a broad swath across the east end of the harbor; with the commercial port and Cabras Island power plant area on the north side, the Naval Station to the south, and

some residential lighting also visible on the hills between (USN 2010d). The existing lights from the commercial port are particularly bright and clearly visible to nesting turtles and hatchlings in the water, and on the beach, at Spanish Steps. The lights of the Naval Station are not quite as bright, but some areas are also clearly visible. It is probable that existing harbor lighting is currently having adverse impacts on green and hawksbill reproductive success at Spanish Steps. Based on the current level of lighting and on the available nesting information, up to 4 adult green turtles and up to 2 adult hawksbill turtles may annually experience some level of light-induced nesting deterrence, and that up to 1,500 green turtle hatchling and up to 750 hawksbill turtle hatchlings may experience increased risk of predation, collision, and exhaustion due to being initially drawn away from the harbor mouth by the artificial lights at the east end of the harbor.

Based on information presented in the Navy's BA, Apra Harbor's turtle habitats and turtle presence can be described as a continuum. The eastern end of the harbor, including the areas proposed for dredging and the CVN wharf area is highly disturbed. Although corals, algae, and sponges, including potential turtle forage are found in the area, benthic resources typically increase in number, size, and diversity as one travels from east to west. Data is limited, but turtle sightings also appear to tend to increase along the same continuum, with turtles being rare in the inner harbor, occasionally present east of Big Blue and Western Shoals including in the area proposed for the CVN wharf and turning basin. Turtles appear to occur in low numbers but are frequently seen on the west sides of these shoals, and they appear to become increasingly common toward the mouth of the harbor, where low-level green turtle nesting continues on the beaches below Spanish Steps, and hawksbill crawls have recently been observed. Low numbers of turtles are also observed in Sasa Bay, east to northeast of Polaris Point, where sponges, macro algae, and sea grass provide forage resources.

Nearshore fisheries on Guam consist primarily of subsistence fishing, but there are also small-scale commercial fisheries for coral reef and pelagic species. Contemporary methods include: boat-based and land-based hook-and-line fishing (handline or rod-and-reel), net fishing (cast, gill, drag, and surround net), spear fishing, hook and gaff, and gleaning (Hensley and Sherwood 1993). Nearshore fisheries occasionally result in entanglement and drowning of sea turtles. Gillnets are the most problematic for turtles, because the nets are left untended, and entangled animals usually drown. Hook-and-line fishing also hooks or entangles turtles, but the chance of survival is higher than if caught in a gillnet. In a study of stranded green turtles in Hawaii (stranded turtles are injured, sick, or dead turtles found on shore), the most common known cause of stranding was the tumor-forming disease, fibropapillomatosis (28%) followed by hook-and-line fishing gear-induced trauma (7%) and gillnet fishing gear-induced trauma (5%) (Chaloupka *et al*. 2008b). However, most turtles drowned in fishing gear probably sink rather than strand, making it very difficult to estimate the total number of green turtles killed annually by nearshore fishing interactions, even in Hawaii where green turtles are much better monitored and studied than in the Marianas (NMFS 2008).

Hazel *et al*. (2007) report that vessel collision is a significant source of anthropogenic mortality for marine turtles. Based on Hawaii data for the period of 1998 to 2007 (NMFS 2008), the estimated total number of green turtles killed annually by boat collisions in the Main Hawaiian Islands (MHI) was between 25 and 50. The number of hawksbills similarly killed was much lower; between 0.2 and 0.4 turtles annually. The nearshore densities of boats and turtles are

much lower around Guam than in Hawaiian nearshore waters, thus the number of green and hawksbill turtles killed annually by boat collisions around Guam is likely much lower. Although little information exists to quantify this impact, vessel collision has been implicated as the cause of three green turtle strandings in Apra Harbor between November 2002 and April 2008 (DAWR unpublished data), suggesting that about three green turtles may be struck by vessels annually.

Other impacts on green and hawksbill turtle environmental baselines within the action area include continued illegal harvest, marine debris, contaminants, and climate change. Direct take through harvest of turtles and their nest continues on Guam and the other inhabited islands of the Mariana Archipelago, however, few data are available to quantify this impact. Vogt (2009) reported obvious poaching activity of nests on Tinian during surveys in 2007. During the 2009 nesting season on Saipan, three out of what is thought to be a total of five nesting turtles were poached as were three nests (DFW 2009). On Guam, DAWR has responded to 17 poachings of greens and 1 hawksbill since 1975 (S. Wusstig personal comm.) On a positive note, some of those 18 animals were rescued alive and released, including the hawksbill.

In addition to the effects of sediment-laden and polluted runoff, Guam's nearshore waters have been impacted by years of poorly treated wastewater effluent discharges around the island. In 1986, the US Environmental Protection Agency (USEPA) issued permits, under the National Pollutant Discharge Elimination System (NPDES), that allowed Guam Waterworks Authority (GWA) to discharge wastewater effluent into the nearshore marine environment following primary treatment of wastewater. Primary treatment follows coarse screening and grit settlement, and removes only about 60% of the suspended solids in the wastewater by allowing the water to rest in settlement tanks that are used to remove material that floats or settles out (Mancl 1996, USGS 2010). Following that, chlorination is normally employed to reduce pathogens. However, the NPDES permits expired in 1991 and were not reissued due to GWA's inability to meet the required standards (US District Court 2003). Additionally, the action area may be suffering impacts from thermal discharges from power plants.

Marine debris continues to accumulate in the ocean and along shorelines within the action area. Turtles may become entangled and drown, and ingested trash may cause intestinal blockage and death. Between October 2004 and September 2008, the American Samoa Department of Marine and Wildlife Resources (DMWR) necropsied 4 green turtles that stranded on Tutuila. Of those 4, 2 had plastic and aluminum in their guts (Tagarino *et al*. 2008). However, because only a small percent of dead or dying sea turtles strand, little information is available to adequately quantify the impacts on green and hawksbill turtles that may result from climate change, marine debris, and contaminants in the action area. Accumulated marine debris on nesting beaches can also impede nesting success by altering nest excavation and through potential entrapment of hatchlings under debris that is inadvertently buried over them when the nesting female covers the clutch. The nesting beaches Spanish Steps are heavily impacted by accumulated marine debris and non-native plants.

The global mean temperature has risen 0.76°C over the last 150 years, and the linear trend over the last 50 years is nearly twice that for the last 100 years (Solomon *et al* [eds] 2007). Because climate change is a global phenomenon, resultant impacts have likely been occurring in the action area although scientific data describing any impacts that have occurred from climate

change in the action area are lacking. As discussed in the Threats Section, climate change is likely beginning to affect sea turtles found in the action area through the impacts of rising sand temperatures, rising sea level, increased typhoon frequency, and changes in ocean temperature and chemistry.

While sex ratios vary naturally within and among seasons and nesting locations, several species already exhibit female bias throughout their major rookeries worldwide (Chan and Liew 1995; Godfrey *et al* 1996; Marcovaldi *et al* 1997; Binckley *et al* 1998; Godfrey *et al* 1999; Godley *et al* 2001; Oz *et al* 2004; Kaska *et al* 2006). Monitoring data over a long enough timescale to discern climate change related trends in sex ratio have not been collected in the action area. Sea level rose approximately 17 cm during the 20th century (Solomon *et al* [eds] 2007) and further increases are expected. There are several predictions for potential future sea turtle nesting habitat loss due to sea level rise (Fish *et al* 2005; Baker *et al* 2006; Fuentes *et al* 2009), however available data are insufficient to determine an existing correlation between past sea level rise and sea turtle population dynamics (VanHoutan 2010).

Global climate change-induced elevated temperatures, altered oceanic chemistry, and rising sea level may be contributing to changes to coral reef and seagrass ecosystems (as described above in Status of the Species) which provide resting and foraging habitat for green and hawksbill sea turtles, although it is difficult to distinguish impacts of climate-related stresses from other stresses that produce more prominent short term effects (Parry *et al* [eds] 2007). Climate change-induced shifts in ocean productivity linked to temperature changes (Harwood 2001; Edwards & Richardson 2004; Hays *et al* 2005) may affect foraging strategies and therefore reproductive capacity for sea turtles (Solow *et al* 2002; Chaloupka *et al* 2008), similar to what has been observed during El Nino events in the Pacific (Limpus and Nicholls 1994; Chaloupka 2001; Saba *et al* 2007; Reina *et al* 2008). These shifts in abundance of foraging resources are also directly linked to observed modifications in phenology for sea turtles such as longer re-migration intervals and temporal shifts in nesting activity (Weishampel *et al* 2004; Hawkes *et al* 2007). However, at this time it is only possible to speculate as to the implications of such impacts, as findings raise numerous follow up questions (listed by Weishampel *et al* 2004) including whether earlier nesting will affect overall fecundity, clutch size, incubation length, hatch success, hatchling survivorship, food availability for hatchlings, mating synchrony, and sex ratio. Changes in reproductive capacity and temporal shifts of nesting activity associated with changing environmental conditions have not been studied specifically in the action area.

Additional potential effects of climate change on sea turtles include range expansion and changes in migration routes (Robinson *et al* 2008). Leatherbacks have extended their range in the Atlantic north by 330km in the last 17 years as warming has caused the northerly migration of the 15°C SST isotherm, the lower limit of thermal tolerance for leatherbacks (McMahon and Hays 2006). Similar studies have not been done for the green and hawksbill sea turtles that may be adversely affected in the action area. As such, scientific data are lacking on changes in migration routes of these sea turtles. Therefore, it is not possible to say with any degree of certainty whether and how their migration routes and ranges have been or are currently being affected.

Causal attribution of recent biological trends to climate change is complicated because non-climatic influences dominate local, short-term biological changes. However, the meta-analyses

of 334 species and the global analyses of 1,570 species show highly significant, nonrandom patterns of change in accord with observed climate warming in the twentieth century. In other words, it appears that these trends are being influenced by climate change-related phenomena, rather than being explained by natural variability or other factors (Parmesan & Yohe 2003). The details discussed previously in this section support the probability that recently observed changes in sea turtle phenology, sex ratio, and foraging characteristics in studied populations may be influenced by climate change-related phenomena. However, the implications of these changes are not clear in terms of population level impacts, and data specific to the action area are lacking. Therefore, as stated earlier, recent impacts from climate change in the action area are believed to be insignificant at this time.

5 Effects of the Action

In this section of a biological opinion, NMFS assesses the probable effects of the proposed action on threatened and endangered species. Effects of the Action refers to the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action that would be added to the environmental baseline. Indirect effects are those that are likely to occur later in time (50 CFR 402.02). The effects of the action are considered within the context of the Status of Listed Species and Environmental Baseline sections of this Opinion to determine if the proposed action can be expected to have direct or indirect effects on threatened and endangered species that appreciably reduce their likelihood of surviving and recovering in the wild by reducing their reproduction, numbers, or distribution (50 CFR 402.02), otherwise known as the jeopardy determination.

Approach. NMFS determines the effects of the action using a sequence of steps. The first step identifies potential stressors associated with the proposed action with regard to listed species. NMFS may determine that some potential stressors result in insignificant, discountable, or beneficial effects to listed species, in which case these potential stressors are considered not likely to adversely affect listed species, and subsequently are considered no further in the opinion. Those stressors that are expected to result in significant negative (i.e., adverse) effects to listed species are analyzed via the second, third, and fourth steps described below.

The second step identifies the magnitude of the stressors (e.g., how many individuals of a listed species would be exposed to the stressors; *exposure analysis*). In this step of our analysis, we try to identify the number, age (or life stage), and gender of the individuals that are likely to be exposed to a proposed action's effects, and the populations or subpopulations those individuals represent.

The third step describes how the exposed individuals are likely to respond to the stressors (*response analysis*). In this step, NMFS determines if the stressors are likely to result in any of the components of take as defined under the ESA (e.g., harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect or attempt to engage in any such conduct).

The final step in determining the effects of the action is establishing the risks those responses pose to listed resources (*risk analysis*). The risk analysis is different for listed species and designated critical habitat. However, the action area does not include proposed or designated critical habitat, thus it is not considered in this opinion. Our jeopardy determinations must be

based on an action's effects on the continued existence of threatened or endangered species as those "species" have been listed, which can include true biological species, subspecies, or distinct population segments of vertebrate species. Because the continued existence of listed species depends on the fate of the populations that comprise them, the viability (probability of extinction or probability of persistence) of listed species depends on the viability of their populations. Thus, because green and hawksbill turtles are globally listed, and these species consist of nesting aggregations, this final step first determines the risk posed by the proposed action to affected nesting aggregations, then relates that risk to the listed species.

5.1 Stressors

The following 9 potential stressors may occur due to the proposed action: elevated noise levels; loss or degradation of sheltering and forage habitat; vessel collision; direct impact by dredging or chiseling equipment; increased artificial lighting; disturbance from human activity and equipment operation; elevated turbidity; increased wastewater effluent; and increased wastes and discharges. NMFS has reviewed each of the stressors to determine if their effects are expected to be significant (e.g. size of the impact), discountable (how likely it is to occur), or beneficial (positive effect). Those that are insignificant, extremely unlikely to occur, or beneficial will not be discussed further in this opinion.

5.1.1 Elevated Noise Levels during Pile Driving

The proposed action is expected to result in nearly 2 years of high intensity noise due to pile driving, which may adversely affect sea turtles. The noise may drive turtles away from sheltering and foraging habitats located at or near the proposed CVN wharf and turning basin. Such behavioral modification is considered an adverse effect, and is thus addressed below in the exposure-response-risk analyses.

5.1.2 Loss or Degradation of Sheltering and Forage Habitat

Inner Harbor. The inner harbor portion of the proposed action is expected to result in the seaward extension of four contiguous inner harbor wharves outward 10 ft (3 m) from their current facings, along of combined total of 4,839 ft (1,475 m). This would permanently increase the wharf front's marine footprint by about 48,390 ft^2 (4,425 m^2). The action also includes maintenance dredging about 114 acres of seafloor adjacent to Sierra and Tango Wharves, and the construction of two ramps for amphibious landing craft for the laydown area. The potentially affected sea floor consists mainly of sticky, fine sand and silty mud sediments that provide no sheltering habitat, and supports little or no forage (USN 2010e). However, the encrusting macroalgae and sponges growing on the upper halves of the existing wharf facings provide potential forage habitat, and Abo Cove, at the east end of the inner harbor supports a seagrass bed. The proposed wharf extensions would cause the temporary loss of the encrusting algae and sponges, lost behind the new facings. Neither the new facings, nor the dredging, or the ramps should affect the seagrass bed. Because sea turtles are very rare in the inner harbor, any forage in that area is virtually unused by turtles. Based on the expectation that the sheltering and forage habitat in the inner harbor is both limited and virtually unused, and that any forage losses would be temporary (until marine fouling organisms colonize the new wharf facings and the new ramps), the loss or degradation of sheltering and forage habitat in the inner harbor is expected to have insignificant impacts on sea turtles, and it will be discussed no further in this opinion.

Outer Harbor. The outer harbor portion of the proposed action includes a large dredging footprint that would impact coral reef areas that provide potential turtle forage and sheltering habitat in an area where turtles are known to occur. The outer harbor where the dredging would occur consists of previously-dredged reefs and soft sediment areas, and large flat-topped reefs occur adjacent to this area. The proposed dredging would take place in an area that has been heavily impacted by previous dredge and fill projects, blasting, and on-going anchoring. Despite the area's history of disturbance, some areas of relatively steep sloped hard substrate with overhangs and other openings that may provide turtle sheltering habitat still exist in the proposed dredging area. However, this habitat type was not specifically surveyed or quantified. The area also supports diverse marine life, including sponge and algae that may provide forage resources for green and hawksbill turtles, and low numbers of turtles have been observed in and around the area. The expected loss or degradation of this habitat would result in the permanent loss or degradation of turtle foraging and sheltering resources. These resource losses are considered an adverse effect, and are thus addressed below in the exposure-response-risk analyses.

5.1.3 Vessel Effects

The proposed action is expected to result in increased military and commercial vessel traffic entering Apra Harbor, and the proposed dredging is expected result in tug and scow trips to the ODMDS. As described in the FEIS, the proposed action is expected to result in 1 additional CSG visit (about 9 large vessels per CSG), and up to 4 additional ATF visits (about 7 large vessels per ATF). About 15 Amphibious Assault Vessel (AAV) trips and up to 20 Landing Craft Air Cushion (LCAC) trips are also expected per ATF visit. This totals 177 additional military trips annually. The FEIS also reported that 362 additional commercial vessel trips are expected during the 2015 construction peak, after which NMFS expects commercial shipping to drop to about 79 arrivals above 14-year average. About 234 tug and scow trips to the ODMDS would be expected should all dredged material be disposed at the ODMDS. The FEIS reported that those trips would occur at a rate of about 1 to 2 per day during the proposed dredging. It is doubtful that the maximum number of military vessels would visit before harbor construction was complete, but if that were to happen, the maximum number of military vessels plus the maximum number of additional commercial vessels plus all of the tug and scow trips combined would total about 773 trips annually. This maximum number is unlikely to occur, and could only conceivably occur during the year of the construction-related peak commercial traffic while dredging was being done. Annual additional traffic would likely be much lower during the construction period, and the additional post-construction vessel traffic would be about 256 trips for military and commercial combined. Apra Harbor operating rules restrict vessel speeds to 12 nautical miles per hour (kts), or less in the outer harbor, and 5 kts or less in the inner harbor (NOS 2010). The large vessels would transit the harbor via established channels that take advantage of the deepest available waters. Based on the low number of these trips, the expected low speeds, and the expectation that in-harbor turtle density is lowest in the channels, NMFS has determined that the potential for additional military or commercial vessels to collide with sea turtles is discountable and this stressor will be discussed no further in this opinion.

5.1.4 Direct Impact by Dredging or Chiseling Equipment

Sea turtles could conceivably be struck by the digging bucket or the drop chisel if they were below either of those pieces of equipment. Potential injuries and their severity would depend on the animal's proximity to the bottom when struck, the angle of the strike, and the body part

impacted. Injuries may include cuts, bruises, broken bones, cracked or crushed carapaces, and amputations, any of which could result in the animal's death. However, clamshell dredging, including the use of a drop chisel, is a relatively stationary activity that impacts very small areas at any given time. Sea turtles must be directly beneath the bucket or chisel in order to be injured or killed by this type of dredging. Also: few sea turtles are expected to be in the dredging area; the applicant has committed to watch for turtles starting 60 minutes prior to commencing dredging or chiseling operations, with work being postponed or halted when turtles are within 50 yards; and the contractor must initiate all dredging/chiseling operations employing a soft start, whereby the dredge or chisel would be slowly lowered to the bottom for the first few drops. The soft start is expected to alert undetected marine animals and allow them time to depart the area before full impact operations begin. Based on implementation of these practices and considering information that sea turtles are likely to depart or avoid areas where dredges and drop chisels are used, we have determined that the likelihood of a sea turtle being adversely injured or killed by clamshell dredging or chiseling is discountable, and this stressor will be discussed no further in this opinion.

5.1.5 Increased Artificial Lighting

Several components of the proposed action include the installation of an undetermined number of tall light poles with 1,000 watt lights in the vicinity of the shore line in the inner harbor and at Polaris Point. The precise number of light poles is expected to vary based upon on-site requirements, but many are expected to replace existing light fixtures. The proposed action also includes 18 months of around-the-clock dredging off of Polaris Point. Lighting from the proposed new construction at Polaris Point, as well as the illuminated dredging barge would be within line-of-sight from the nearshore waters at Spanish Steps. The proposed dredging area is between 3,600 and 4,600 meters east of Spanish Steps. The proposed lights have the potential to deter or disorient nesting green and hawksbills and their hatchlings in the marine waters at Spanish Steps. However, as described in the FEIS, and noted above, many of the lights to be installed at the Naval Station would replace existing fixtures. In addition, the Navy's mitigation measures for artificial lighting require that lighting systems be designed to meet minimum safety and security standards, and to the maximum extent practicable employ hooded lights for construction near turtle terrestrial habitats (USN 2010e).

NMFS is aware of no scientific studies that measure or assess the artificial lighting that is currently visible from Spanish Steps. In addition, there are no current studies that quantify or evaluate the impacts that illumination may be having on the nesters and hatchlings at that particular nesting beach. However, as described in the Environmental Baseline Section, the east end of Apra Harbor is an industrial area that is already brightly illuminated at night across a wide swath. Given the existing lighting in this industrial area, the distance of the dredging site from Spanish Steps, the limited scope of the project area that would be visible from Spanish Steps, and the expected use of mitigation measures to reduce horizontal light transmission to the maximum extent practicable, NMFS considers it likely that any additional illumination from the proposed action would be barely detectable above the existing lighting levels at the Naval Station. Accordingly, NMFS expects that the proposed action would result in no significant increase in illumination at or near the nesting beaches at Spanish Steps. Consequently, NMFS has determined that the impacts of additional illumination would be insignificant on the affected sea turtles, and this stressor will be discussed no further in this opinion.

5.1.6 Disturbance from Human Activity and Equipment Operation

This stressor refers to construction-related disturbances other than exposure to elevated noise levels. Exposure to construction activities may startle sea turtles should they encounter them. Sea turtle density is considered low in the proposed construction areas, and turtles typically avoid human activity around Guam because they are wary of humans due to continued poaching (S. Wusstig personal comm.). Based on this, the most likely effect of this interaction is a moderate to high energy avoidance behavior leading to the animal rapidly leaving the area without injury. Additionally, the Navy would reduce the likelihood of this interaction by watching for and avoiding sea turtles before commencing work and by postponing or halting operations when protected species are within a minimum of 50 feet of construction activities other than pile driving and dredging, which have protected species safety ranges of 50 m (USN 2010a). Based on the information above, we expect that disturbances from human activity and equipment operation would be infrequent and non-injurious, resulting in insignificant affects on green and hawksbill turtles. As such, this stressor will be discussed no further in this opinion.

5.1.7 Increased Turbidity

Green and hawksbill sea turtles are often found in turbid waters. Since sea turtles breathe air instead of water, exposure to increased turbidity should not adversely affect their respiration or other biological functions. However, turtles may avoid dense turbidity plumes in favor of clearer water. The use of a clamshell bucket to dredge the inner and outer harbors is expected to mobilize bottom sediments and create a plume of suspended solids. The applicant has committed to employing silt curtains around dredging to the greatest extent practicable, but the use of surface-to-bottom curtains is unlikely in some areas. As such, the turbidity plume is expected to extend beyond the dredging footprint, particularly around the CVN turning basin. Although it is impossible to predict how individual animals might react to plumes of elevated turbidity, we expect that a low number of sea turtles may temporarily avoid the dredging area due to turbidity plumes. Avoidance due to turbidity would likely be temporary, and the displacement distance is expected to be short, plus any movement away from the dredging area would have an added benefit of reducing the likelihood of a turtle being injured by dredging. We expect that the impacts of this stressor would be insignificant on the affected sea turtles because aerial avoidance due to turbidity would likely be temporary, the displacement distance is expected to be short, and any movement away from the dredging area would have an added benefit of reducing the likelihood of a turtle being injured by dredging. Based on the expected insignificance of exposure, this stressor will be discussed no further in this opinion.

5.1.8 Increased Wastewater Effluent

The proposed action is expected to result in increased wastewater discharged into the nearshore marine waters around Guam. Most of the increased effluent discharge is expected to occur at the Northern District Wastewater Treatment Plant (NDWTP) where the current design capacity is 12.0 million gallons per day (mgd) average daily flow, and the average daily flow is currently 5.7 mgd. The recently relocated outfall into the ocean is located about 1,900 feet off shore, in about 140 feet of water. This outfall currently discharges without a functioning diffuser due to design problems. According to the FEIS, the proposed action could result in a maximum additional flow from the NDWTP of 6.4 mgd during the 2014 construction peak (12.1 mgd total flow), as well as much smaller increases at other WTPs around the island. The post-construction additional flow at the NDWTP is expected to stabilize at about 4.9 mgd above the current level

(10.6 mgd total). According to the FEIS, the Navy is considering a suite of options including: restoring and expanding the NDWTP's primary treatment capabilities; expanding and upgrading the NDWTP to secondary treatment. However, no commitment of financial or material resources has been made as of this time. The Navy is also considering implementing FFR to ensure that the increased population does not exceed the WTP's capabilities; and implementing their AMP to monitor environmental conditions to minimize adverse impacts from the proposed action.

The limited research available to assess the impacts of the NDWTP on marine resources found no adverse impacts on the health of corals exposed to the effluent (McKenna *et. al.* 2001). Pastorok and Bilyard (1985) suggest that in well-flushed waters along open coasts, sewage effluent has little or no adverse impact on coral reef communities. Additionally, there is no record of fibropapillomatosis (FP) in green turtles from Guam. FP is the only turtle disease currently linked with wastewater effluent (Guimaraes dos Santos *et. al.* 2010). Although the discharged effluent is currently below primary treatment standards, the volume of the maximum expected additional discharge is small. Additionally, the NDWTP discharges into open ocean waters beyond typical green and hawksbill sheltering and foraging habitats, and off the leeward coast, where the prevailing currents are expected to draw the plume away from shore. Based on the Navy's study of this outfall, the effluent rises quickly to the surface with minimal horizontal dispersion in mid-column. At the surface, prevailing winds and currents disperse and dilute the plume. Phytoplankton assimilate nutrients in the existing plume, while zooplankton and small fish graze on the phytoplankton and some of the suspended solids. Based on the expected planktonic trophic interactions, no detectable changes are expected in the standing phytoplanktonic biomass (no expected algal blooms) as a result of the increased effluent discharge. NMFS expects no negative impacts on turtle habitat in the vicinity of the outfall. Based on the best available information: 1) the expected volume of effluent is small, 2) the effluent is discharged beyond typical green and hawksbill nearshore habitat, 3) the plume is expected rise to the surface where it will quickly disperse away from nearshore turtle habitat, and 4) available studies indicate no adverse habitat impacts nor FP due to the outfall; NMFS concludes that the expected increase in wastewater effluent discharge would have insignificant impacts on green and hawksbill turtles. As such, this stressor will be discussed no further in this opinion.

5.1.9 Increased Wastes and Discharges

Construction wastes may include plastic trash and bags that may be ingested and cause digestive blockage or suffocation, or if large enough, along with discarded sections of ropes and lines, may entangle marine life. Equipment spills and discharges likely consist of hydrocarbon-based chemicals such fuel oils, gasoline, lubricants, hydraulic fluids and other toxicants, which could expose protected species to toxic chemicals. Depending on the chemicals and their concentration, the effects of exposure may range between animals temporarily avoiding an area, to death of the exposed animals. Local and Federal regulations prohibit the intentional discharge of toxic wastes and plastics into the marine environment. Additionally, the Navy has incorporated into their proposed action BMPs that include measures intended to prevent the introduction of wastes and toxicants into the marine environment (USN 2010a). Based on the information above, we expect that construction-related discharges and spills would be infrequent, small, and quickly cleaned if they do occur. Therefore, we have determined that exposure to construction-related wastes and

discharges would result in insignificant effects on green and hawksbill turtles, and this stressor will be discussed no further in this opinion.

Stressors Summary. As explained above, 2 of the 9 stressors associated with the proposed action were considered likely to adversely affect green and hawksbill turtles (elevated noise levels, and loss or degradation of sheltering and forage habitat). These stressors are addressed in the exposure-response-risk analyses below. The other 7 stressors (direct impact by dredging or chiseling equipment, increased artificial lighting, disturbance from human activity and equipment operation, elevated turbidity, increased wastewater effluent, and increased wastes and discharges) were determined to be not likely to adversely affect sea turtles and are addressed no further in this opinion.

5.2 Exposure

This section analyzes the proposed action's potential for exposing green and hawksbill sea turtles to the 2 stressors associated with the proposed action that were identified above as likely to result in adverse effects to green and hawksbill turtles: 1) Adverse levels of sound energy during pile driving operations in Apra Harbor and 2) impacts of lost or degraded sheltering and forage habitat due to dredging in outer Apra Harbor.

5.2.1 Exposure to Elevated Noise Levels during Pile Driving

This analysis is based on the piling types, the method of driving, the expected substrate, and the duration of work as described in the March 12, 2010 BA and the FEIS (USN 2010a & e), as well as the expected source levels for similar pile driving actions, based on the California Department of Transportation's Compendium of Pile Driving Sound Data (Compendium) (CALTRANS 2007). The exposure analysis is organized as follows:

1: Estimate the in-water source level for each pile driving project.

2: Estimate the ranges where in-water sound energy would fall to current thresholds for expected effects.

3: Estimate the areal extent of affected habitat where green or hawksbill sea turtles may be potentially exposed to sound energy at or above the threshold adverse affect.

5.2.1.1 Estimate the in-water source level for each pile driving project:

As described in Section 3, the CVN wharf project would require about 2,050 hours of work to impact drive about 410 24-inch (61 cm) wide steel pipe pilings. Assuming 24-hour work days, 7 days a week, the CVN Wharf would require a minimum of about 3 months of pile-driving. Similarly, the inner harbor wharf project would involve up to 18 months of around-the-clock work to impact drive about 1,115 23.6-inch steel sheet pilings and 1,684 36- X 18-inch steel H-piles along 4,840 linear feet (1,475 m) of wharf front.

Acoustics Background. Sound can be measured and quantified in several ways, but the logarithmic decibel (dB) is the most commonly used unit of measure, and sound pressure level (SPL) is a common and convenient term used to describe intensity. In water, sound pressure is typically referenced to a baseline of 1 micropascal (re 1 μPa), vice the 20 μPa baseline used for in-air measurements. Consequently, 26 dB must be added to an in-air measurement to convert to an appropriate in-water value for an identical acoustic source (Bradley and Stern 2008). To assess the potential impact of a sound on marine resources, NMFS often assesses impacts based

on the root-mean-square (dB_{rms}) of an acoustic pulse. This is the portion of a pulse that contains 90% of the sound pressure. For brevity, all further references to SPL assume dB_{rms} re 1 μPa, unless specified differently.

Sound Transmission in Water. Transmission loss (attenuation of sound intensity over distance) varies according to several factors in water, such as water depth, bottom type, sea surface condition, salinity, and the amount of suspended solids in the water. Sound energy dissipates through mechanisms such as spreading, scattering, and absorption (Bradley and Stern 2008). Spreading refers to the apparent decrease in sound energy at any given point on the wave front because the sound energy is spread across an increasing area as the wave front radiates outward from the source. In unbounded homogenous water, sound spreads out spherically, loosing as much as 7 dB with each doubling of range. Toward the other end of the spectrum, sound expands cylindrically when vertically bounded such as by the surface and substrate, losing only about 3 dB with each doubling of range. Scattering refers to the sound energy that leaves the wave front when it "bounces" off of a surface or particles in the water. Absorption refers to the energy that is lost through conversion to heat due to fiction. Irregular substrates, rough surface waters, and particulates in the water column increase scattering loss, while soft substrates, such as mud and silt increase absorption loss. Sound typically dissipates more rapidly in shallow, turbid waters over soft substrates (74 FR 18492). The water of Apra Harbor is expected to be a poor environment for acoustic propagation because it is relatively shallow, with an irregularly shaped bottom and high levels of silt and mud.

Accurately predicting received noise levels at a given range (isopleth) requires complex equations and detailed information that is rarely available. The equation "RL = SL – 20LogR" is used to calculated spherical spreading loss, and "RL = SL – 10LogR" is used for cylindrical spreading (RL = received level; SL = source level; and R = range in meters). Actual spreading loss is typically somewhere between spherical and cylindrical, with absorption and scattering increasing the loss. Consequently, predictions are often made by estimating transmission loss using an equation with a spreading coefficient between -20 and -10. To account for the acoustic environment expected within Apra Harbor, RL = SL – 15LogR was used to calculate estimated transmission loss and estimate ranges to threshold isopleths. Outside of the harbor, the bottom drops away dramatically and transmission loss likely approaches that of spherical spreading.

Pile Driving Noise. The in-water source level (SL) is the sound energy at 1 m from the source. The SL of impact pile driving is typically high, sometimes in excess of 200 dB (CALTRANS 2007). Frequencies vary according to several factors, including the type of piling and substrate as well as the intensity of impact. Signal analysis of sheet piles indicates a relatively broadband signal with most of the energy between 25 and 4,000 Hz. The dominant frequency range for 24-inch steel pipe piles falls between 125 and 2,500 Hz, with a peak at about 375 Hz. H-pile signals were described as "…higher frequency content than steel pipe…", with frequencies above 500 Hz to over 1,000 Hz. SPL is also affected by pile type and the substrate (the harder and larger the piling, the louder; the harder the bottom, the louder), as well as the impact energy (the harder the impact, the louder). Measured SPLs for individual pile driving events may vary over time. Green and hawksbill sea turtles are the only ESA-listed marine animals expected to occur within Apra Harbor where pile driving noise may reach levels capable of causing adverse effects. As described in Section 4, greens and hawksbills are thought to be low frequency specialists, with

hearing ranges that overlap with the expected frequency range of the pile driving signals. Thus, NMFS considers it likely that green and hawksbills can hear, and respond to pile driving noise.

5.2.1.2 Estimate the ranges where in-water sound energy would fall to current threshold for expected effects:

Neither the Navy nor NMFS has site-specific noise measurements for pile-driving in Apra Harbor. Consequently, the Navy and NMFS referred to the CALTRANS Compendium, and other sources cited in the Navy's BA, under the assumption that reported sound levels would closely approximate sound levels expected for similar pilings, driven in a similar manner in Apra Harbor. As described in the BA, impact driving steel sheet piles would be the loudest of the three piling types. Back-calculations with measured levels between 189 and 190 dB at 10 meters (m) suggest a SL of 205 dB (Table 3). Impact driving 24-inch steel pipe piles is expected to produce a SL of 203 dB, while the SL for impact driving 18-inch H-piles is expected to be 195 dB. The mouth of Apra Harbor is about 5,000 m from the nearest proposed pile driving (CVN Pier), where the estimated received sound level drops to 148 dB. As mentioned above, transmission loss outside of the harbor is likely to increase because spreading loss is expected increase due the dramatic increase in water depth.

Table 3. Estimated source levels and ranges to effects threshold isopleths for proposed pile driving types.

Steel Pilings	SL	Range to 180 dB PTS	Range to 160 dB TTS
23.6-in Sheet	205 dB	46 m	1,000 m
24-in Pipe	203 dB	34 m	741 m
18-in H	195 dB	10 m	214 m

Exposure to high intensity noises may adversely affect marine life. Effects vary with the frequency, intensity, and duration of the sound source, and the hearing characteristics of the exposed animal. In extreme cases, exposure to very high levels of sound can cause soft tissue injuries that may directly result in fatality. Exposure to lower levels may cause injury in the form of permanent hearing damage, also referred to as permanent threshold shift (PTS). Exposure to even lower levels may cause behavioral effects that range from temporarily reduced sensitivity also referred to as temporary threshold shifts (TTS), to temporarily masked communications and/or acoustic environmental cues, and areal avoidance. For exposure to sounds in water $\geq$ 180 dB is the threshold for PTS for cetaceans. Exposure to in-water sounds $\geq$ 160 dB is the threshold for TTS for all marine mammals.

Currently, no acoustic thresholds have been established for sea turtles. However, existing research available into sea turtle sensory biology suggests that sea turtles are less acoustically sensitive than cetaceans, relying more heavily on visual cues, rather than auditory input (Hazel, *et al*. 2007, Ridgeway *et al*. 1969). Thus, application of the marine mammal thresholds is considered conservative for sea turtles. Estimating attenuation based on RL = SL - 15logR suggests that the 180 and 160 dB isopleths would occur at ranges of 46 and 1,000 meters, respectively for sheet piles, whereas driving the H-piles would have ranges well within those of the co-located sheet piles (Table 3, and Figure 4). Similarly, the 180 and 160 dB isopleths for driving the pipe piles would occur at ranges of 34 and 741 meters. The estimated received level falls to 148 dB at the mouth of the harbor, at which point the spreading loss is expected to increase. Based on the information above, we expect that adverse levels of sound would be restricted to the area within Apra Harbor, and that at most, exposure of ESA-listed animals to

pile driving noise outside of the harbor may result in low levels of temporarily masked communications or acoustic environmental cues, resulting in insignificant behavioral responses that are likely to range between "awareness" of the noise to low level areal avoidance.



Figure 4. Apra Harbor showing the approximate ranges to the 180 dB (≈50 m) and 160 dB (≈1000 m) isopleths for sheet pile driving (red lines), and to the 180 dB (≈40 m) and 160 dB (≈740 m) isopleths for pipe pile driving (yellow lines).

5.2.1.3 Estimate the areal extent of affected habitat where green or hawksbill sea turtles may be potentially exposed to sound energy at or above the threshold adverse affect:

Available data strongly suggest that low numbers of green and hawksbill sea turtles reside year-round to rest and forage in nearshore waters, and sightings confirm ongoing presence of greens in Apra Harbor, including greens periodically observed on the surface in the area of the proposed CVN turning basin. Low numbers of hawksbills are also expected to occasionally occur in the harbor. Additionally, low level green turtle nesting has been confirmed at the mouth of the harbor at Spanish Steps (USN 2010a). However, current data are insufficient to determine precisely the total number or density of either species around Guam or in Apra Harbor. Although the Navy's BMPs require that pile driving be postponed or halted when turtles are within 100 m, NMFS considers it unlikely that turtles would be consistently detectable in the water at ranges beyond 50 meters. As described above, 46 m is the range at which potentially injurious levels of sound (PTS) are expected to radiate outward from driving sheet pilings, and 34 m is the range for PTS from pipe pilings. Consequently, NMFS expects that no turtles would be exposed to sound levels at or above 180 dB, but pile driving may expose a low but undetermined number of turtles to sound levels at or above 160 dB (TTS threshold) out to about 1,000 m for sheet pilings, and 741 m for pipe pilings (Figure 4). NMFS is currently unable to quantify the number of turtles likely to be adversely affected by this stressor. However, the areal extent of the expected zone of acoustic impact (out to the 160 dB isopleth) encompasses about 747 acres of potential turtle habitat. Based on the estimation that there is about 23,000 acres of potential green and hawksbill turtle habitat around Guam (Section 3 above), 747 acres represents about 3.2% of Guam's available turtle habitat.

5.2.2 Exposure to Loss or Degradation of Sheltering and Forage Habitat

As discussed in Section 5.1.2 the loss or degradation of sheltering and forage habitat in the inner harbor is expected to have insignificant impacts on sea turtles. This analysis assesses the effects the proposed action is expected to have on ESA-listed sea turtles through the loss or degradation of their sheltering and forage resources due to the proposed action in the outer harbor. This analysis is limited strictly to the potential impacts on those species as defined by the ESA, and does not assess habitat quantity or ecosystem functions as may apply to valuation estimates for compensatory mitigation under the National Environmental Policy Act (NEPA) or any other statue. The analysis is based on reported turtle sheltering and forage resources expected to be permanently lost or degraded, or temporarily denied to green and hawksbill sea turtles in outer Apra Harbor, the expected spatial and temporal extent of the habitat impacts, and the number of green and hawksbill sea turtles potentially affected by those habitat impacts. The exposure analysis is organized as follows:

1: Describe the sheltering potential and forage resources within the proposed dredging footprint, and in adjacent areas.
2: Estimate the spatial and temporal extent of directly and indirectly impacted habitats.
3: Estimate the areal extent of lost or degraded green and hawksbill turtle habitat.

5.2.2.1 Describe sheltering potential and forage resources within the proposed dredging footprint, and in adjacent areas:

As described in the Environmental Baseline Section, the proposed dredging would take place in an area that has been heavily impacted by previous dredge and fill projects, blasting, and on-going anchoring. Despite the area's history of disturbance, some areas of relatively steep sloped hard substrate with overhangs and other openings that may provide turtle sheltering habitat still exist in the proposed dredging area. However, this habitat type was not specifically surveyed or quantified. The area supports diverse marine life, including low numbers of turtles.

The DEIS characterized the outer harbor in the vicinity of the proposed dredging area as consisting of three major and eight secondary biotopes. The primary biotopes are: large flat-topped reefs; dredged reefs; and soft sediment areas. The later two are the biotopes found in the proposed dredging area. The large flat-topped reefs are the shoals, such as Big Blue, Jade and Western Shoals that boarder the operational channel and proposed turning basin. Secondary biotopes include "rubble, mud, and sand", which accounts for about 35% of the total dredge footprint; and "algal beds", which accounts for about 40% of the footprint. The remaining 25% is made up of coral "supracolonies", various coral communities, and mixed communities of corals, algae, and sponges. Benthic surveys were conducted to describe the general benthic cover, and to identify algae and sponges present in the area. It did not quantify the abundance of those resources, but described benthic habitat in percentages of the bottom covers by particular organisms. Over 90 algal species and more than 50 species of sponge were identified in the area, with about 10 of the algae identified as known or suspected green turtle forage.

Russell and Balazs (2009) report that green turtles in Kaneohe Bay, Oahu have modified their feeding behavior to include seven nonnative algae that are now growing in the bay. The turtles consumed 130 species of marine vegetation, with the three most commonly consumed being nonnative species, *Acanthophora spicifera, Gracilaria salicornia,* and *Hypnea musciformis,*

(documented in the dredge area). Thus, it must be assumed that green turtles are likely opportunistic feeders, and that turtles in Apra Harbor likely feed on forage resources beyond the known forage species.

Although sponges are adult hawksbill's primary forage resource (Meylan 1988), they are known to have a broader diet, consuming zooanthids, soft corals, corallimorphs, ascidians, mobile invertebrates, and polyps of hard corals (Leon and Bjorndal 2002, Obura *et al.* 2010). Lutz and Musik (1997) suggest that the more juvenile the hawksbill, the more omnivorous the diet, including algae such as *Gracilaria* and *Sargassum spp* (documented in the dredge area), as well as seagrasses, soft corals, tunicates, and bryozoans. The authors also report that gravid females are know to eat *Halimeda spp* (documented in the dredge area), apparently for its calcium to aid production of eggshells. Specific information is lacking to identify forage sponges to genus for Pacific hawksbills, but Lutz and Musik (1997) and Fuentes (2009) report that many sponges of the Class Demospongiae are hawksbill forage. At least nine of the genera identified in the survey belong to the Class Demospongiae. Thus, NMFS considers it likely that at least some of those sponges may be forage resources for hawksbills, as are some of the identified algae.

5.2.2.2 Estimate the spatial and temporal extent of directly and indirectly impacted habitats:

To widen and deepen the operational channel, as well as create the turning basin and prepare the Polaris Point shoreline for the CVN wharf, dredging of about 53 acres, including up to about 33 acres of coral reef habitat would be required. The proposed dredging footprint includes shallow areas southwest of Jade Shoals and northeast to east of Big Blue, including Polaris Point at the entrance to the inner harbor (Figure 5). In addition to the area expected to be directly impacted by the dredging, the Navy has determined that reef habitats extending up to 656 ft (200 m) outward from the dredging area may be impacted by sediment deposition. Based on their plume modeling, the Navy considers the area of indirect impact to be an over-estimate. Dredging is expected to require about 18 months of around-the-clock work to complete.

5.2.2.3 Estimate the areal extent of lost or degraded green and hawksbill turtle habitat:

As described above at 5.2.1.3, green turtles are periodically observed on the surface in the proposed dredging area, and although much less common than greens, hawksbills also occur in the harbor, and are expected to occasionally occur in or near the proposed dredging area. Because data are insufficient to determine the total number or density for either species, NMFS has determined that a low but undetermined number of green and hawksbill sea turtles may be adversely affected by the expected habitat loss and/or degradation due to the proposed dredging. NMFS is currently unable to quantify the number of turtles likely to be adversely affected by this stressor. However, the FEIS estimated that the total impacted area (direct and indirect impacts) would be about 172 acres, which is likely an overestimate due to the need to use -60ft (vice -51ft) for the dredging depth in the Navy's modeling. Assuming that the entire area constitutes green and or hawksbill turtle habitat, this represents about 0.7% of Guam's available turtle habitat. The 53 acres to be dredged represents about 0.2% of potential turtle habitat that would be permanently lost or degraded. The remaining 119 acres of indirectly impacted habitat would represent about 0.5% of potential turtle habitat that would be temporarily degraded by increased sedimentation and mechanical disturbances that would likely induce turtles to avoid the area.

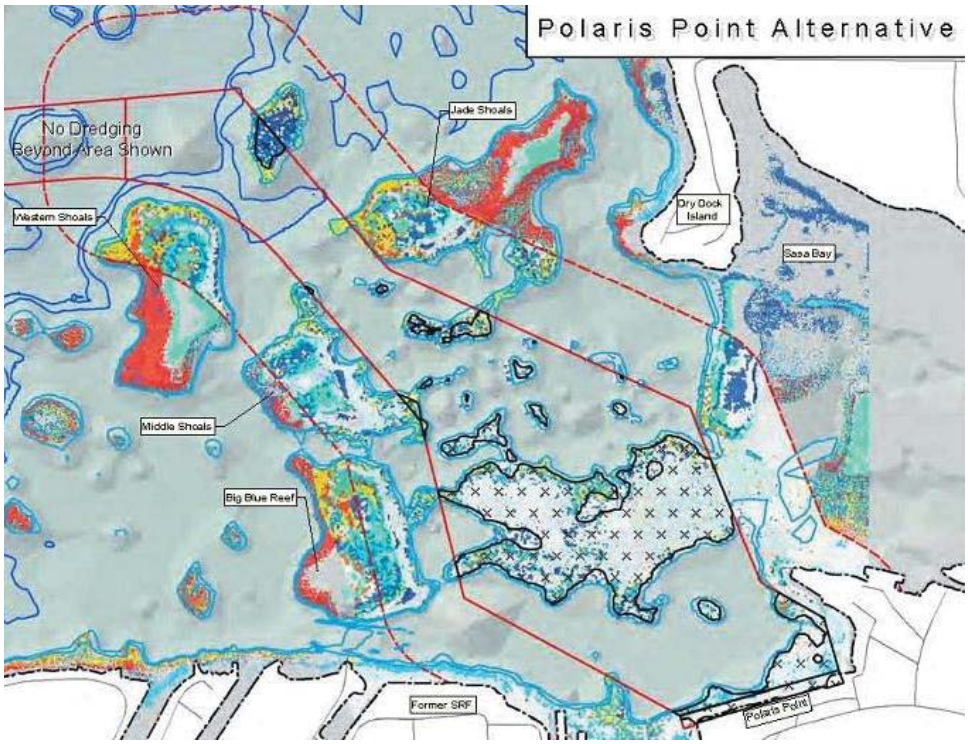

Figure 5. The area of impact expected for dredging in outer Apra Harbor. Direct impacts would be within the solid black lines. Indirect impacts due to suspended sediment would be contained within the dashed lines (USN 2010).

5.3 Response

This section analyzes the responses of green and hawksbill turtles to the 2 stressors associated with the proposed action that were identified above as likely to result in adverse effects to green and hawksbill turtles: 1) Adverse levels of sound energy during pile driving operations in Apra Harbor; and 2) impacts of lost or degraded sheltering and forage habitat due to dredging in outer Apra Harbor.

5.3.1 Response to Elevated Noise Levels during Pile Driving

The proposed action involves about 2 years of round-the-clock pile driving: 550 days to drive the sheet and H-piles, and 205 days to drive the pipe piles. The probable response to exposure to pile driving noise would be the movement of a low, but unknown number of turtles away from sheltering and forage habitats located at or near the proposed CVN wharf and turning basin. Because turtles appear to be relatively acoustically unresponsive, particularly when compared to marine mammals, NMFS expects that affected turtles may move a short distance away from the proposed pile driving if received levels exceed their tolerance thresholds, which are presently unknown. As described above in subsection 5.2.1.2, the 180 dB isopleth is expected at about 34 m from the CVN wharf, whereas the 160 dB isopleth would be at about 750 m. Although the 160 dB isopleth for inner harbor pile diving is expected to occur at 1,000 m, in the area where turtles are expected, that isopleth occurs within the expected footprint of the 160 dB isopleth for the CVN wharf (Figure 4). No specific information is available to estimate the lateral movement that would be expected for sea turtles under these circumstances. However, NMFS expects that after initially moving away, some exposed turtles may move back toward the area as they become conditioned to the new stimulus. Although it is conceivable that some turtles may remain within the area where they may experience some low level of TTS, NMFS expects that no sea turtles would be injured by exposure to pile driving sounds, and the potential TTS should have no

measurable impacts on the turtles' ability to forage, shelter, and avoid predators or other threats such as vessels. The 160 dB isopleth for CVN wharf pile driving could extend outward to a little over half the width of the channel into Sasa Bay. It is possible that some turtles may be initially discouraged from entering or exiting Sasa Bay during while pile driving is occurring. However, as mentioned above, after an initial period of possible avoidance, affected turtles are likely to become conditioned to the on-going noise and return to normal transits to and from Sasa Bay.

Based on the information above, NMFS expects that no sea turtles would be directly injured by this stressor, but an unknown number of green and hawksbill turtles are expected to experience behavioral modification in the form of temporary areal avoidance of an area equivalent to about 3.2% of Guam's available turtle habitat (including the inner harbor), before they become conditioned to the new stimulus and reclaim some of the area, where they may experience some level of TTS. Although this would be an adverse affect, the significance of this impact is not expected to rise to the level of take. Normal behaviors and areal access are expected to return soon after the cessation of pile driving (dredging impacts on habitat not withstanding).

5.3.2 Response to Loss or Degradation of Sheltering and Forage Habitat

As described at subsection 5.2.2.1, the area proposed for dredging the CVN turning basin and wharf contains turtle sheltering and forage resources, which are expected to be reduced or eliminated as a result of the proposed dredging. Consequently, in addition to the "temporary" movement away from the area due to project activities and elevated noise levels, some resident turtles would likely permanently avoid the area in favor of less impacted habitats in adjacent areas of the harbor, and reduced sheltering and forage resources would be available to transient turtles moving to and from Sasa Bay.

The estimated 53-acre foot print for the proposed dredging consists of a mix of benthic habitats "patches", several of which currently support varying amounts of sloped structure, macroalgae, and sponge growth that constitute turtle sheltering and forage resources. Because those habitat patches are disjoint and spread around the 53-acre footprint, NMFS considers the entire area turtle habitat that would be lost or degraded as a result of the proposed action. An additional 119 acres of adjacent habitat is expected to be indirectly and temporarily impacted by dredging-related sedimentation. Algae and sponges may recolonize some of the dredged area over time. However, the dredging is expected to reduce the area's rugosity (the area would be made flatter). Therefore, the amount of potential sheltering habitat is expected to be permanently reduced. Also, the area of sediment-covered substrate would likely increase, thus suitable substrate for sponge and algal growth is expected to be permanently reduced. Because underutilized sheltering and forage resources are readily available on the adjacent reef areas, NMFS expects that no sea turtles would experience any reduction in vitality due to reduced availability of these resources in the dredged area.

Based on the information above, NMFS expects that no sea turtles would be directly injured or killed by this stressor. However, an unknown number of turtles are expected to experience behavioral modification in the form of temporary or permanent areal avoidance of up to 172 acres of potential habitat at the eastern end of the outer harbor representing about 0.7% of potential island-wide turtle habitat. Those turtles are also expected to experience behavioral modification in the form of permanently lost or degraded sheltering and forage resources

formerly available within the 53-acre dredging footprint, which represents about 0.2% of potential island-wide turtle habitat. Normal behaviors and areal access are expected to return to the non-dredged areas soon after the cessation of dredging. Although this would be an adverse affect, based on the expectation that no injury or vitality reduction would be experienced, the magnitude of this impact is not expected to rise to the level of take.

5.4 Risk

This section analyzes the risk posed by the proposed action to green and hawksbill sea turtles due to the 2 stressors associated with the proposed action that were identified above as likely to result in adverse effects to green and hawksbill turtles: 1) Adverse levels of sound energy during pile driving operations in Apra Harbor; and 2) impacts of lost or degraded sheltering and forage habitat due to dredging in outer Apra Harbor.

5.4.1 Risk from Elevated Noise Levels during Pile Driving

Based on the available data used in the exposure and response analyses above, we expect that a low but undeterminable number of green and/or hawksbill turtles may be harassed, through behavioral modification in the form of temporary areal avoidance of habitat at the eastern end of the outer harbor equivalent to about 3.2% of Guam's available turtle habitat. No turtles are expected to be directly injured or killed, but some of these turtles could potentially experience low level TTS that would have no measurable impacts on the turtles' ability to forage, shelter, and avoid predators or other threats. As described above in the Status of Listed Species section, resident turtles on Guam likely belong to multiple NAs located elsewhere in Oceania, whereas turtles nesting on Guam likely forage elsewhere. However, genetic information is inadequate to determine which NAs within Oceania the affected resident turtles belong to. Additionally, although we do not know the exact number of animals that would be affected, we know that the number would be extremely small in comparison to the number of individuals of the affected species found across Oceania, and even larger numbers represented around the world. Given the low number of turtles expected to be affected, that those animals would most likely be from multiple NAs, and the expectation that no injury or reduction in fitness would result due to these stressors, the risk to the affected nesting aggregations is considered negligible.

5.4.2 Risk from Loss or Degradation of Sheltering and Forage Habitat

Based on the available data used in the exposure and response analyses above, we expect that a low but undeterminable number of green and/or hawksbill turtles may be harassed, through behavioral modification in the form of permanently lost or degraded sheltering and forage resources at the eastern end of the outer harbor within the 53-acre dredging footprint (0.2% of potential island-wide turtle habitat), and through temporary or permanent areal avoidance of 53 to 172 acres of potential habitat, representing up to about 0.7% of potential island-wide turtle habitat.

Although the expected resource losses and areal avoidance would be adverse affects on these turtles, no turtles are expected to be directly injured or killed, nor would they experience any measurable reduction in fitness. As described above in the Status of Listed Species section, resident turtles on Guam likely belong to multiple NAs located elsewhere in Oceania, whereas turtles nesting on Guam likely forage elsewhere. However, genetic information is inadequate to determine which NAs within Oceania the affected resident turtles belong to. Also, although we

do not know the exact number of animals that would be affected, we know that the number would be extremely small in comparison to the number of individuals of the affected species found across Oceania, and even larger numbers represented around the world. Given the low number of turtles expected to be affected, that the animals would most likely be from multiple NAs, and the expectation that no injury or reduction in fitness would result due to these stressors, the risk to the affected nesting aggregations is considered negligible.

5.5 Cumulative Impacts

"Cumulative Impacts" are the additive, synergistic, multiplicative, and/or antagonistic effects that may result from interactions between and among the stressors produced by an action and other pre-existing stressors. Based on prevailing currents, and because foraging turtles show strong fidelity for preferred foraging areas, NMFS is doubtful that, with the exception of collision, in-harbor impacts are likely to interact with the expected out-of-harbor impacts. As such, those areas are discussed individually. As discussed environmental baseline section, turtles within Apra Harbor are routinely exposed to stressors that include: 1) elevated in-water noise levels due to harbor activities and vessel traffic related to the naval station and the commercial port; 2) reduced water quality due to runoff from industrial areas, shipboard effluents, and sediment-laden streams; 3) reduced benthic habitat quality due to previous blasting and dredging, as well as on-going anchoring and sediment-laden river runoff; and 4) light pollution on nesting beaches due to nighttime harbor operations. Outside the harbor, turtles are exposed to stressors that include: 1) on-going intentional take; 2) runoff that transports anthropogenic pollutants and sediments; and 3) poorly treated wastewater effluents.

The proposed in-harbor work is expected to result in increased ambient noise levels in the harbor, which would also spread outward somewhat into the Philippine Sea to the west. This would be particularly so during the 2 years of proposed impact pile driving, but would also persist over current levels due to the expected increase in number and frequency of vessels visiting the harbor. Despite the high level of attention in-water noise has been receiving in recent years, the impacts of increased noise levels in the harbor are less worrisome than the subtle but inexorable shift in the harbor's health and ecology toward an industrial harbor that would eventually be incapable of supporting its current level of diversity, which is undoubtedly much lower than it was prior to the 1940s. Dredging and wharf work would result in a continued trend away from natural shorelines and benthic substrates at the east end of the harbor, and extend those impacts incrementally westward into the more pristine areas of the harbor. Although its impact has been determined to be insignificant, the proposed action would result in increased nighttime artificial light levels in the harbor, representing a small but incremental shift further away from the natural conditions upon which green and hawksbill turtles depend.

Outside of the harbor, turtles are exposed to on-going intentional take (harvest of adults and juveniles in nearshore waters, and the take of nesting adults and nests onshore), and the nearshore reefs have been impacted by point and non-point discharges that have introduced sediments and pollutants at ever increasing rates. This has altered and degraded benthic communities upon which ESA-listed sea turtles depend, while simultaneously directly exposing the turtles to potentially harmful substances. Although the impact of the expected increased effluent flow has been determined to be insignificant, without improved treatment, the proposed

increased effluent flow represents another incremental shift away from the natural processes green and hawksbill turtles depend upon.

Although the cumulative impacts of the proposed action are not expected to synergistically exceed any threshold of adverse affect for ESA-listed marine species, the proposed action is expected to result in the continued incremental shift away from natural processes within Apra Harbor, and along Guam's west shoreline, toward impacted benthic communities that are becoming increasingly incapable of aiding in the recovery of ESA-listed sea turtles. Implementation of the conservation recommendations described later in this opinion would help reduce this trend.

6 Cumulative Effects

"Cumulative effects," as defined in the ESA implementing regulations, are limited to the effects of future State, tribal, local, or private actions that are reasonably certain to occur in the action area considered in this Opinion (50 CFR 402.02). Cumulative effects, as defined in the ESA, do not include the continuation of actions described under the Environmental Baseline, and future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to Section 7 of the ESA. Expansion of the Port Authority's facilities at the Guam Commercial Harbor is under consideration to support future island growth, including the proposed action. This work could include construction dredging on the north side of the Apra Harbor that would be on the same scale as the dredging proposed in this action. However, because funding for the harbor expansion is uncertain, that action is considered separate and unrelated to the proposed action considered in this opinion. Consequently, that project will not be considered here.

Other sources of cumulative effects (fisheries interactions, vessel traffic, and marine debris) are described in the Environmental Baseline section, and are not only expected to continue, but are likely intensify over time, causing cumulative effects on green and hawksbill sea turtles. The expected dramatic growth of the human population on Guam, as well as across the rest of the Pacific region, would likely result in increased coastal development, fishing pressure, vessel traffic, and pollution of the marine environment. Impacts may include accelerated degradation or loss of forage, resting, and nesting habitats; increased take in fisheries including intentional harvest of turtles and eggs; increased vessel strikes; and increased entanglement in, and ingestion of, marine debris. Although the extent of these increased stressors is unquantifiable, and the corresponding effects are also unquantifiable, it is clear that unless adequately addressed to reduce their impacts, these vectors of cumulative effect would present increasing challenges to the continued survival of green and hawksbill sea turtles.

Global climate change is expected to continue and will therefore continue to impact sea turtles and their habitats. Rising temperatures at nesting beaches may continue to exacerbate a female bias and could also increase embryonic mortality if beaches are already at the high end of thermal tolerance for sea turtle nests (Matsuzawa *et al.* 2002). Only low level nesting of greens and hawksbills takes place inside the action area. However turtles that occur in the action area come from nesting aggregations that may be affected by impacts at their nesting beaches of origin throughout the Pacific. The best available demonstrations of the potential effects of sea level rise indicate that some sea turtle nesting beaches will lose a percentage of their

current area by 2100 (Fish *et al* 2005; Baker *et al* 2006; Fuentes *et al* 2009). However, these were modeled on static systems and did not account for geomorphological dynamics. A quantitative analysis of physical changes in 27 atoll islands in the central Pacific over a 19 to 61 year period, that corresponds with a rate of sea level rise of 2.0 mm per year, shows that 86% of islands remained stable (43%) or increased in area (43%) while only 14% of study islands exhibited a net reduction in island area (Webb & Kench 2010), evidence that changes will not be uniform or predictable and sea level rise may or may not result in beach loss.

Alterations to foraging habitats and prey resources, changes in phenology and reproductive capacity that correlate with fluctuations in SST, and potential changes in migratory pathways and range expansion (all discussed previously in Environmental Baseline) are additional ways in which sea turtles may continue to be impacted by climate change. Many marine species, including the pelagic life stages of sea turtles in the action area, forage in areas of nutrient rich oceanic upwelling, the strength, location, and predictability of which may change with increasing global temperatures (Harwood 2001).

Although there is much speculation on the potential impacts of climate change on species and ecosystems, there are multiple layers of uncertainty associated with these analyses making it impossible to accurately predict the most likely scenario that will result and consequently what impacts species and ecosystems will face, particularly in Pacific Island countries (Barnett 2001). Effects of climate change will not be globally uniform (Walther *et al* 2002) and information regarding the magnitude of future climate change is speculative and fraught with uncertainties (Nicholls and Mimura 1988). In particular, there is no comprehensive assessment of the potential impacts of climate change within the action area or specific to sea turtles that may be within the action area.

In addition to the uncertainty of the rate, magnitude, and distribution of future climate change and its associated impacts on temporal and spatial scales, the adaptability of species and ecosystems are also unknown. Impacts of climate change and hence its 'seriousness' can be modified by adaptations of various kinds (Tol *et al* 1998). Ecological systems evolve in an ongoing fashion in response to stimuli of all kinds including, climatic stimuli (Smit *et al* 2000). Sea turtles may exhibit a variety of adaptations to cope with climate change impacts although it will likely take decades to centuries for these shifts to occur (Limpus 2006) making it increasingly difficult to predict future impacts of climate change on sea turtles in the action area. For example, sea turtles are known to be highly mobile and in the past have shown the ability to adapt to changes in their environment and relocate to more suitable foraging and nesting sites over the course of multiple generations. Implications of climate change at the population level are a key area of uncertainty and one of active research (e.g. Jonzén *et al* 2007) and cannot currently be reliably quantified in terms of actual mortalities resulting from climate change impacts over any time scale. Nor can they be qualitatively described or predicted in such a way that could be more meaningfully evaluated in the context of this biological opinion. Within the temporal scale of the proposed action, any future synergistic impacts of climate change in the action area that might interact with the effects of the proposed action are not considered significant.

7 Integration and Synthesis of Effects

The purpose of this Opinion is to determine if the proposed action is likely to jeopardize the continued existence of listed species (50 CFR 402.02). "Jeopardize the continued existence of" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species. This opinion considers the Effects of the Action within the context of the Status of Listed Species and Environmental Baseline, as described in the Approach section (beginning of Section 7 Effects of the Action). We determine if reduction in fitness to individuals of listed species resulting from the proposed action are sufficient to reduce the viability of the populations those individuals represent (measured using changes in the populations' abundance, reproduction, spatial structure and connectivity, growth rates, or variance in these measures to make inferences about the population's extinction risks). In order to make that determination, we use the population's base condition as the context for the overall effects of the action on the affected populations. Finally, our Opinion determines if changes in population viability are likely to be sufficient to reduce the viability of the species those populations comprise or impair long term recovery of those species, consistent with recovery objectives, as set forth in the species' recovery plan and other sources. The following discussion summarizes the probable risks the proposed action poses to green and hawksbill sea turtles by integrating the Effects of the Action, Status of Listed Species, Environmental Baseline, and Cumulative Effects sections of this opinion

Parmesan and Yohe (2003) consider climate change a driver of small-magnitude but consistent impact that is important in that it systematically affects century-scale biological trajectories and ultimately the persistence of species. Based on this consideration and the uncertainties in predicting future impacts described earlier, the significance of climate change in the context of this analysis is low considering the limited temporal and spatial scale over which the action is likely to occur. There is currently no demonstrated link between climate change-induced environmental impacts such as sea level rise and marine turtle population indices in the modern record. This may be because most sea turtle data sets only overlap with the most recent 20-50 years of climate data, a period which is not long enough to discern changes in climate directly linked to anthropogenic causes.

As indicated above in the description of the proposed action, the action components that potentially affect ESA-listed species under NMFS jurisdiction consist of construction of vessel berthing and related facilities, as well as harbor dredging in Apra Harbor. Additional indirect effects are expected to result from increased wastewater discharge, as well as an increase in commercial vessel traffic in Apra Harbor. The total period of construction is approximately 10 years. Pile driving and dredging operations are expected to last about 2 to 3 years. We anticipate that over the expected timeframe of the action and within the action area, recent and future mortalities that can be linked directly to climate change impacts will not be discernible because non-climate related causes dominate local, short-term biological changes. Also, it is difficult to predict how the uncertain effects of climate change will impact sea turtles when combined with other threats. Although it is likely that some sea turtle nesting sites will lose a percentage of their area to rising sea levels and typhoon activity, the synergistic impacts of these threats in the action area, and the sea turtles' ability to adapt, remain uncertain. In summary, as discussed previously in the Status of the Species, Environmental Baseline, and Cumulative Effects sections, very little

scientific data have been collected regarding the current or future impacts of anthropogenic climate change on sea turtles, either globally or in the action area. Therefore, we cannot predict with precision how climate change will continue to impact sea turtle populations or how they will adapt to environmental changes in various habitats. Based on the best available data, we conclude that climate change-related impacts to sea turtles and sea turtle adaptations to climate change are both long-term processes that will manifest over a timescale that exceeds the term of this biological opinion. Both processes are also subject to many uncertainties and are not yet well enough understood to permit more meaningful quantitative or qualitative analysis. As such, climate change-related impacts do not appear to have had a measurable impact on these species or to be likely to reduce the likelihood of recovery of these species in the context of the proposed action.

7.1 Green Sea Turtles

As described in the Effects of the Action section, we expect that:

1. A low but undeterminable number of green turtles would experience behavioral modification resulting from temporary areal avoidance of sheltering and forage habitat at the eastern end of the outer harbor equivalent to about 3.2% of island-wide turtle habitat, due to exposure to elevated noise levels during pile driving, but no injury or reduction in fitness are expected to result due from this stressor;
2. A low but undeterminable number of green turtles would experience behavioral modification resulting from the permanent loss and/or degradation of 53 acres of sheltering and forage habitat at the eastern end of the outer harbor equivalent to about 0.2% of island-wide turtle habitat. They would also experience behavioral modification resulting from temporary or permanent areal avoidance of up to 172 acres of sheltering and forage habitat, representing up to about 0.7% of island-wide potential turtle habitat during the dredging operations, but no injury or reduction in fitness are expected to result due from these stressors; and
3. In addition to the effects resulting from the 2 stressors above, and as described in the cumulative impacts sub-section of the Effects section, the proposed action is expected to result in an incremental but permanent reduction in green turtle habitat quality, which is a continued movement away from the natural processes upon which Guam's green turtles depend.

As discussed in Status of Listed Species, about 18,000 to 38,000 green turtles nest annually in Oceania (adult females only), and about 150 to 250 green turtles reside in the nearshore waters of Guam (juveniles and adults of both sexes). As summarized in Figure 2, many of the major green sea turtle nesting aggregations in Oceania are stable or increasing, while many of the smaller nesting aggregations are declining. As discussed in the Environmental Baseline, most green turtle nesting and foraging areas on Guam have been impacted by coastal development and pollution, while intentional harvest of turtles continues in some areas, and fisheries interactions and boat collisions likely take low numbers of turtles.

As discussed more fully in the Cumulative Effects and Environmental Baseline sections, the effects of climate change, fisheries interactions, vessel traffic, and marine debris within the action area are expected to continue, and likely worsen, in the future. Although the impact and time scale of these effects on the trajectory of the affected green turtle populations is currently

uncertain, those impacts are expected to occur on a time scale, against which the impacts of the proposed action would be indistinguishable.

As described in the effects analysis, although the proposed action is anticipated to result in no take of green turtles, it could result in the loss, degradation, or avoidance of less than 1% of the available sheltering and forage habitat around Guam. Based on the available information, sheltering and forage habitat is not a limiting factor for green turtles around Guam. As described in the Environmental Baseline section, the habitat to be lost or degraded has been heavily impacted by previous and on-going activities, and it is located in the middle of a heavily used channel. Additionally, under-utilized habitat of equal or greater value is readily available in adjacent areas. Consequently, the habitat impacts expected to result from the proposed action is not expected to reduce the reproduction or abundance of green sea turtles at Guam or to impede the recovery of that species around the island.

As described above in the status of the species section, the turtles found in Guam's waters represent a very small proportion of green turtles across Oceania. They originate from multiple NAs (likely at least 3; Japan, the Philippines, and Guam), and the largest NAs in Oceania are increasing. Although trend information is unavailable for Guam and the Philippines, abundance appears to be increasing for the Japan NA. Given that the proposed action is expected to result in no take of green turtles, we do not expect the impacts of the proposed action to reduce the reproduction, abundance, or distribution, or recovery of the affected green sea turtle NAs. As such, the proposed action is not expected to adversely affect the recovery of green sea turtles in Oceania. Therefore, when taken in context with the status of the species, the environmental baseline, cumulative impacts and effects, the proposed action is not likely to appreciably reduce the likelihood of survival and recovery of this species, as listed under the ESA.

7.2 Hawksbill Sea Turtles

As described in the Effects of the Action section, we expect that:

1. A low but undeterminable number of hawksbill turtles would experience behavioral modification resulting from temporary areal avoidance of sheltering and forage habitat at the eastern end of the outer harbor equivalent to about 3.2% of island-wide turtle habitat, due to exposure to elevated noise levels during pile driving, but no injury or reduction in fitness are expected to result due from this stressor;
2. A low but undeterminable number of hawksbill turtles would experience behavioral modification resulting from the permanent loss and/or degradation of 53 acres of sheltering and forage habitat at the eastern end of the outer harbor equivalent to about 0.2% of island-wide turtle habitat. They would also experience behavioral modification resulting from temporary or permanent areal avoidance of up to 172 acres of sheltering and forage habitat, representing up to about 0.7% of island-wide potential turtle habitat during the dredging operations, but no injury or reduction in fitness are expected to result due from these stressors; and
3. In addition to the effects resulting from the 2 stressors above, and as described in the cumulative impacts sub-section of the Effects section, the proposed action is expected to result in an incremental but permanent reduction in green turtle habitat quality, which is a continued movement away from the natural processes upon which Guam's hawksbill turtles depend.

As discussed in Status of Listed Species, about 5,400 to 6,100 hawksbill turtles nest annually in Oceania (adult females only). About 22 to 37 hawksbill turtles reside in the nearshore waters of Guam (juveniles and adults of both sexes). As discussed in Status of Listed Species, hawksbill sea turtle nesting aggregations in Oceania are generally decreasing. As discussed in the Environmental Baseline, most hawksbill turtle nesting and foraging areas on Guam have been impacted by coastal development and pollution. Intentional harvest of turtles continues in some areas, and fisheries interactions and boat collisions likely take low numbers of turtles.

As discussed in the Cumulative Effects section, the effects of climate change, fisheries interactions, vessel traffic, and marine debris within the action area are expected to continue, and likely worsen, in the future. Although the impact and time scale of these effects on the trajectory of the affected hawksbill turtle populations is currently uncertain, those impacts are expected to occur on a time scale, against which the impacts of the proposed action would be indistinguishable.

As described in the effects analysis, although the proposed action is anticipated to result in no take of hawksbill turtles, it could result in the loss, degradation, or avoidance of less than 1% of the available sheltering and forage habitat around Guam. Based on the available information, sheltering and forage habitat is not a limiting factor for hawksbill turtles around Guam. As described in the Environmental Baseline section, the habitat to be lost or degraded due to the proposed action has been heavily impacted by previous and on-going activities, and it is located in the middle of a heavily used channel. Additionally, under-utilized habitat of equal or greater value is readily available in adjacent areas. Consequently, the habitat impacts expected to result from the proposed action is not expected to reduce the reproduction or abundance of hawksbill sea turtles at Guam or to impede the recovery of that species around the island.

As described above in the status of the species section, the hawksbills found in Guam's waters represent a very small proportion of green turtles across Oceania. They likely originate from multiple NAs. The number and locations of which are currently unknown, but the population trends at those NAs could be decreasing. Given that the proposed action is expected to result in no take of hawksbill sea turtles at Guam we do not expect the impacts of the proposed action to reduce the reproduction, abundance, or distribution of the affected hawksbill sea turtle NAs, and as such, would not aversely affect the recovery of those NAs. As such, the proposed action is not expected to adversely affect the recovery of hawksbill sea turtles in Oceania. Therefore, when taken in context with the status of the species, the environmental baseline, cumulative impacts and effects, the proposed action is not likely to appreciably reduce the likelihood of survival and recovery of this species, as listed under the ESA.

8 Conclusion

After reviewing the current status of ESA-listed green and hawksbill sea turtles, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is NMFS' Opinion that the U.S. Navy's proposed Guam and Commonwealth of the Northern Mariana Islands Military Relocation is not likely to jeopardize the continued existence of green sea turtles or hawksbill sea turtles.

As described above in Section 3, no critical habitat has been designated or proposed for designation for any ESA-listed marine species in the action area or elsewhere in the Mariana Archipelago. Therefore, the proposed action would have no effect on designated or proposed critical habitat under NMFS jurisdiction.

9 Incidental Take Statement

Section 9 of the ESA and protective regulations pursuant to Section 4(d) of the ESA prohibit the take of endangered and threatened species without a special exemption. "Take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, collect, or attempt to engage in any such conduct. "Incidental take" is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of Section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with the reasonable and prudent measures and terms and conditions of the Incidental Take Statement (ITS).

Based on the best information available, implementation of the proposed action is expected to adversely affect an undeterminable number of green and hawksbill sea turtles, primarily through behavioral modification as described in the Integration and Synthesis of Effects section. Although NMFS has determined that the proposed action is likely to adversely affect green and hawksbill sea turtles, we have also determined that the expected impacts would not rise to the level of take of those animals. Because no take is expected, no ITS is necessary, nor can an ITS be issued for this action.

10 Conservation Recommendations

Section 7(a)(1) of the ESA directs Federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or develop information.

The following conservation recommendations are provided pursuant to Section 7(a)(1) of the ESA:

1. The Navy is strongly encouraged to employ acoustic attenuation devices, such as bubble curtains, to reduce the acoustic impacts of pile driving.
2. The Navy is strongly encouraged to monitor and report the amount of dredging that occurs. The Navy shall develop a protocol that utilizes Geographic Information System (GIS) to monitor location of the dredge, and document dredging to ensure that dredging does not exceed the intended footprint and/or total acreage. The protocol should include a trigger to ensure that project management is notified when dredging approaches 53 acres dredged, or when dredging starts to go outside the intended footprint, with a clear mechanism in place to ensure that those limits are not exceeded.
3. The Navy is strongly encouraged to minimize artificial illumination visible at Spanish Steps.

a. The Navy should assess and document light levels at the Spanish Steps nesting beach, to include: preconstruction; construction, including during CVN dredging; and post construction to ensure that lights visible from the nesting beach and nearby waters are minimized to the greatest extent possible.
b. NMFS recognizes the Navy's need to provide adequate illumination to ensure safe operations 24 hours a day. However, lighting selected for the harbor should be minimized through reduction, shielding, lowering and appropriate placement of lights to avoid excessive illumination of nearshore areas and waters while meeting all safety and security regulations. Where applicable, long wavelength light sources, such as low pressure sodium or amber or red LED, are recommended.
c. To meet light reduction goals, unnecessary lighting should be turned off; as such NMFS also recommends installation of lighting systems that employ variable power settings that provide low-intensity "turtle-friendly" settings as well as full operational light settings, with the understanding that lower illumination levels would be employed during periods when the area is not in full operational use and/or not specifically required.
d. The Navy should, within safety constraints, require construction crews to reduce their lighting so that westward visibility of those lights is minimized, particularly during nighttime dredging. As above, construction lighting should be minimized through reduction, shielding, lowering and appropriate placement of lights to avoid excessive illumination of the water surface and to prevent or minimize visibility of lights from the nesting beach. Shielded low pressure sodium vapor lights are recommended for lights on offshore equipment that cannot be eliminated and for illumination of waters. Construction light intensity must be reduced to the minimum standard required by OSHA for General Construction areas, in order not to misdirect sea turtles. Shields should be affixed to the light housing and be large enough to block all light from being transmitted outside the construction area.
e. Work with the Guam Port Authority to encourage their adoption of similar lighting practices at the commercial port facilities in Apra Harbor.

4. The Navy is strongly encouraged to reduce the effects of wastewater effluent on the marine environment.
    a. The Navy should secure the required funding and commit to upgrading the HWTP and the NDWTP to secondary treatment standards or better.
    b. The Navy should monitor the impacts of wastewater effluent, particularly at the NDWTP outfall, including: performing benthic habitat surveys at the NDWTP outfall to assess pre-build-up habitat conditions, as well as turtle distribution and habitat use in the area; and performing water quality surveys to document down-plume productivity impacts as well as assessing bioaccumulation in the down-plume trophic web.
5. The Navy is strongly encouraged to initiate efforts to reduce the impacts of vessels on sea turtles around Guam. The Navy should require protected species related training for all DoD military and civilian personnel stationed in the Marianas, as well as their dependants. This training should include information about the special status of sea turtles as well as providing standoff distances and recommended speeds to avoid

collisions, and reporting procedures for interactions and strandings. This training should be developed with the assistance of NMFS Protected Resources Division.

6. The Navy is strongly encouraged to perform quarterly trash and debris removal from the Spanish Steps nesting beaches, as well as periodic efforts to replace non-native vegetation with appropriate native species, to improve turtle nesting success.
7. The Navy should pursue its intention to enter into a Memorandum of Understanding (MOU) with relevant Federal resource agencies, to include NMFS, to develop a better understanding of turtle population dynamics in the Marianas.
8. The Navy is strongly encouraged to undertake hatchling orientation studies at Spanish Steps to assess the extent to which hatchlings are attracted to harbor lighting rather than migrating directly out to sea.
9. The Navy is strongly encouraged to apply for and acquire relevant federal permits to undertake turtle programmatic activities on their properties to facilitate effective and collaborative monitoring and management activities (to include standardized nesting beach monitoring activities and nest inventories to assess reproductive success).
10. The Navy is strongly encouraged to support efforts to reduce the effects of wastewater effluent, such as bringing the Hagatna and Northern District Wastewater Treatment Plants up to secondary treatment standards or better.

11 Reinitiation Notice

This concludes formal consultation on The U.S. Navy's proposed Guam and Commonwealth of the Northern Mariana Islands (CNMI) Military Relocation. As provided in 50 CFR 402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained or is authorized by law, and if:

1. A take occurs;
2. New information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this Opinion;
3. The agency action is subsequently modified in a manner that may affect listed species or critical habitat to an extent, or in a manner not considered in this Opinion; or
4. A new species is listed or critical habitat designated that may be affected by the action.

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Endangered Species Act – Section 7 Consultation

Biological Opinion

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Acronyms

ANF	Annual Nesting Females
BA	Biological Assessment
BMP	Best Management Practices
CFR	Code of Federal Regulations
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
cm	Centimeter
CNMI	Commonwealth of the Northern Mariana Islands
DAWR	Division of Aquatic Wildlife Resources, Guam
dB	Decibel
DFW	Division of Fish and Wildlife, CNMI
EEZ	Exclusive Economic Zone
ESA	Endangered Species Act
FAO	Food and Agricultural Organization of the United Nations
FR	Federal Register
FSM	Federated States of Micronesia
GBR	Great Barrier Reef (Australia)
HCD	Habitat Conservation Division (PIRO)
Hz	Hertz (a measurement of frequency equivalent to cycles per second)
ITS	Incidental Take Statement
km	Kilometer
m	Meter
MHI	Main Hawaiian Islands
mm	Milimeter
NA	Nesting Aggregation
NAVFACMAR	Naval Facilities Engineering Command Marianas
NMFS	National Marine Fisheries Service (also NOAA Fisheries)
NOAA	National Oceanic and Atmospheric Administration
NWP	Nationwide Permit
PIFSC	Pacific Islands Fisheries Science Center
PIRO	Pacific Islands Regional Office
PNG	Papua New Guinea
PRD	Protected Resources Division (PIRO)
PTS	Permanent Threshold Shift
RMI	Republic of the Marshall Islands
RL	Received Level
rms	Root-Mean-Square
SL	Source Level
SPL	Sound Pressure Level
SST	Sea Surface Temperature
TTS	Temporary Threshold Shift
US	United States
USFWS	US Fish and Wildlife Service

Introduction

Section 7(a)(2) of the Endangered Species Act of 1973, as amended (ESA; 16 U.S.C. 1539(a)(2)) requires each Federal agency to insure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of critical habitat of such species. To "jeopardize the continued existence" means "to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species" (50 CFR 402.02). A Federal agency is required to consult formally with the National Marine Fisheries Service (NMFS) for marine species or their designated critical habitat or with the United States Fish and Wildlife Service (USFWS) for terrestrial and freshwater species or their designated critical habitat when that agency's action "may affect" an ESA-listed species. Federal agencies are exempt from the requirement for formal consultation if they have received from NMFS or USFWS written concurrence with a determination that an action "may affect, but is not likely to adversely affect" ESA-listed species or their designated critical habitat (see ESA Section 7 Implementing Regulations; 50 CFR 402).

This document represents NMFS' biological opinion (Opinion) of the effects on marine species protected under the ESA that may result from the repair and modernization of about 2,500 linear feet of existing waterfront structures at Sumay Cove, in Apra Harbor, Guam. This Opinion is based on the review of: the U.S. Navy's (Navy) June 1, 2011, Biological Assessment (BA) for Sumay Cove Repair and Modernization, Naval Base Guam; recovery plans for U.S. Pacific populations of listed sea turtles; published and unpublished scientific information on the biology and ecology of threatened and endangered marine species, as well as of other species of concern in the action area; monitoring reports and research in the region; biological opinions on similar actions; and relevant scientific and gray literature (see Literature Cited).

1 Consultation History

Informal consultation between the Naval Facilities Engineering Command Marianas (NAVFACMAR hereafter referred to as the Navy) and NMFS Pacific Islands Regional Office (PIRO) was completed on February 10, 2009, for the proposed installation of a floating dock system at the Sumay Cove Marina (NMFS PCTS File No. I/PIR/2008/07331, PIRO Reference No. I-PI-08-717-LVA). In early October 2010, the Navy contacted PIRO Protected Resources Division (PRD) to discuss the changes to the proposed action covered under the 2009 informal consultation. On October 13, 2010, PIRO PRD recommended, via electronic mail (e-mail), that formal consultation would be appropriate for the modified action. Subsequent to that, numerous communications were shared via phone and e-mail, and a site visit was conducted with personnel from the Navy and PIRO Habitat Conservation Division (HCD) in attendance. On June 21, 2011, NMFS PIRO received the Navy's June 10, 2011, request for formal consultation, which stated the Navy's determination that the proposed action would be likely to adversely affect green sea turtles (*Chelonia mydas*) and hawksbill sea turtles (*Eretmochelys imbricata*), but would be not likely to adversely affect the remaining ESA-listed marine species. The consultation request also included the Navy's June 1, 2011, BA for the action. A formal consultation was initiated on that date for green and hawksbill turtles, resulting in this Opinion.

2 Description of the Proposed Action and Action Area

The proposed action is described in the June 1, 2011, BA, and consists of Naval Base Guam performing work to repair and modernize waterfront facilities at Sumay Cove in Apra Harbor, Guam. In summary, the project consists of the operation of a land-based and barge mounted heavy equipment to complete three components: 1) Shoreline Repairs; 2) Small Craft Berthing Improvements; and 3) Boat Ramp Repairs.

Shoreline Repairs: A land-based pile driver would impact drive about 1,000 linear feet of 24-inch (61 cm) steel sheet piles along the eastern shoreline, and around two mole piers at the north end of the Sumay Cove peninsula. The new sheet piles would start near the midpoint along the existing sheet-pile seawall (Station 36+65), and continue northeasterly out and around the eastern mole pier. The western mole pier would also be re-faced with new sheet piles, but no piles would be installed along the shoreline between the two mole piers. The new piles would be driven down to about 25 feet below the mudline, about 18 inches seaward of the existing seawall. The new seawall would be tied back, the void between the previous and new seawalls would be backfilled, and new concrete pile caps and skirts would also be constructed to finish the sea wall. Pile driving would be done during normal working hours, and is expected to require 120 8-hour days to complete. No nights or Sunday work is proposed. Working 6 days a week, about 5 months of daylight pile driving is expected for this component.

Small Craft Berthing Improvements: Land-based and barge mounted heavy equipment would be used to install 55 15.5-inch octagonal concrete piles, and to install floating dock sections along about 1,670 linear feet of existing seawall, beginning at Station 36+65, and extending southwesterly (into) along the eastern side of the Sumay Cove peninsula. Heavy equipment with an auger would drill the sea floor to the desired depth then reverse drill (leaving the sediments in-place) to loosen bottom sediments before the concrete piles are impact driven to 20 feet below the mudline. Once the piles are installed, a crane would place modular concrete cells onto the water, where they would be joined to each other and connected to the pilings to form multi-berth floating docks. Gangways and service connections (water, power, and lights) would be also be installed. The total time to complete this work would be about 5 months, including about 60 days (10 weeks) of pile driving.

Boat Ramp Repairs: The two existing Moral Welfare and Recreation (MWR) Boat Ramps would be removed and replaced with expanded dimensions. One ramp would be widened by about 6 feet; the other would be lengthened by about by about 6 feet. The existing ramps would be chipped away to expose the existing rebar, expanded reinforcement would be installed, forms would be placed, and concrete would be pumped into the forms. This component is expected to take about 25 days to complete.

In addition to the work described above, divers may be used if necessary to repair equipment or to perform inspections.

Appropriate conditions and best management practices (BMP) are detailed in the BA and would apply to this action. These protective measures would include requirements to maintain constant vigilance for the presence of ESA-listed marine species during all aspects of the proposed action, to postpone or halt work (particularly pile driving) when protected species are within 50 yards

(46 m) of the work, to properly install and maintain silt curtains and erosion controls, to employ ramp-up techniques for pile driving, to minimize the introduction of pollutants into the marine environment, and to conduct acoustic monitoring of pile driving operations to validate or correct acoustic estimates, and to adjust safety ranges accordingly.

2.1 Interrelated/Interdependent Actions

The proposed action would result in the repair or replacement of existing waterfront structures that are currently in-use. Although the Shoreline and Boat Ramp Repairs projects would include small expansions of their original footprints, they would result in the construction of nearly identical replacement structures, located in virtually the original locations. The future use of these structures is expected to return to levels that would be effectively the same as they would have been had the proposed work not been done. Although the Small Craft Berthing Improvements component is expected to increase available vessel berthing, the proposed action is expected to result only in an increase in the number of moored vessels, not an increase in vessel traffic. Any future increase in vessel traffic at Sumay Cove would be result from population increases on the island of Guam that is unrelated to the action under consideration here. Should the mooring facilities be left unexpanded, NMFS expects that additional vessel traffic would utilize the preexisting boat ramp vice mooring at the docks. Based on this, NMFS expects no interrelated or interdependent actions to result from the proposed action.

2.2 Action Area

With regard to ESA-listed marine species under NMFS jurisdiction, the action area for this project is limited to the marine waters around Guam (Figures 1 and 4). For all work, other than pile driving, the action area is estimated to be the in-water areas of Apra Harbor within a 46-meter arc around those activities, and the down-current extent of any plumes that may result from mobilized sediments or discharges of wastes or toxic chemicals such as fuels and/or lubricants associated with the machinery used for this activity. However, during the proposed pile driving, the action area is extended seaward up to 25 km from Sumay Cove to include the waters that may be ensonified by pile-driving noise capable of eliciting behavioral response in ESA-listed marine species.

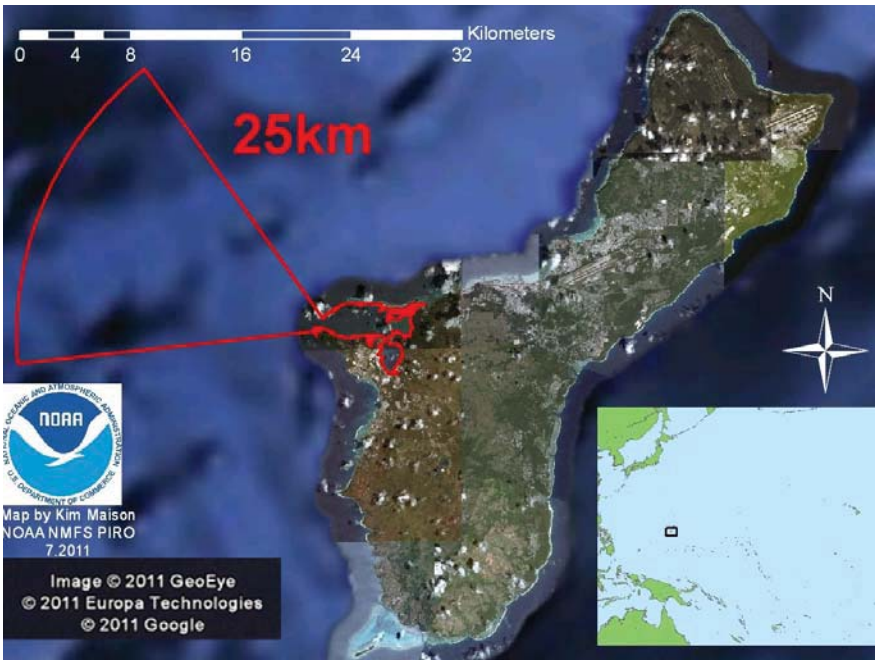

Figure 1. Action Area: Guam, with Apra Harbor and the 25-kilometer offshore area expected to be ensonified outlined in red.

3 Status of the Species

The Navy determined that the proposed action is likely to adversely affect green and hawksbill turtles, but is not likely to adversely affect blue, fin, humpback, sei, and sperm whales, as well as leatherback, loggerhead and olive ridley sea turtles (Table 1). Green and hawksbill turtles are the subject of this Opinion.

This section presents biological or ecological information for green and hawksbill sea turtles affected by the proposed action relevant to formulating the Opinion. Subsections 3.1 and 3.2 provide species-specific descriptions of distribution and abundance, life history characteristics (especially those affecting vulnerability to the proposed action), threats to the species, major conservation efforts, and other relevant information. Factors affecting those species within the action area are described in more detail in the Environmental Baseline (Section 4). No critical habitat has been designated for either of these species in the Pacific Ocean. Therefore, this project would have no effect on designated critical habitat under NMFS jurisdiction.

3.1 Green Sea Turtles

Green turtles are distributed circumglobally, and can be found in the Pacific, Indian, and Atlantic Oceans as well as the Mediterranean Sea, as described in the most recent green turtle 5-year status review (NMFS & USFWS 2007a). As shown above in Table 1, in 1978, all green turtles were listed as threatened under the ESA, except for the breeding populations in Florida and on the Pacific coast of Mexico, which were listed as endangered.

Table 1. ESA-listed marine species that may be affected by proposed action.

Species	Scientific Name	ESA Status	Listed	Federal Register
Species not likely to be adversely affected by the proposed action.				
Blue Whale	*Balaenoptera musculus*	Endangered	12/02/1970	35 FR 18319
Fin Whale	*Balaenoptera physalus*	Endangered	12/02/1970	35 FR 18319
Humpback Whale	*Megaptera novaeangliae*	Endangered	12/02/1970	35 FR 18319
Sei Whale	*Balaenoptera borealis*	Endangered	12/02/1970	35 FR 18319
Sperm Whale	*Physeter macrocephalus*	Endangered	12/02/1970	35 FR 18319
Leatherback Sea Turtle	*Dermochelys coriacea*	Endangered	06/02/1970	35 FR 8491
Loggerhead Sea Turtle	*Caretta caretta*	Threatened	07/28/1978	43 FR 32800
Olive Ridley Sea Turtle	*Lepidochelys olivacea*			
Nesting aggregations on west coast of Mexico		Endangered	07/28/1978	43 FR 32800
All other Olive Ridley Sea Turtles		Threatened	07/28/1978	43 FR 32800
Species likely to be adversely affected by the proposed action.				
Green Sea Turtle	*Chelonia mydas*			
Nesting aggregations in Florida and Mexico		Endangered	07/28/1978	43 FR 32800
All other Green Sea Turtles		Threatened	07/28/1978	43 FR 32800
Hawksbill Sea Turtle	*Eretmochelys imbricata*	Endangered	07/28/1978	43 FR 32800

3.1.1 Distribution and Abundance

Globally, most green sea turtle nesting populations declined substantially during the 20th century. Conservation efforts over the past 25 years or more appear to have had some positive results, as indicated below. However, threats and impacts persist for many green sea turtle populations (NMFS & USFWS 2007a). Following are brief descriptions of distribution and abundance of green turtles in the three major ocean basins, with more detail provided for Oceania in the Pacific Basin where the action area is located. These descriptions are based on the numbers of nesting

females, or their nests, because those are the best available methods for confirming sea turtle distribution or for estimating density and population trends.

Indian Ocean

There are numerous nesting sites for green sea turtles in the Indian Ocean. One of the largest nesting sites for green sea turtles worldwide occurs on the beaches of Oman where an estimated 20,000 green sea turtles nest annually. Based on a review of 32 index sites, declines in green turtle nesting were evident for many of the Indian Ocean index sites (Seminoff 2004). While several of these had not demonstrated further declines in the more recent past, Comoros Island and the Seychelles are the only index sites in the western Indian Ocean that showed evidence of increased nesting (NMFS & USFWS 2007a).

Atlantic Ocean / Mediterranean Sea

The 5-year status review for the species identified nine geographic areas considered to be primary sites for green sea turtle nesting in the Atlantic/Caribbean, and four in the Mediterranean and reviewed the trend in nest count data for each (NMFS and USFWS 2007a). Atlantic areas include: (1) Florida, USA; (2) Yucatán Peninsula, Mexico; (3) Tortuguero, Costa Rica; (4) Aves Island, Venezuela; (5) Galibi Reserve, Suriname; (6) Isla Trindade, Brazil; (7) Ascension Island, United Kingdom; (8) Bioko Island, Equatorial Guinea; and (9) Bijagos Archipelago (Guinea-Bissau). Mediterranean sites include: (1) Turkey; (2) Cyprus; (3) Israel/Palestine; and (4) Syria. Nesting at all of the Atlantic sites was considered to be stable or increasing with the exception of Bioko Island and the Bijagos Archipelago where the lack of sufficient data precluded a meaningful trend assessment for either site. Lack of sufficient data also precluded meaningful trend assessments for the Mediterranean sites. The most important nesting concentration for green turtles in the Atlantic is at Tortuguero, Costa Rica, where nesting has increased since the 1970s. Nest count data from 1999-2003 suggest nesting by 17,402- 37,290 females per year. These sites are not inclusive of all green sea turtle nesting in the Atlantic or Mediterranean. However, other sites support lower levels of nesting and contribute a much smaller proportion to the total number of green turtles in these areas (NMFS and USFWS 2007a).

Pacific Ocean

Green turtles occur in the eastern, central, and western Pacific. Foraging areas are found throughout the Pacific, including along the southwestern U.S. coast (NMFS and USFWS 1998a). Nesting is known to occur at hundreds of sites throughout the Pacific, with major nesting occurring in Indonesia, Malaysia, the Philippines, Australia, Micronesia, Hawaii, New Caledonia, Mexico, the Galapagos Islands, and other sites (NMFS & USFWS 2007a). Oceania is a subset of the Pacific, and includes Micronesia (where the action area is located), Melanesia, and Polynesia. In this opinion, Oceania is defined as also including Australia's Great Barrier Reef (GBR), because a high proportion of green turtles occurring in Oceania nest on the GBR. Based on the best information currently available, about 18,000 to 38,000 green turtles nest annually in Oceania (Figure 2) (NMFS 2010a).

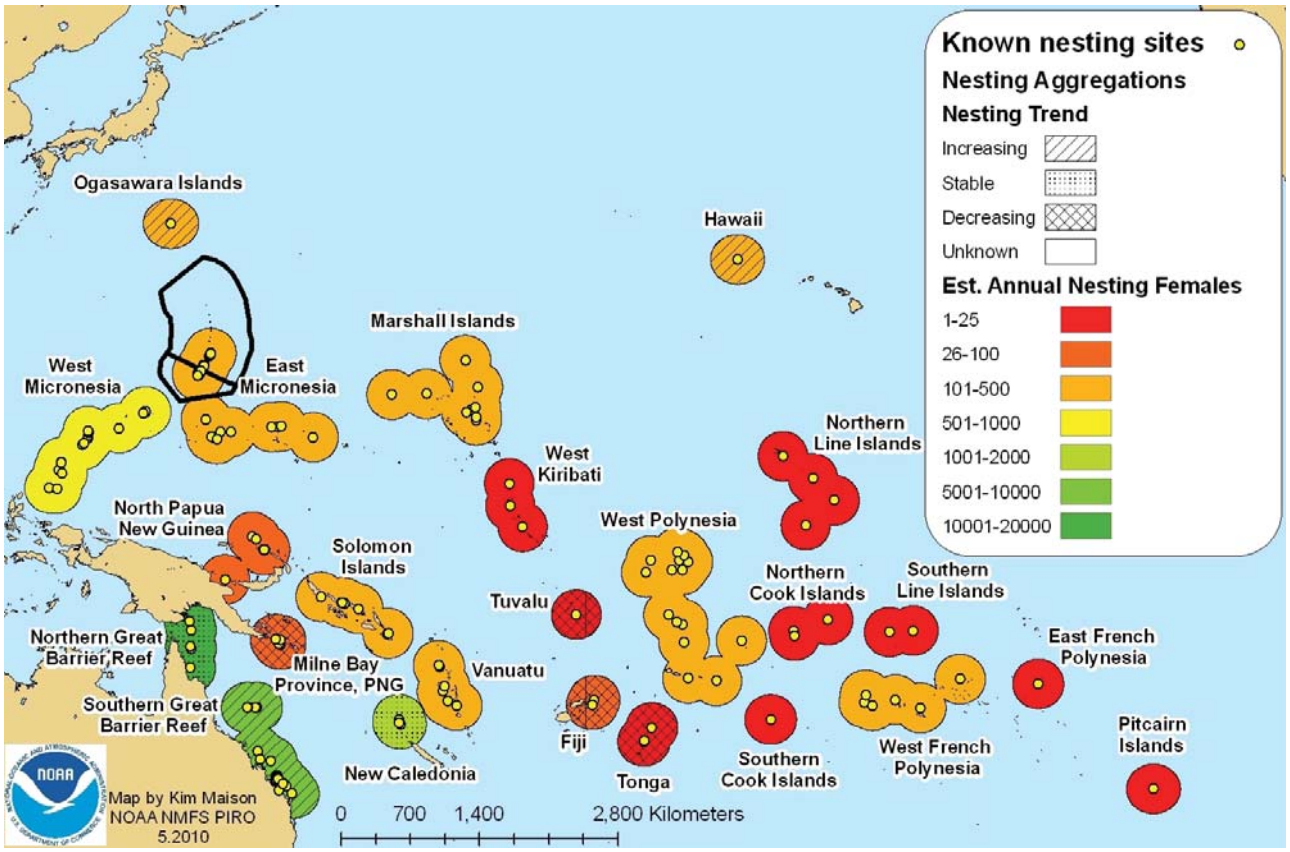

Figure 2. Green turtle nesting aggregations in Oceania.

However, about 90% of nesting takes place among two Australian nesting aggregations (NAs) (Northern GBR and Southern GBR which includes the Coral Sea Platform), with over half of all the nesting occurring on a single island; Raine Island in the Northern GBR (Chaloupka *et al*. 2008a, Limpus 2009). Nesting trends appear stable at Raine Island, and are increasing at Heron Island in the Southern GBR, as well as at Chichi-jima in the Ogasawara Islands (Chaloupka *et al*. 2008a). However, these trends do not necessarily correlate with a stable or increasing total number of turtles because of low nesting success and hatchling production at Raine Island, where the majority of nesting for Oceania occurs (Limpus *et al*. 2003; Limpus 2009). Also, NAs with small numbers of nesting females, like those throughout the islands and atolls of central and south Pacific, may be of greater importance than their proportional numbers indicate. Many of these NAs are geographically isolated, and likely harbor unique genetic diversity, which may be lost if these small NAs or their components become extirpated (Avise & Bowen 1994).

Mariana Archipelago

Sub-adult and adult green turtles occur in low abundance in nearshore waters around the Mariana Islands. Although it is likely that they occur around all of the Mariana Islands, nesting is thought to occur only in the southern islands of the CNMI and on Guam. There are no reports of turtles nesting at northern island locations. Genetic samples from nesting rookeries in the western Pacific Islands suggest that nesting greens in Guam and the CNMI are indistinguishable from each other, but distinct from those in Palau, Yap and the Marshall Islands (Dutton 2009).

Kolinski *et al*. (2004) estimated 1,000 to 2,000 turtles inhabit reef areas in the southern CNMI (Rota, Tinian, Aguiguan, Saipan, and Farallon de Mendillia). Information on nesting trend is currently insufficient for the CNMI. However, anecdotal information from residents suggests that nesting activity has decreased over time, likely as a direct result of illegal harvest (NMFS and USFWS 2007a). Since 1999, the CNMI Division of Fish and Wildlife (DFW) has monitored nesting at a minimum of five beaches on Saipan (CNMI DFW 2009), where between 4 and 18 nests are laid annually (CNMI DFW unpublished annual reports). Monitoring on Saipan, between March 4 and August 31, 2009, confirmed 16 green turtle nests, but also confirmed that three nesting turtles and three nests were poached during the same time (CNMI DFW 2009). On Tinian, nesting likely occurs on all or most of the accessible beaches (Pultz *et al*. 1999), and a July 22-31, 2009 rapid assessment yielded 35 nests at 5 beaches (CNMI DFW 2009). Eleven beaches on Rota are known to support nesting (Ilo *et al*. 2005), and a rapid assessment on July 12, 2009 yielded 13 nests (CNMI DFW 2009).

On Guam, the 5-year status review for green sea turtles reports that nesting was stable between 1990 and 2001 with the number of annual nesters fluctuating between 2 and 60 females, with nearly constant near shore abundance 150 to 250 turtles (NMFS and USFWS 2007a). Foraging and resting green turtles are often seen in close proximity to seagrass beds and reef flats, including Cocos Lagoon, Apra Harbor, Tarague Beach and several other locations around the island (Wiles *et al.* 1995). Guam's Division of Aquatic Wildlife Resources (DAWR) has maintained a bimonthly aerial survey program to monitor near shore fisheries and record opportunistic animal sightings, including marine turtles. These surveys confirm the year-round presence of a resident population of green sea turtles in Guam's nearshore waters. A total of 351 sea turtles were observed during aerial surveys between 1998 and 2008, with an annual mean of 32 turtles. Sightings include low numbers of turtles observed throughout Apra Harbor (DAWR unpublished data), and green turtles have been reported in Sumay channel by recreational boaters (Navy 2011).

Opportunistic nesting surveys counted 55 green turtle nests at various beaches around Guam between October 1, 2006 and July 31, 2008 (DAWR 2009). Known nesting beaches on Guam include: Ritidian National Wildlife Refuge, Haputo, Urunao, Tumon Bay, Cabras Island, Spanish Steps (Dangkolo and Dikiki), Cocos Island, Acho Bay, Nomña Bay, Jinapsan, and Tarague Beach (DAWR 2004; Grimm and Farley 2008). Of these beaches, two locations are on Navy lands: Haputo, and Spanish Steps, with an additional 6 to 8 unmonitored beaches occurring on Navy lands (Grimm and Farley 2008). Nesting activity peaks from April to July on Guam but often appears to continue throughout the entire year (Grimm and Farley 2008).

3.1.2 Life History Characteristics Affecting Vulnerability to Proposed Action

Following hatching at their natal beaches, green turtle hatchlings spend several years of early development in the oceanic (pelagic) zone followed by recruitment to coastal areas where post-recruitment juveniles and adults forage and mature in shallow coastal areas, feeding primarily on algae and seagrass. When on their foraging grounds, post-recruitment green turtles are often referred to as "residents". The majority of sea turtles in coastal areas spend their time at depths <5 m below the surface (Schofield *et al.* 2010, Hazel *et al.* 2009), and most resident green turtles show strong long-term site fidelity (over years) to preferred nearshore foraging and sheltering habitats, often until the habitat can no longer support their increasing size (Balazs and Chaloupka

2004; Balazs *et al*. 1987 and 1998; Chaloupka and Limpus 2001; Godley *et al*. 2003; Grant *et al*. 1997; Seminoff *et al*. 2003). Upon reaching sexual maturity, adult greens typically undertake long migrations between their resident foraging grounds and their natal nesting areas, where they mate and females nest. Nesting females are referred to as "nesters", which distinguishes them from "resident" turtles that regularly forage in that area. Although males also make mating migrations, because they do not crawl out on the beach as the females do, those males are nearly impossible to distinguish from the resident males.

Green turtle forage grounds and natal nesting areas are frequently located in different island groups, and residents at a given island group may originate from multiple natal nesting areas. Between 1971 and 1996, 46 adult female greens were flipper tagged after they nested at Rose Atoll, American Samoa. Three were recaptured; two in Fiji, and one in Vanuatu (Balazs *et al*. 1994). Between 1993 and 1995 seven post-nesting green turtles were satellite tagged at Rose Atoll. Most migrated 1,600 km to foraging areas in Fiji, and one migrated to French Polynesia (Craig *et al*. 2004). Of 513 greens tagged in French Polynesia between 1972 and 1991, six were recovered in Fiji, three in Vanuatu, two in New Caledonia, and one each were recovered in Tonga, and in the Cook Islands. Five post-nesting green turtles were satellite tracked in the Republic of the Marshall Islands (RMI) in 2007-2008. One turtle migrated to Bikini Atoll, RMI, another to Tarawa Atoll in Kiribati, one traveled to the Philippines passing through the Northern Mariana Islands, while two turtles circled for long periods of time in the open ocean with one having a final transmitted location in the exclusive economic zone (EEZ) of the Federated States of Micronesia (FSM) and the other in RMI (PIRO and PIFSC unpublished data). The last two turtles may have been exhibiting oceanic foraging strategies (Kabua *et al.* 2009). Seven post-nesting green turtles were satellite tracked from Yap, FSM during 2005-2006. Five migrated to the Philippines, one to Malaysia, and one turtle's transmitter ceased sending signals while still in the FSM (Kolinski *et al.* Draft manuscript 2007). An additional seven post-nesting greens were tracked from Yap in 2007. Four migrated to the Ryukyu Islands of Japan and three went to the Philippines (PIRO and PIFSC unpublished data). While information for Tutuila is limited, there is every reason to believe that green turtles there would display similar life history characteristics as other green turtle populations; migrating great distances between resident forage habitats and their natal beaches were they mate and nest.

Sea turtle hearing research is limited, but available information about sea turtle sensory biology suggests that they are low frequency specialists, with greens thought to be most acoustically sensitive between 200 and 700 hertz (Hz) (Ridgway *et al.* 1969). Because the hearing range of green turtles overlaps with the expected frequency range of the pile driving signals, NMFS considers it likely that greens can hear and respond to pile driving noise. Existing information also suggests that sea turtles rely more heavily on visual cues, rather than auditory, to initiate threat avoidance (Hazel *et al*. 2007).

Based on the description of the proposed action and on green turtle life history characteristics, post-recruitment juvenile and adult green turtles sheltering and foraging in Apra Harbor are the life stages most likely to be affected by the expected high intensity noise from pile driving. Because the green turtles found around Guam are likely to migrate widely between their preferred forage and nesting areas, the proposed action may affect greens from multiple NAs across a broad area of the south and western Pacific (Figure 2).

3.1.3 Threats to the Species

Global threats to green turtles are described in the 5-year review (NMFS & USFWS 2007a). The major threats to the species are alteration of nesting and foraging habitat, fishing bycatch, and direct harvest, which are briefly described below. Climate change also appears to be a growing threat to this species, and is also mentioned below.

Destruction and alteration of green turtle nesting and foraging habitats is occurring throughout the species' global range, especially through coastal development, beach armoring, beachfront lighting, vehicular/ pedestrian traffic, invasive species, and pollution from discharges and runoff. Under natural conditions, beaches can move landward or seaward with fluctuations in sea level. However, extensive shoreline hardening (e.g., seawalls) inhibits this natural process. Beach armoring is typically done to protect the coastal development from erosion during storms, but armoring blocks turtle nesting and often leads to beach loss. Coastal development also increases artificial lighting, which may disorient emerging hatchlings, causing them to crawl inland towards the lights instead of seaward. Coastal development also improves beach access for humans, resulting in more vehicular and foot traffic on beaches, causing compaction of nests and thereby reducing emergence success. Adult green turtles are opportunistic feeders, but are considered primarily herbivores that forage on seagrass and algae in shallow nearshore areas and coral reefs. Contamination from effluent discharges and runoff has degraded these habitats, and invasive species may reduce native algae species preferred by green turtles or could exacerbate susceptibility to, or development of disease (NMFS & USFWS 2007a; Guimaraes dos Santos *et al*. 2010).

Green turtles are susceptible to fisheries bycatch, particularly in nearshore artisanal fisheries. These fisheries use a diverse variety of gears, including long-lining, drift gillnets, set-nets, pound-nets, trawls, and others. Despite operating in the areas with the greatest density of adult green turtles, artisanal fisheries are typically the least regulated of all fisheries (NMFS & USFWS 2007a). Industrial fisheries such as the Hawaii-based deep-set and American Samoa longline fisheries also interact with green turtles, especially juveniles. Harvest of green turtles for their meat, shells, and eggs has been a major factor in the past declines of green turtles. Although reduced from previous levels, legal and illegal harvest of adults and eggs continues in most of the NAs described above, and remains a major factor in some parts of the species' range, including in the Marianas.

Although green turtles are probably beginning to be affected by impacts associated with anthropogenic climate change in several ways (described in more detail in the Environmental Baseline section below), no significant climate change-related impacts to green turtle populations have been observed to date. However, over the long-term, climate change-related impacts will likely influence biological trajectories in the future on a century scale (Parmesan and Yohe 2003). For example, increasing temperatures at nesting beaches may impact sex ratios of hatchlings (many rookeries already exhibit strong female bias [Binckley *et al*. 1998; Chan and Liew 1995; Godfrey *et al*. 1996; Godfrey *et al*. 1999; Godley *et al*. 2001; Kaska *et al*. 2006; Marcovaldi *et al*. 1997; Oz *et al*. 2004]) and/or increase embryonic mortality (Matsuzawa *et al*. 2002). Increased nest mortality has also been linked to erosion due to increased typhoon frequency (Van Houtan and Bass 2007) and intensity, which are predicted consequences of climate change (Webster *et al*. 2005). Seagrasses are a major food source for green turtles

worldwide. Seagrass habitats may suffer from decreased productivity and/or increased stress due to sea level rise and salinity and temperature changes (Short and Neckles 1999; Duarte 2002). Climate change induced shifts in ocean productivity linked to temperature changes (Harwood 2001; Edwards & Richardson 2004; Hays *et al*. 2005) may affect foraging strategies and therefore reproductive capacity for green turtles (Solow *et al*. 2002) similar to what has been observed during El Nino events in the western Pacific (Limpus and Nicholls 1994; Chaloupka 2001). While there is some available data on past trends, these data are limited, and current scientific methods are not able to reliably predict the future magnitude of climate change and associated impacts or the adaptive capacity of this species. Due to a lack of scientific data, the specific effects climate change will have on this species in the future are not predictable or quantifiable to any degree that would allow for more detailed analysis in this consultation (Hawkes *et al*. 2009). Based on the available information, climate change-related impacts are not considered significant within the context of the temporal scale of this action, as discussed further in the Environmental Baseline and Cumulative Effects sections below.

3.1.4 Conservation of the Species

Green turtles nesting in the US have benefited from both State and Federal laws passed in the early 1970s banning the harvest of turtles and their eggs. Protection and management activities since 1974 throughout the Hawaiian Archipelago and habitat protection at the French Frigate Shoals nesting area since the 1950's have resulted in increased population trends of both nesting and foraging turtles (Balazs and Chaloupka 2004). Elsewhere, the protection of nesting beaches against large-scale egg harvest appears to have reversed some downward nesting trends. Using long-term data sets, encouraging trends in green turtle nester or nest abundance over the past 25 years has become apparent in at least six locations including Hawaii, Australia, Japan, Costa Rica and Florida (Chaloupka *et al*. 2008a).

Efforts to reduce fisheries bycatch, such as the improvements made in the Hawaii-based longline fishery since the 1990s, has reduced green turtle interactions (NMFS & USFWS 2007a). Internationally, the conservation and recovery of green turtles is facilitated by a number of regulatory mechanisms at international, regional, national and local levels, such as the Food and Agricultural Organization of the United Nations (FAO) Technical Consultation on Sea Turtle-Fishery Interactions, the Inter-American Convention for the Protection and Conservation of Sea Turtles, the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), and others. As a result of these designations and agreements, many of the intentional impacts on sea turtles have been reduced: harvest of eggs and adults have been slowed at several nesting areas through nesting beach conservation efforts and an increasing number of community-based initiatives are in place to slow the take of turtles in foraging areas (Gilman *et al*. 2007; NMFS & USFWS 2007a).

3.2 Hawksbill Sea Turtles

Hawksbill turtles are distributed circumglobally, and can be found in the Pacific, Indian, and Atlantic Oceans, but not in the Mediterranean Sea, as described in the most recent hawksbill turtle 5-year status review (NMFS & USFWS 2007b). As shown above in Table 2, in 1978, all hawksbill turtles are listed as endangered under the ESA. Hawksbills are the most tropical sea turtle species, ranging from approximately 30° N latitude to 30° S latitude. They are closely associated with coral reefs and other hard-bottom habitats, but are also found in other habitats

including inlets, bays, and coastal lagoons. There are only five remaining nesting aggregations with more than 1,000 females nesting annually. These nesting aggregations are in the Seychelles, Mexico, Indonesia, and two in Australia (NMFS and USFWS 2007b). The global population has declined by more than 80 percent over the last three generations. Hawksbills face many of the same threats affecting green sea turtles. In addition, there continues to be a commercial market for hawksbill shell products, despite protections afforded to the species under U.S. law and international conventions (NMFS and USFWS 2007b).

3.2.1 Distribution and Abundance

Globally, most of the important hawksbill sea turtle nesting populations declined substantially during the 20th century. Hawksbill turtles are distributed across three major ocean basins; the Atlantic, the Indian, and the Pacific. More detail provided for the action area is located in Oceania, an area within the Pacific Basin.

Atlantic Ocean

In the western Atlantic, the largest hawksbill nesting population occurs on the Yucatán Peninsula of Mexico. Nesting also occurs in Antigua, Barbados, Costa Rica, Cuba, and Jamaica. Within the U.S., nesting occurs in Puerto Rico, the U.S. Virgin Islands, and along the southeast coast of Florida. At the two principal nesting beaches in the U.S. Caribbean where long-term monitoring has been carried out, populations appear to be increasing (Mona Island, Puerto Rico) or stable (Buck Island Reef National Monument, St. Croix, USVI) (NMFS and USFWS 2007b).

Indian Ocean

Of the approximately 83 nesting rookeries that have been identified for hawksbill sea turtles, 31 occur in the Indian Ocean. Many of those nesting areas are relatively small hosting 100 or fewer nesting females annually. However, some nesting rookeries in Madagascar, Iran, and Western Australia may have as many as 1,000 to 2,000 nesting females annually. Based on the number of nesting females the population trends at the 31 nesting rookeries over the recent past (last 20 years) have remained stable in two locations, declined at five, and are unknown for 24. Historically (20 to 100 years ago), population trends at these nesting rookeries were in decline at 17 sites and are unknown for 14 (NMFS and USFWS 2007b).

Pacific Ocean

Hawksbill turtles nest broadly in the Pacific, including on the islands and mainland of Southeast Asia, from China to Japan, and throughout the Philippines, Malaysia, Indonesia, Papua New Guinea (PNG), the Solomon Islands, and Australia, with the largest nesting concentration occurring on remote islands in the GBR area. However, along the eastern Pacific Rim where nesting was common in the 1930s, hawksbills are now rare or absent (NMFS and USFWS 2007b). Hawksbill nesting information is available for eight locations within Oceania: GBR, PNG, Solomon Islands, Vanuatu, Fiji, Micronesia (Federated States of Micronesia (FSM) and Palau), the Samoan Islands (Western Samoa and American Samoa), and the Mariana Islands. Hawksbill nesting may occur elsewhere within the range of this population, but little to no information is available, and nesting activity at those sites is thought to be very low. Based on the best information currently available, about 5,400 to 6,100 hawksbill turtles nest annually in Oceania, (NMFS 2010a) and the overall trend is downward (NMFS & USFWS 2007b).

Mariana Archipelago

Sub-adult and adult hawksbill turtles occur in low abundance in nearshore waters around the Mariana Islands (NMFS & USFWS 2007b). In CNMI, they have been sighted as far north as Anatahan (Ilo *et al.* 2005) and sporadically around Farallon de Medinilla (Kolinski *et al*. 2004; Ilo and Manglona 2002). They are occasionally observed by divers in the waters of Saipan, and two hawksbills were captured there in 2009 during the in-water monitoring program (CNMI DFW 2009). Hawksbills are also infrequently sighted around Rota (Kolinski *et al*. 2004; Ilo *et al.* 2005). No nesting trend data are available for the CNMI. Although anecdotal information suggests that hawksbill nesting occurred in the CNMI in the past, no nesting activity has been documented in recent years (CNMI DFW unpublished annual reports to PIRO).

Grimm and Farley (2008) report that hawksbills are frequently sighted in the nearshore waters surrounding Guam. However, they are less common than green sea turtles (NMFS and USFWS 2007b). According to Wiles *et al.* (1995), hawksbills represent about 13% of turtles sighted around Guam. Based on this and the estimated 150 to 250 green turtles present, NMFS estimates that about 22 to 37 hawksbills reside year-round in the nearshore waters around Guam. Between 5 and 10 hawksbills are estimated to nest annually at Guam, and although trend data are lacking, the population is thought to be declining (NMFS & USFWS 2007b). The first reported hawksbill turtle nest on Guam was in November 1991 (NMFS & USFWS 1998b) and in 1997 a possible hawksbill nest was reported from a beach at Sumay Cove (Grimm and Farley 2008). In 2008, four nesting attempts at Adotgan Dikiki (Spanish Steps) were attributed to a hawksbill turtle (Grimm and Farley 2008).

3.2.2 Life History Characteristics Affecting Vulnerability to Proposed Action

As with green turtles, hawksbills hatch at their natal beaches, hatchlings spend several years of early development in the oceanic (pelagic) zone. At about 35 cm carapace length, juveniles recruit to coastal areas where post-recruitment juveniles and adults forage and mature in shallow coastal areas, feeding primarily on sponges, but also on other benthic invertebrates, coral, and algae. When on their foraging grounds, post-recruitment hawksbill turtles are often referred to as "residents". The majority of sea turtles in coastal areas spend their time at depths <5 m below the surface (Schofield *et al.* 2010, Hazel *et al.* 2009). Upon reaching sexual maturity, adult hawksbills typically undertake long migrations between their resident foraging grounds and their natal nesting areas, where they mate and females nest. As with greens, nesting females are referred to as "nesters", which distinguishes them from "resident" turtles that regularly forage in that area. Although males also make mating migrations, because they do not crawl out on the beach as the females do, those males are nearly impossible to distinguish from the resident males.

As with green turtles, hawksbill forage grounds and natal nesting areas are frequently located in different island groups, and residents at a given island group may originate from multiple natal nesting areas. Thus, upon maturation, adult hawksbills undertake long migrations between their resident foraging grounds and their natal nesting areas (NMFS & USFWS 2007b). Two post-nesting hawksbills were fitted with satellite tags on Tutuila, American Samoa; one migrated several hundred km to Western Samoa, and the other migrated more than 1,000 km to the Cook Islands (Tagarino *et al*. 2008). Post-nesting hawksbills on the GBR are reported to migrate more

than 2,000 km (Miller *et al*. 1998). Currently, post-nesting tracking information is unavailable for Guam's hawksbills.

Research into turtle hearing is limited, and no specific information is available for hawksbills. However, based on the similarity in hearing between greens and loggerheads, and the hawksbill's close taxonomic relationship to these species, NMFS considers it likely that hawksbill hearing is also similarly specialized for low frequencies. As described above, green turtles are thought to be most acoustically sensitive between 200 and 700 Hz (Ridgway *et al.* 1969). Loggerhead (*Caretta carreta*) hearing is very similar to that of greens, being most sensitive between 250 and 1,000 Hz (Bartol *et al*. 1999). Because the hearing range of hawksbill sea turtles likely overlaps with the expected frequency range of the pile driving signals, NMFS considers it likely that hawksbills can hear, and respond to pile driving noise. Existing information about sea turtle sensory biology also suggests that sea turtles rely more heavily on visual cues, rather than auditory, to initiate threat avoidance (Hazel *et al*. 2007).

Based on the description of the proposed action and on hawksbill turtle life history characteristics, post-recruitment juvenile and adult hawksbill turtles sheltering and foraging in Apra Harbor are the life stages most likely to be affected by the expected high intensity noise from pile driving. Because the hawksbill turtles found around Guam are likely to migrate widely between their preferred forage and nesting areas, the proposed action may affect hawksbills from multiple NAs across a broad area of the south and western Pacific.

3.2.3 Threats to the Species

Global threats to turtles are described in the 5-year review. As discussed for green turtles (Section 3.1.3), destruction and alteration of habitat, as well as direct harvest are considered the major threats to hawksbills. Climate change also appears to be a growing threat. Destruction and alteration of hawksbill nesting and foraging habitats is occurring throughout the species' global range, especially through coastal development, beach armoring, beachfront lighting, vehicular/ pedestrian traffic, invasive species, and pollution from discharges and runoff. The adverse impacts of these threats described for greens, are virtually the same for hawksbills (NMFS & USFWS 2007b), so they are not repeated here. Although hawksbills interact with some fisheries, their bycatch rates are much lower than for the other sea turtle species, particularly with industrial fisheries.

Harvest of hawksbill shells and eggs continues to be a major threat. Due to the beauty of their shells, hawksbill adults may be harvested more heavily than other sea turtle species. Despite protections under CITES, the "tortoiseshell" trade continues in many areas. As with other sea turtle species, egg harvest continues unabated in parts of the Pacific, including Southeast Asia, Melanesia, and Polynesia (NMFS & USFWS 2007b). Kinch (2007) estimates that about 250 hawksbill turtles are sold annually in Port Moresby, but this may represent only a small fraction of the overall subsistence and semi-commercial take of hawksbills in PNG. It is estimated that large numbers of hawksbill turtles from Australian rookeries are being harvested in neighboring countries including Indonesia, PNG, Solomon Islands and Fiji to supply meat and/or tortoiseshell for use locally or for export.

Although green turtles are probably beginning to be affected by impacts associated with anthropogenic climate change in several ways (described in more detail in the Environmental Baseline section below), no significant climate change-related impacts to hawksbill turtle populations have been observed to date. However, over the long-term, climate change-related impacts will likely influence biological trajectories in the future on a century scale (Parmesan and Yohe 2003). In the future, climate change-related increasing temperatures, sea level rise, changes in ocean productivity, and increased frequency of storms events are all potential threats to hawksbills for the same reasons described above for green turtles. Additionally, because hawksbills typically inhabit coral reef communities, they are vulnerable to changes that affect these communities, such as increased bleaching events, increased occurrence of disease, and weakening of coral skeletons that may result from global climate change (McWilliams *et al.* 2005; Langdon *et al.* 2000; Ohde and Hossain 2004). As with green turtles, only limited data are available on past trends, and current scientific methods are not able to reliably predict the future magnitude of climate change and associated impacts or the adaptive capacity of this species. Due to a lack of scientific data, the specific future effects climate change will have on this species are not predictable or quantifiable to any degree that would allow for more detailed analysis in this consultation (Hawkes *et al.* 2009). Based on the available information, climate change-related impacts are not considered significant within the context of the temporal scale of this action, as discussed further in the Environmental Baseline and Cumulative Effects sections below.

3.2.4 Conservation of the Species

Numerous conservation programs are being implemented around the world to protect nesting habitat and reduce harvesting and fisheries bycatch of all sea turtle species, and numerous regulatory mechanisms are in place at international, regional, national and local levels to protect sea turtles (Section 3.1.4 above). Many of these programs likely benefit hawksbills. However, hawksbills continue to decline rapidly in the Pacific and Indian Ocean areas (NMFS & USFWS 2007b).

4 Environmental Baseline

The environmental baseline for a biological opinion includes: past and present impacts of all State, Federal, or private actions and activities in the action area; the anticipated impacts of all proposed Federal projects in the action area that have already undergone Section 7 consultation; and the impact of State or private actions which are contemporaneous with the consultation in process (50 CFR 402.02). The Consultation Handbook further clarifies that the environmental baseline is an analysis of the effects of past and ongoing human and natural factors leading to the current status of the species, its habitat (including designated critical habitat), and ecosystem, within the action area (USFWS & NMFS 1998). The purpose of describing the environmental baseline in this manner within a biological opinion is to provide the context for the effects of the proposed action on the listed species. As described in Section 2 above, the action area for this consultation consists of the nearshore waters within 25 kilometers of Apra Harbor on Guam, (Figures 1 and 4). The past and present impacts of human and natural factors leading to the status of green and hawksbill sea turtles within the action area include coastal development, fishing interactions, vessel strikes, direct take, marine debris, and climate change.

Guam is a small tropical island of volcanic origin that is surrounded by coral reefs. It is the southernmost island in the Marianas, and with a land area of 210 miles^2 (544 km^2), it is also the largest. The island is about 30 miles (48 km) long, with about 78 miles (125.5 km) of shoreline. The northern third of the island consists of a relatively flat coralline limestone plateau with steep coastal cliffs and narrow coastal plains. Low hills in the center, give way to mountains in south, where the highest point, 1,332 ft (406 m) Mt Lamlam is located.

The Central Intelligence Agency World Factbook estimated the island's population at 183,286 in June 2011, with an estimated growth rate of 1.314% (CIA 2011). Additionally, components of the Guam and CNMI Military Relocation project, which is expected to result in the relocation of Marines from Okinawa and other military build-up projects on Guam, has been underway since 2010. Based on the information in the Final Environmental Impact Statement for that action (USN 2010a), the relocation could temporarily increase the population by about 79,000 people during the projected 2014 construction peak, and stabilize at about 33,000 additional people permanently moved to Guam by 2020.

Portions of the nearshore marine environment around Guam have been degraded by impacts from: intense combat during World War II (WWII); shoreline development; sediment-laden runoff; and pollution from run-off and years of poorly treated wastewater effluent. Apra Harbor is a natural deep-water harbor, which has been heavily modified, particularly since World War II (Figure 3).

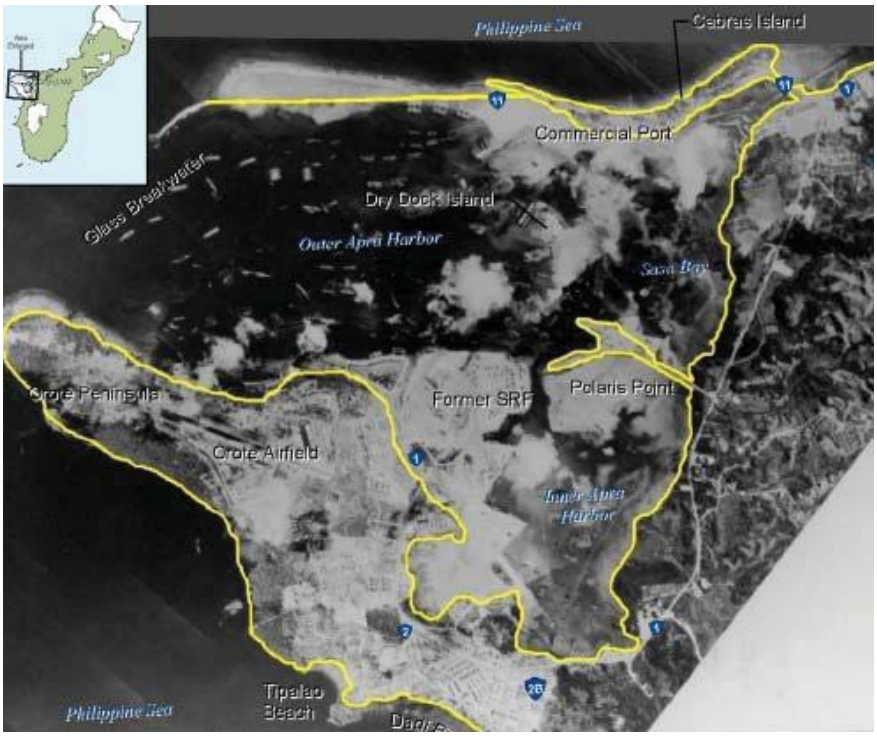

Figure 3. Apra Harbor July 1945. The yellow line indicates the approximate shoreline prior to the dredging and fill projects of the 1940s (USN 2011).

Much of the harbor's current topography and bathymetry is manmade; the result of work begun by the US Government in 1943. Extensive dredging and fill projects resulted in the creation of Inner Apra Harbor and its channel. Other fill projects resulted in the creation of Dry Dock Peninsula, Polaris Point, and the manmade northeastern and southeastern shorelines, and the Glass Breakwater, which extends from Cabras Island, out and across Luminau Reef to provide increased protection for the harbor. Other impacts include the knolls (hard bottom sites that protrude at least 25 ft (7.6 m) above the harbor bottom) that were explosively cleared during WWII, because they were considered navigational

hazards. Some of the shallower knolls have been used as anchorage sites since WWII, and some are still used by military and commercial vessels. Sunken ships rest on the sea floor at several locations throughout the harbor, as does metallic wreckage and other debris. The east end of Apra Harbor is highly developed and brightly illuminated at night. As viewed from Spanish Steps, which is located approximately 4,600 meters west of Polaris Point, industrial facilities light-up a broad swath across the east end of the harbor; with the commercial port and Cabras Island power plant area on the north side, the Naval Station to the south, and some residential lighting also visible on the hills between (USN 2010b). The existing lights from the commercial port are particularly bright and clearly visible to nesting turtles and hatchlings in the water, and on the beach, at Spanish Steps. The lights of the Naval Station are not quite as bright, but some areas are also clearly visible. It is probable that existing harbor lighting is currently having adverse impacts on green and hawksbill reproductive success at Spanish Steps. Other on-going activities that may impact sea turtles in Apra Harbor include period maintenance dredging as well as repair and maintenance of existing seawalls and wharves at both the Naval Station and at the Guam commercial port. In addition to the increased population mentioned above, the Navy's proposed build-up would also result in construction and maintenance dredging, the oversheeting of four wharves, and the construction of a new carrier pier. This work would be done at the east end of the outer harbor as well as within in inner Apra Harbor. NMFS completed formal consultation with the Navy for the proposed build-up on August 25, 2010, and determined that the proposed action would not jeopardize any ESA-listed marine species (NMFS 2010b).

Based on information presented in the Navy's BA, Apra Harbor's turtle habitats and turtle presence can be described as a continuum. The eastern end of the harbor, including Sumay Cove, is highly disturbed. Although corals, algae, and sponges that may serve as turtle forage are found in the area, benthic resources typically increase in number, size, and diversity as one travels from east to west. Data is limited, but turtle sightings also tend to increase along the same continuum, with turtles being rare in the inner harbor, and occasionally present east of Big Blue and Western Shoals. Turtles appear to occur in low numbers but are frequently seen on the west sides of these shoals, and they appear to become increasingly common toward the mouth of the harbor, where low-level green turtle nesting continues on the beaches below Spanish Steps, and hawksbill crawls have recently been observed. Low numbers of turtles are also observed in Sasa Bay, east to northeast of Polaris Point, where sponges, macro algae, and sea grass provide forage resources.

Nearshore fisheries on Guam consist primarily of subsistence fishing, but there are also small-scale commercial fisheries for coral reef and pelagic species. Contemporary methods include: boat-based and land-based hook-and-line fishing (handline or rod-and-reel), net fishing (cast, gill, drag, and surround net), spear fishing, hook and gaff, and gleaning (Hensley and Sherwood 1993). Nearshore fisheries occasionally result in entanglement and drowning of sea turtles. Gillnets are the most problematic for turtles, because the nets are left untended, and entangled animals usually drown. Hook-and-line fishing also hooks or entangles turtles, but the chance of survival is higher than if caught in a gillnet. In a study of stranded green turtles in Hawaii (stranded turtles are injured, sick, or dead turtles found on shore), the second and third most common known causes of stranding were fishing related. Hook-and-line fishing gear-induced trauma accounted for 7%, and gillnet fishing gear-induced trauma was responsible for 5% (Chaloupka *et al*. 2008b). However, most turtles drowned in fishing gear probably sink rather

than strand, making it very difficult to estimate the total number of green turtles killed annually by nearshore fishing interactions, even in Hawaii where turtles are much better monitored and studied than in the Marianas (NMFS 2008).

Hazel *et al*. (2007) report that vessel collision is a significant source of anthropogenic mortality for marine turtles. Based on Hawaii data for the period of 1998 to 2007 (NMFS 2008), the estimated total number of green turtles killed annually by boat collisions in the Main Hawaiian Islands (MHI) was between 25 and 50. The number of hawksbills similarly killed was much lower; between 0.2 and 0.4 turtles annually. The nearshore densities of boats and turtles are much lower around Guam than in Hawaiian nearshore waters, thus the number of green and hawksbill turtles killed annually by boat collisions around Guam is likely much lower. Although little information exists to quantify this impact, vessel collision has been implicated as the cause of three green turtle strandings in Apra Harbor between November 2002 and April 2008 (DAWR unpublished data).

Direct take through harvest of turtles and their nest continues on Guam and the other inhabited islands of the Mariana Archipelago, however, few data are available to quantify this impact. Vogt (2009) reported obvious poaching activity of nests on Tinian during surveys in 2007. During the 2009 nesting season on Saipan, three out of what is thought to be a total of five nesting turtles were poached as were three nests (DFW 2009). On Guam, DAWR has responded to 17 poachings of greens and 1 hawksbill since 1975 (S. Wusstig personal comm.).

Marine debris continues to accumulate in the ocean and along shorelines within the action area. Turtles may become entangled and drown, and ingested trash may cause intestinal blockage and death. Between October 2004 and September 2008, the American Samoa Department of Marine and Wildlife Resources (DMWR) necropsied 4 green turtles that stranded on Tutuila. Two of those turtles had plastic and aluminum in their guts (Tagarino *et al*. 2008). However, because only a small percent of dead or dying sea turtles strand, little information is available to adequately quantify the impacts on green and hawksbill turtles that may result from ingestion of marine debris. Although no documentation is available to describe ingestion for turtles on Guam, it is reasonable to expect that turtles here and elsewhere are equally likely to ingest marine debris they encounter as are turtles in American Samoa. Accumulated marine debris on nesting beaches can also impede nesting success by altering nest excavation and through potential entrapment of hatchlings under debris that is inadvertently buried over them when the nesting female covers the clutch. For example, the nesting beaches at Spanish Steps (southwestern Apra Harbor) are heavily impacted by accumulated marine debris.

The global mean temperature has risen 0.76°C over the last 150 years, and the linear trend over the last 50 years is nearly twice that for the last 100 years (Solomon *et al.* [eds] 2007). Because climate change is a global phenomenon, resultant impacts have likely been occurring in the action area although scientific data describing any impacts that have occurred from climate change in the action area are lacking. As discussed in the Threats Section, climate change is likely beginning to affect sea turtles found in the action area through the impacts of rising sand temperatures, rising sea level, increased typhoon frequency, and changes in ocean temperature and chemistry.

While sex ratios vary naturally within and among seasons and nesting locations, several species already exhibit female bias throughout their major rookeries worldwide (Chan and Liew 1995; Godfrey *et al.* 1996; Marcovaldi *et al.* 1997; Binckley *et al.* 1998; Godfrey *et al.* 1999; Godley *et al.* 2001; Oz *et al.* 2004; Kaska *et al.* 2006). Monitoring data over a long enough timescale to discern climate change related trends in sex ratio have not been collected in the action area. Sea level rose approximately 17 cm during the 20th century (Solomon *et al.* [eds] 2007) and further increases are expected. There are several predictions for potential future sea turtle nesting habitat loss due to sea level rise (Fish *et al.* 2005; Baker *et al.* 2006; Fuentes 2009). However, available data are insufficient to determine an existing correlation between past sea level rise and sea turtle population dynamics (Van Houtan 2010).

Global climate change-induced elevated temperatures, altered oceanic chemistry, and rising sea level may be contributing to changes to coral reef and seagrass ecosystems (as described above in Status of the Species) which provide resting and foraging habitat for green and hawksbill sea turtles, although it is difficult to distinguish impacts of climate-related stresses from other stresses that produce more prominent short term effects (Parry *et al.* [eds] 2007). Climate change-induced shifts in ocean productivity linked to temperature changes (Harwood 2001; Edwards & Richardson 2004; Hays *et al.* 2005) may affect foraging strategies and therefore reproductive capacity for sea turtles (Solow *et al.* 2002; Chaloupka *et al.* 2008a), similar to what has been observed during El Nino events in the Pacific (Limpus and Nicholls 1994; Chaloupka 2001; Saba *et al.* 2007; Reina *et al.* 2008). These shifts in abundance of foraging resources are also directly linked to observed modifications in phenology for sea turtles such as longer re-migration intervals and temporal shifts in nesting activity (Weishampel *et al.* 2004; Hawkes *et al.* 2007). However, at this time it is only possible to speculate as to the implications of such impacts, as findings raise numerous follow up questions (listed by Weishampel *et al.* 2004) including whether earlier nesting will affect overall fecundity, clutch size, incubation length, hatch success, hatchling survivorship, food availability for hatchlings, mating synchrony, and sex ratio. Changes in reproductive capacity and temporal shifts of nesting activity associated with changing environmental conditions have not been studied specifically in the action area.

Additional potential effects of climate change on sea turtles include range expansion and changes in migration routes (Robinson *et al.* 2008). Leatherbacks have extended their range in the Atlantic north by 330km in the last 17 years as warming has caused the northerly migration of the 15°C sea surface temperature (SST) isotherm, the lower limit of thermal tolerance for leatherbacks (McMahon and Hays 2006). Similar studies have not been done for the green and hawksbill sea turtles that may be adversely affected in the action area. As such, scientific data are lacking on changes in migration routes of these sea turtles. Therefore, it is not possible to say with any degree of certainty whether and how their migration routes and ranges have been or are currently being affected.

Causal attribution of recent biological trends to climate change is complicated because non-climatic influences dominate local, short-term biological changes. However, the meta-analyses of 334 species and the global analyses of 1,570 species show highly significant, nonrandom patterns of change in accord with observed climate warming in the twentieth century. In other words, it appears that these trends are being influenced by climate change-related phenomena, rather than being explained by natural variability or other factors (Parmesan & Yohe 2003). The

details discussed previously in this section support the probability that recently observed changes in sea turtle phenology, sex ratio, and foraging characteristics in studied populations may be influenced by climate change-related phenomena. However, the implications of these changes are not clear in terms of population level impacts, and data specific to the action area are lacking. Therefore, as stated earlier, recent impacts from climate change in the action area are believed to be insignificant at this time.

5 Effects of the Action

In this section of a biological opinion, NMFS assesses the probable effects of the proposed action on threatened and endangered species. Effects of the Action refers to the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action that would be added to the environmental baseline. Indirect effects are those that are likely to occur later in time (50 CFR 402.02). The effects of the action are considered within the context of the Status of Listed Species and Environmental Baseline sections of this Opinion to determine if the proposed action can be expected to have direct or indirect effects on threatened and endangered species that appreciably reduce their likelihood of surviving and recovering in the wild by reducing their reproduction, numbers, or distribution (50 CFR 402.02), otherwise known as the jeopardy determination.

Approach. NMFS determines the effects of the action using a sequence of steps. The first step identifies potential stressors associated with the proposed action with regard to listed species. NMFS may determine that some potential stressors result in insignificant, discountable, or beneficial effects to listed species, in which case these potential stressors are considered not likely to adversely affect listed species, and subsequently are considered no further in the opinion. Those stressors that are expected to result in significant negative (i.e., adverse) effects to listed species are analyzed via the second, third, and fourth steps described below.

The second step identifies the magnitude of the stressors (e.g., how many individuals of a listed species would be exposed to the stressors; *exposure analysis*). In this step of our analysis, we try to identify the number, age (or life stage), and gender of the individuals that are likely to be exposed to a proposed action's effects, and the populations or subpopulations those individuals represent.

The third step describes how the exposed individuals are likely to respond to the stressors (*response analysis*). In this step, NMFS determines if the stressors are likely to result in any of the components of take as defined under the ESA (e.g., harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect or attempt to engage in any such conduct).

The final step in determining the effects of the action is to establish the risks those responses pose to listed resources (*risk analysis*). The risk analysis is different for listed species and designated critical habitat. However, the action area does not include proposed or designated critical habitat, thus it is not considered in this opinion. Our jeopardy determinations must be based on an action's effects on the continued existence of threatened or endangered species as those "species" have been listed, which can include true biological species, subspecies, or distinct population segments of vertebrate species. Because the continued existence of listed species depends on the fate of the populations that comprise them, the viability (probability of

extinction or probability of persistence) of listed species depends on the viability of their populations. Thus, because green and hawksbill turtles are globally listed, and these species consist of nesting aggregations, this final step first determines the risk posed by the proposed action to affected nesting aggregations, then relates that risk to the listed species.

5.1 Stressors

The following 7 potential stressors may occur due to the proposed action: exposure to elevated noise levels; collision with vessels; direct impact by heavy equipment; disturbance from human activity and equipment operation; loss or degradation of sheltering and forage habitat; exposure to elevated turbidity; and exposure to wastes and discharges. NMFS has reviewed each of the stressors to determine if their effects are expected to be significant (e.g. size of the impact), discountable (how likely it is to occur), or beneficial (positive effect). Those that are insignificant, extremely unlikely to occur, or beneficial will not be discussed further in this opinion.

5.1.1 Elevated Noise Levels

The proposed action is expected to result in about 180 8-hour days (about 30 6-day workweeks) of high-intensity in-water noise due to pile driving. Exposure to this noise may impact turtle hearing and may drive turtles away from sheltering and foraging habitats located at or near the proposed project site. These impacts are considered adverse effects. Because the potential for adverse effects from this stressor is considered greater than discountable, the effects of these impacts will be addressed below in the exposure-response-risk analyses.

5.1.2 Collision with vessels

Sea turtles must surface to breathe, and they are known to rest or bask at the surface. Therefore, when at or near the surface, they are at risk of being struck by vessels or their propellers as the vessels transit to and from the project site. Potential injuries and their severity will depend on the speed of the vessel, the part of the vessel that strikes the animal, and the body part impacted. Injuries from boat strikes may include bruising, broken bones or carapaces, and lacerations. The recovery plan for green sea turtles indicates that boat collision is a major threat around the MHI. Although not identified as a significant risk for either species in the Marianas, the recovery plans for both turtle species suggest that the incidence of collision is expected to increase as vessel size, speed, and traffic density increases, or as animal density increases (NMFS & USFWS 1998a & b).

Existing information about sea turtle sensory biology suggests that sea turtles rely more heavily on visual cues, rather than auditory, to initiate threat avoidance. Research also suggests that sea turtles can not be expected to consistently notice and avoid vessels that are traveling faster than 2 nautical miles per hour (Hazel et al. 2007). Consequently, vessel operators must be responsible to actively watch for and avoid sea turtles, and to adjust their speed based on expected animal density and on lighting and turbidity conditions to allow adequate reaction time to avoid marine animals. Based on the limited number of trips expected, the understanding that vessel operations will be primarily limited to Apra Harbor, and on the expectation that the vessels will operated in accordance with the conservation measures for this action (USN 2011) that require operators to watch for and avoid protected species, and to operate vessels at reduced speeds NMFS considers

that the risk of collisions between action-related vessels and green and hawksbill turtles is discountable, and this stressor will be discussed no further in this opinion.

5.1.3 Direct Impact by Heavy Equipment

Sea turtles could conceivably be struck by pile driving equipment or an anchor if they were below either of those pieces of equipment. Potential injuries and their severity would depend on the animal's proximity to the bottom when struck, the angle of the strike, and the body part impacted. Injuries may include cuts, bruises, broken bones, cracked or crushed carapaces, and amputations, any of which could result in the animal's death. However, the proposed work would be a relatively stationary activity, that is restricted a relatively small area. Sea turtles must be directly beneath the equipment in order to be injured or killed by direct impact. Few sea turtles are expected to be within Sumay Cove under undisturbed conditions, and they are likely to avoid the area due to the high level of in-water noise and human activity. Also, the applicant has committed to watch for turtles, starting 30 minutes prior to commencing work, with work being postponed or halted when turtles are within 46 m (50 yards). Based on the information above, NMFS believes that sea turtles are capable and likely to avoid the area, and we are unaware of any information that contradicts that judgment. As such, we have determined that the likelihood of a sea turtle being adversely injured or killed by direct impact with heavy equipment is discountable, and this stressor will be discussed no further in this opinion.

5.1.4 Disturbance from Human Activity and Equipment Operation

This stressor refers to construction-related disturbances other than exposure to elevated noise levels. Exposure to construction activities may startle sea turtles should they encounter them. Sea turtle density is considered low in the proposed construction area, and turtles typically avoid human activity around Guam where direct take (poaching) continues. Based on this, the most likely effect of this interaction would be an avoidance behavior leading to the animal rapidly leaving the project area without injury. Additionally, the contractor would reduce the likelihood of this interaction by watching for and avoiding sea turtles before commencing work and by postponing or halting operations when protected species are within 46 m (50 yards). Based on the information above, we expect that disturbances from human activity and equipment operation would be infrequent and non-injurious, resulting in insignificant affects on green and hawksbill turtles. As such, this stressor will be discussed no further in this opinion.

5.1.5 Loss or Degradation of Sheltering and Forage Habitat

The proposed 18-inch oversheeting of the existing seawall would permanently remove about 139 m^2 (1,500 ft^2) of benthic habitat in Sumay Cove. The channel floor consists primarily of sand and unconsolidated sediments; the result of dredge-and-fill operations that created the current shorelines. The seawall to be oversheeted is covered by hermatypic and soft corals, turf algae, sponges, and tunicates. About 37% of sea floor within 2 m of the seawall is covered by soft corals (USN 2011); likely growing on substrate provided by debris. Although low numbers of sea turtles may utilize this habitat, higher value habitat is readily available on the shoals and reef areas immediately north and west of the channel entrance. Because the area of lost habitat would be small and is highly impacted, and because high value habitat is readily available nearby, we expect that the loss of sheltering and forage habitat due to this action would have insignificant effects on green and hawksbill turtles, and as such will be discussed no further in this opinion.

5.1.6 Increased Turbidity

Green and hawksbill sea turtles are often found in turbid waters. Since sea turtles breathe air instead of water, exposure to increased turbidity should not adversely affect their respiration or other biological functions. Although it is impossible to predict how individual animals might react to plumes of elevated turbidity, some turtles may avoid dense turbidity plumes in favor of clearer water. The Navy's contractor would be required to install silt curtains around in-water work to minimize the movement of sediments mobilized by that work. Additionally, all backfill would be done behind the newly-installed sheet piles, which should virtually eliminate increase turbidity from that component. Thus, we expect that turbidity plumes would be small (limited to the area immediately adjacent to the work) and virtually undetectable outside of the silt curtains. Based on the expectation that areal avoidance due to pile driving and other activities would be greater than the extent of detectable plumes of elevated turbidity, NMFS considers it unlikely that any sea turtles would approach close enough to the work area to be exposed to project-related elevated turbidity. Based on this information, we expect that exposure to elevated turbidity would have insignificant impacts on sea turtles, and this stressor will be discussed no further in this opinion.

5.1.7 Wastes and Discharges

Construction wastes may include plastic trash and bags that may be ingested and cause digestive blockage or suffocation, or if large enough, along with discarded sections of ropes and lines, may entangle marine life. Equipment spills, discharges, and run-off from the project area could contain hydrocarbon-based chemicals such fuel oils, gasoline, lubricants, hydraulic fluids and other toxicants, which could expose protected species to toxic chemicals. Depending on the chemicals and their concentration, the effects of exposure may range between animals temporarily avoiding an area, to death of the exposed animals. Local and Federal regulations prohibit the intentional discharge of toxic wastes and plastics into the marine environment. Additionally, the Navy has incorporated into their proposed action conservation measures that include measures intended to prevent the introduction of wastes and toxicants into the marine environment (USN 2011). Based on the information above, we expect that construction-related discharges and spills would be infrequent, small, and quickly cleaned if they do occur. Therefore, we have determined that exposure to construction-related wastes and discharges would result in insignificant effects on green and hawksbill turtles, and this stressor will be discussed no further in this opinion.

In summary, 1 of the 7 stressors associated with the proposed action is considered likely to adversely affect green and hawksbill turtles (exposure to elevated noise levels). This stressor is addressed in the exposure-response-risk analyses below. The other 6 stressors (collision with vessels, direct impact by heavy equipment, disturbance from human activity and equipment operation, loss or degradation of sheltering and forage habitat, exposure to increased turbidity, and exposure to wastes and discharges) were determined to be not likely to adversely affect sea turtles and are addressed no further in this opinion.

5.2 Exposure

This section analyzes the proposed action's potential for exposing green and hawksbill sea turtles to adverse levels of sound energy during pile driving operations.

5.2.1 Exposure to Elevated Noise Levels during Pile Driving

This analysis is based on the pile type, the method of driving, the expected substrate, and the duration of work as described in the June 1, 2011, BA (USN 2011) and the expected source levels for similar pile driving actions, based on the California Department of Transportation's (CALTRANS) Compendium of Pile Driving Sound Data (Compendium) (CALTRANS 2007). The exposure analysis is organized as follows:

1: Estimate the in-water source level for the pile type.

2: Estimate the ranges where in-water sound energy would fall to current thresholds for expected effects.

3: Estimate the number of green or hawksbill sea turtles potentially exposed to adverse levels of sound energy.

5.2.1.1 Estimate the in-water source level for each piling type:

As described in Section 2, the project would include about 180 8-hour workdays to impact drive about 1,000 linear feet of 24-inch (61 cm) wide steel sheet pilings, and 55 16.5-inch octagonal concrete pilings.

Acoustics Background. Sound can be measured and quantified in several ways, but the logarithmic decibel (dB) is the most commonly used unit of measure, and sound pressure level (SPL) is a common and convenient term used to describe intensity. In water, sound pressure is typically referenced to a baseline of 1 micropascal (re 1 μPa), vice the 20 μPa baseline used for in-air measurements. Consequently, 26 dB must be added to an in-air measurement to convert to an appropriate in-water value for an identical acoustic source (Bradley and Stern 2008). To assess the potential impact of a sound on marine resources, NMFS often assesses impacts based on the root-mean-square (dB_{rms}) of an acoustic pulse. This is the portion of a pulse that contains 90% of the sound pressure. For brevity, all further references to SPL assume dB_{rms} re 1 μPa, unless specified differently.

Sound Transmission in Water. Transmission loss (attenuation of sound intensity over distance) varies according to several factors in water, such as water depth, bottom type, sea surface condition, salinity, and the amount of suspended solids in the water. Sound energy dissipates through mechanisms such as spreading, scattering, and absorption (Bradley and Stern 2008). Spreading refers to the apparent decrease in sound energy at any given point on the wave front because the sound energy is spread across an increasing area as the wave front radiates outward from the source. In unbounded homogenous water, sound spreads out spherically, loosing as much as 7 dB with each doubling of range. Toward the other end of the spectrum, sound may expand cylindrically when vertically bounded such as by the surface and substrate, losing only about 3 dB with each doubling of range. In addition to spreading, sound energy can be lost through scattering and absorption. Scattering refers to the sound energy that leaves the wave front when it "bounces" off of an irregular surface or particles in the water. Absorption refers to the energy that is lost through conversion to heat due to fiction. Irregular substrates, rough surface waters, and particulates in the water column increase scattering loss, while soft substrates, such as mud and silt increase absorption loss. The relatively shallow nearshore waters of most harbors and marinas, such as Sumay Cove and Apra Harbor with their irregular bottoms and high levels of silt and mud, are considered poor environments for acoustic

propagation because sound typically dissipates more rapidly under those conditions than in open waters.

Accurately predicting received noise levels at a given range (isopleth) requires complex equations and detailed information that is rarely available. Typically, predictions are made by estimating spreading loss based on the equations RL = SL – 20LogR, for spherical spreading, and RL = SL – 10LogR for cylindrical spreading (RL = received level; SL = source level; and R = range in meters (m)). Actual spreading loss is thought to be somewhere between the two, with absorption and scattering increasing the loss. In the absence of site specific transmission loss data, the practical spreading loss equation, RL = SL – 15LogR, is often used to estimate the RL for actions in shallow nearshore marine environments. That formula was used in this analysis to account for the acoustic environment expected within Sumay Cove and Apra Harbor. Outside of Apra Harbor, the sea floor drops away quickly and transmission loss likely approaches that of spherical spreading.

Pile Driving Noise. The in-water SL is the sound energy at 1 m from the source. The SL of impact pile driving is typically high, sometimes in excess of 200 dB (CALTRANS 2007). Frequencies vary according to several factors, including the pile type, the substrate, and the intensity of impact. The SL is also affected by pile type and the substrate (typically, the harder and larger the piling, the louder; the harder the bottom, the louder), as well as the impact energy (the harder the impact, the louder). However, measured sound levels for individual pile driving events may vary over time. Signal analysis of impact-driving sheet piles indicates a relatively broadband signal with most of the energy between 25 and 4,000 Hz, whereas concrete piles have a signature with two components; a low frequency peak at about 200 Hz and high frequency broadband signal between 1,000 and 3,000 Hz (CALTRANS 2007).

Neither the Navy nor NMFS has site-specific noise measurements for pile-driving in Apra Harbor. Consequently, both agencies referred to the CALTRANS Compendium, with the expectation that reported sound levels would closely approximate sound levels for similar piles, driven in a similar manner for this action. Based on the Compendium, impact driving steel sheet piles would be the louder of the two piling types. Back-calculations from measured levels of 189 dB at 10 m and 194 dB at 5 m suggest a SL of 204 dB for sheet piles (Table 2). Back-calculation from a measured level of 173 dB at 10 m suggests a SL of 188 dB for impact driving 16-inch concrete piles, which is the piling described in the compendium that most closely approximates the proposed 16.5-inch concrete piles.

Table 2. Estimated source levels and ranges to effects threshold isopleths for proposed pile driving.

Piling	SL	Range to 180 dB	Range to 160 dB
Steel Sheet	204 dB	40 m	850 m
16-in Concrete	188 dB	3.5 m	74 m

5.2.1.2 Estimate the ranges where in-water sound energy would fall to current threshold for expected effects:

The effects on marine life from exposure to high intensity noises vary with the frequency, intensity, and duration of the sound source, and the hearing characteristics of the exposed animal. Exposure to very high levels of sound can cause soft tissue injuries that could directly result in

fatality. Exposure to lower levels may cause injury in the form of permanent hearing damage, also referred to as permanent threshold shift (PTS). Exposure to even lower levels may cause behavioral effects that include temporary threshold shifts (TTS), temporarily masked communications and/or acoustic environmental cues, and areal avoidance. The cetacean PTS threshold for exposure to in-water sounds is ≥ 180 dB. The same threshold for pinnipeds is ≥ 190 dB. Exposure to impulsive in-water sounds at ≥ 160 dB is the TTS threshold for all marine mammals, whereas the TTS threshold for exposure to non-impulsive sound (continuous noise) is ≥ 120 dB. However, the non-impulsive TTS threshold would not apply because impact pile driving causes impulsive noise.

Green and hawksbill sea turtles are the only ESA-listed marine animals expected to occur within or near Sumay Cove where pile driving noise may reach levels capable of causing adverse effects. As described in Section 3, greens and hawksbills are thought to be low frequency specialists, with hearing ranges that overlap with the expected frequency range of the pile driving signals. Consequently, NMFS expects that green and hawksbills can hear and respond to pile driving noise. Currently, no acoustic thresholds have been established for sea turtles. However, existing research into sea turtle sensory biology suggests that sea turtles are less acoustically sensitive than cetaceans, relying more heavily on visual cues, rather than auditory input (Hazel, *et al*. 2007, Ridgeway *et al*. 1969). The U.S. Navy described recent surveys at Guam where one of its biologists reported green turtles behaving normally on a reef within ~100 m of dredging-related chiseling of a fossilized reef (USN 2011). Although no sound levels were recorded, the biologist reported that he could feel his body physically vibrate due to the concussion of the chisel drop. Despite this, the turtles appeared undisturbed by the activity. This anecdotal evidence supports the idea that sea turtles may be relatively unresponsive to some acoustic stimuli, particularly when compared to marine mammals. Thus, NMFS considers application of the marine mammal thresholds conservative for sea turtles.

Estimating attenuation based on RL = SL - 15logR suggests that the 180 and 160 dB isopleths would occur at ranges of 40 and 850 meters, respectively for the sheet piles, and at 3.5 and 74 meters for the concrete piles (Table 2, and Figure 4). The mouth of Apra Harbor is about 3,700 m from the proposed sheet pile driving, where the estimated received sound level would be about 150 dB.

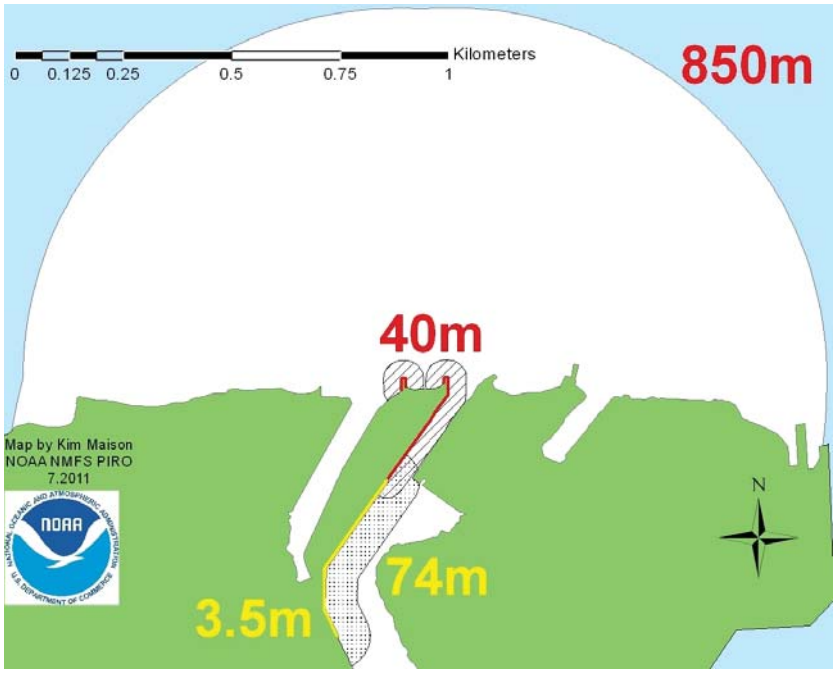

Figure 4. Sumay Cove and Apra Harbor with the 180 dB and 160 dB isopleths indicated (40 m and 850 m for sheet piles; 3.5 m and 74 m for concrete piles).

As mentioned above, transmission loss outside of Apra Harbor is likely to increase because spreading loss is expected increase due the dramatic increase in water depth. Based on the information above, we expect that potentially adverse levels of sound would be restricted to the area within Apra Harbor, and that at most, any ESA-listed animals exposed to pile driving noise outside of the harbor may temporarily experience low levels of masked communications and/or acoustic environmental cues, resulting in insignificant behavioral responses that are likely to range between awareness of the noise to low level areal avoidance.

5.2.1.3. Estimate the number of green or hawksbill sea turtles potentially exposed to adverse levels of sound energy:

Available information suggests that low numbers of green and hawksbill sea turtles reside year-round to rest and forage in nearshore waters around Guam. Sightings confirm ongoing presence of greens in Apra Harbor, including greens periodically observed in Sumay Cove Channel (USN 2011), and low numbers of hawksbills are also expected to occasionally occur in the harbor. However, current data are insufficient to determine precisely the total number or density of either species around Guam or in Apra Harbor. The project BMP require that pile driving be postponed or halted when ESA-listed species are within 46 m (50 yards). As described above, potentially injurious levels of sound, at or above 180 dB, are expected to occur only within 40 m of pile driving, and the Navy has committed to employ acoustic monitoring to verify acoustic propagation and to adjust the shutdown range to ensure that it is protective for turtles. Due to the current inability to quantify the number of turtles likely to be within Apra Harbor, NMFS expects that a low but undeterminable number of turtles within 850 m of the pile driving (range to the 160 dB isopleth) may be exposed to sound levels capable of causing behavioral effects (Figure 4). Based on the expectation that no turtles would be exposed to in-water sound levels approaching the marine mammal threshold for acoustic-related injury, which is considered conservative for sea turtles, NMFS expects that no sea turtles would be exposed to injurious sound levels.

5.3 Response

This section analyzes the responses of green and hawksbill turtles exposed to adverse levels of sound energy during pile driving operations.

5.3.1 Response to Elevated Noise Levels during Pile Driving

The proposed action involves a total of 180 days of daylight work over 30 weeks to impact drive steel sheet piles along 1,000 linear feet of existing seawall. This work is expected to cause potentially adverse levels of in-water sound that may radiate outward to about 850 m. Data regarding the potential response of sea turtles exposed to pile driving noise is are limited, but responses are expected to be context-specific and highly variable. For instance, an exposed turtle in close proximity may become startled by onset of the activity. At greater distances, a reaction that would be best described as awareness is likely. Other reactions to elevated noise could include increased swimming speed, increased surfacing, and movement away from the source. Lenhardt (2002) reported that adult loggerheads initially increase swimming speed and avoided impulsive sounds generated by air guns when received levels ranged from 151 to 175 dB but they eventually habituated to the sound. Moein, *et al.* (1995) reported that upon first exposure, juvenile loggerhead turtles avoided a source that emitted in-water signals at 175, 177, and 179 dB, but the turtles appeared to habituate to the stimuli. However, distances at which the levels

were recorded were not disclosed, and the turtles were enclosed in a net pen. As described above at 5.2.1.2, green turtles were observed near reef chiseling, where the observer reported that his body physically vibrated due to the concussion of the chisel drop. Despite this, the turtles were apparently undisturbed by the activity (USN 2011).

Based on the available evidence NMFS expects that sea turtles in the immediate area near pile driving may initially startle and swim away from the area (behavioral modification) if received levels exceed their tolerance thresholds, which are presently unknown. NMFS is unaware of specific information that would support an estimate of the lateral movement that would be expected for sea turtles under these circumstances. However, NMFS expects that the movement would have no adverse impact on the quantity or quality of available shelter or forage habitat. After initially moving away, some exposed turtles may move back toward the area as they become habituated to the new stimulus, with no measurable impacts expected to occur on those turtles' ability to forage, shelter, and avoid predators or other threats such as vessels.

Based on the information above, NMFS expects that no sea turtles would be injured by exposure to pile driving sounds, and that no behavioral responses are expected to rise to a level that could be considered harassment. Normal behaviors and areal access are expected to return soon after the cessation of pile driving.

5.4 Risk

This section analyzes the risk posed by the proposed action for green and hawksbill turtles exposed to adverse levels of sound energy during pile driving operations.

5.4.1 Risk from Elevated Noise Levels during Pile Driving

Based on the available data used in the exposure and response analyses above, we expect that no green or hawksbill turtles would be injured or killed by this stressor. However, a low but indeterminable number of turtles may be affected through behavioral modification in the form of temporary areal avoidance that would have no measurable impacts on the turtles' ability to forage, shelter, and avoid predators or other threats. As described above in the Status of Listed Species section, resident turtles around Guam likely belong to multiple NAs located elsewhere in Oceania, whereas turtles nesting on Guam likely forage elsewhere, but available genetic information is inadequate to determine which NAs the resident turtles belong to. Although we do not know the exact number of animals that would be affected, we know that the number would be extremely small in comparison to the number of individuals of the affected species found across Oceania, and even larger numbers represented around the world. Given the low number of turtles expected to be affected, that those animals would most likely be from multiple NAs, and the expectation that no injury or reduction in fitness would result due to the proposed action, the risk to the affected nesting aggregations is considered negligible.

5.5 Cumulative Impacts

"Cumulative Impacts" are the additive, synergistic, multiplicative, and/or antagonistic effects that may result from interactions between and among the stressors produced by an action and other pre-existing stressors. As discussed in the environmental baseline section, turtles within Apra Harbor and adjacent marine habitats are routinely exposed to numerous environmental stressors that include shoreline development, poor water quality, frequent close proximity with

human activities in an area where such interactions may result in intentional take, vessel collisions, fisheries interactions, exposure to marine debris, and climate change.

The proposed action is expected to temporarily increase in-water noise levels within Apra Harbor, which would also spread outward somewhat into the Pacific Ocean. Exposure to the proposed action's pile driving noise may result in a short term low-level increase in the stresses experienced by these animals, but that additional stress is expected to be minimal, and to return to background levels shortly (within hours) after the work stops. Based on the best information available, the cumulative impacts of the proposed action are not expected to result in any impacts on ESA-listed marine species not already addressed in the Effects of the Action Section above.

6 Cumulative Effects

"Cumulative effects," as defined in the ESA implementing regulations, are limited to the effects of future State, tribal, local, or private actions that are reasonably certain to occur in the action area considered in this Opinion (50 CFR 402.02). Cumulative effects, as defined in the ESA, do not include the continuation of actions described under the Environmental Baseline, and future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to Section 7 of the ESA.

Sources of cumulative effects (coastal development, fisheries interactions, vessel strikes, direct take, marine debris, and climate change) are described in the Environmental Baseline section, and are not only expected to continue, but are likely intensify over time, causing cumulative effects on green and hawksbill sea turtles. The continued growth of the human population on Guam, as well as across the rest of the Pacific region, would likely result in increased coastal development, fishing pressure, vessel traffic, and pollution of the marine environment. Impacts may include accelerated degradation or loss of forage, resting, and nesting habitats; increased take in fisheries including intentional harvest of turtles and eggs; increased vessel strikes; and increased entanglement in, and ingestion of, marine debris. Although the extent of these increased stressors is unquantifiable, and the corresponding effects are also unquantifiable, it is clear that unless adequately addressed to reduce their impacts, these vectors of cumulative effect will present increasing challenges to the continued survival of green and hawksbill sea turtles.

Global climate change is expected to continue and will therefore continue to impact sea turtles and their habitats. Rising temperatures at nesting beaches may continue to exacerbate a female bias and could also increase embryonic mortality if beaches are already at the high end of thermal tolerance for sea turtle nests (Matsuzawa *et al*. 2002). The turtles that occur in the action area likely originate from several NAs, including those that nest on Tutuila, and others that nest on distant islands and atolls. Many of these NAs may be affected by impacts on their nesting beaches of origin throughout the Pacific. The best available demonstrations of the potential effects of sea level rise indicate that some sea turtle nesting beaches will lose a percentage of their current area by 2100 (Fish *et al.* 2005; Baker *et al.* 2006; Fuentes 2009). However, these were modeled on static systems and did not account for geomorphological dynamics. A quantitative analysis of physical changes in 27 atoll islands in the central Pacific over a 19- to 61-year period, that corresponds with a rate of sea level rise of 2.0 mm per year, shows that 86% of islands remained stable (43%) or increased in area (43%) while only 14% of study islands

exhibited a net reduction in island area (Webb & Kench 2010), evidence that changes will not be uniform or predictable and sea level rise may or may not result in beach loss.

Alterations to foraging habitats and prey resources, changes in phenology and reproductive capacity that correlate with fluctuations in SST, and potential changes in migratory pathways and range expansion (all discussed previously in Environmental Baseline) are additional ways in which sea turtles may continue to be impacted by climate change. Many marine species, including the pelagic life stages of sea turtles in the action area, forage in areas of nutrient rich oceanic upwelling, the strength, location, and predictability of which may change with increasing global temperatures (Harwood 2001).

Although there is much speculation on the potential impacts of climate change on species and ecosystems, there are multiple layers of uncertainty associated with these analyses making it impossible to accurately predict the most likely scenario that will result and consequently what impacts species and ecosystems will face, particularly in Pacific Island countries (Barnett 2001). Effects of climate change will not be globally uniform (Walther *et al.* 2002) and information regarding the magnitude of future climate change is speculative and fraught with uncertainties (Nicholls and Mimura 1988). In particular, there is no comprehensive assessment of the potential impacts of climate change within the action area or specific to sea turtles that may be within the action area.

In addition to the uncertainty of the rate, magnitude, and distribution of future climate change and its associated impacts on temporal and spatial scales, the adaptability of species and ecosystems are also unknown. Impact assessment models that include adaptation often base assumptions (about when, how, and to what conditions adaptations might occur) on theoretical principles, inference from observed observations, and arbitrary selection, speculation, or hypothesis (see review in Smit *et al.* 2000). Impacts of climate change and hence its 'seriousness' can be modified by adaptations of various kinds (Tol *et al.* 1998). Ecological systems evolve in an ongoing fashion in response to stimuli of all kinds, including climatic stimuli (Smit *et al.* 2000). Sea turtles may exhibit a variety of adaptations to cope with climate change impacts although it will likely take decades to centuries for these shifts to occur (Limpus 2006) making it increasingly difficult to predict future impacts of climate change on sea turtles in the action area. For example, sea turtles are known to be highly mobile and in the past have shown the ability to adapt to changes in their environment and relocate to more suitable foraging and nesting sites over the course of multiple generations. Implications of climate change at the population level is a key area of uncertainty and one of active research (e.g. Jonzén *et al.* 2007) and currently cannot be reliably quantified in terms of actual mortalities resulting from climate change impacts over any time scale. Nor can they be qualitatively described or predicted in such a way that could be more meaningfully evaluated in the context of this biological opinion. Within the temporal scale of the proposed action, any future synergistic impacts of climate change in the action area that might interact with the effects of the proposed action are not considered significant.

7 Integration and Synthesis of Effects

The purpose of this Opinion is to determine if the proposed action is likely to jeopardize the continued existence of listed species (50 CFR 402.02). "Jeopardize the continued existence of"

means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species. This opinion considers the Effects of the Action within the context of the Status of Listed Species and Environmental Baseline, as described in the Approach section (beginning of Section 5 Effects of the Action).

We determine if reduction in fitness to individuals of listed species resulting from the proposed action are sufficient to reduce the viability of the populations those individuals represent (measured using changes in the populations' abundance, reproduction, spatial structure and connectivity, growth rates, or variance in these measures to make inferences about the population's extinction risks). In order to make that determination, we use the population's base condition (established in the Status of Listed Species and Environmental Baseline sections of this opinion), considered together with Cumulative Effects, as the context for the overall effects of the action on the affected populations. Finally, our Opinion determines if changes in population viability are likely to be sufficient to reduce the viability of the species those populations comprise or impair long term recovery of those species, consistent with recovery objectives, as set forth in the species' recovery plan and other sources. The following discussion summarizes the probable risks the proposed action poses to green and hawksbill sea turtles.

7.1 Green Sea Turtles

As described in the Effects of the Action section, we expect that a low but indeterminable number of green turtles could experience behavioral modification in the form of temporary areal avoidance due to exposure to elevated noise levels during pile driving. However, no fatality, injury, harassment, or reduction in fitness is expected to result from this exposure.

As discussed in the Status of Listed Species, about 18,000 to 38,000 green turtles nest annually in Oceania (adult females only). Although a low number of green turtles reside in the nearshore waters around Tutuila (sub-adults and adults of both sexes), that number is currently unknown, and no population trend data are available. As summarized in Figure 2, many of the major green sea turtle nesting aggregations in Oceania are stable or increasing, while many of the smaller nesting aggregations are declining. As discussed more fully in the Environmental Baseline and Cumulative Effects sections, the effects of coastal development, fisheries interactions, vessel strikes, direct take, marine debris, and climate change within the action area are expected to continue, and likely worsen, in the future. However, the impact and time scale of these effects on the trajectory of the affected green turtle populations is currently uncertain, and those impacts are expected to occur on a time scale, against which the impacts of the proposed action would be indistinguishable.

Because the proposed action is anticipated to result in no fatality, injury, harassment, or reduction in fitness of green turtles around Guam, the impacts of the proposed action are not expected to reduce the reproduction or abundance of green turtles there, or to impede the recovery of that species around the island. As described in the Status of Listed Species, the turtles found in Guam's waters represent a very small proportion of green turtles across Oceania. They originate from multiple NAs, and the largest NAs in Oceania are increasing. Given that the proposed action is expected to result in no injury or reduction in fitness or reproduction of green turtles at the level of the individual, we expect that the impacts of the proposed action would not

reduce the reproduction, abundance, or distribution, or recovery of the affected green sea turtle NAs. As such, the proposed action is not expected to negatively affect the survival or recovery of green sea turtles in Oceania. Therefore, when taken in context with the status of the species, the environmental baseline, cumulative impacts and effects, the proposed action is not likely to appreciably reduce the likelihood of survival and recovery of this species, as listed under the ESA.

7.2 Hawksbill Sea Turtles

As described in the Effects of the Action section, we expect that a low but indeterminable number of hawksbill turtles could experience behavioral modification in the form of temporary areal avoidance due to exposure to elevated noise levels during pile driving. However, no fatality, injury, harassment, or reduction in fitness is expected to result from this exposure.

As discussed in the Status of Listed Species, about 5,400 to 6,100 hawksbill turtles nest annually in Oceania (adult females only). Although a low number of hawksbill turtles reside in the nearshore waters around Tutuila (sub-adults and adults of both sexes), that number is currently unknown, and no population trend data are available. As discussed in the Status of Listed Species, hawksbill sea turtle nesting aggregations in Oceania are generally decreasing. As discussed more fully in the Environmental Baseline and Cumulative Effects sections, the effects of coastal development, fisheries interactions, vessel strikes, direct take, marine debris, and climate change within the action area are expected to continue, and likely worsen in the future. However, the impact and time scale of these effects on the trajectory of the affected hawksbill turtle populations is currently uncertain, and those impacts are expected to occur on a time scale, against which the impacts of the proposed action would be indistinguishable.

Because the proposed action is anticipated to result in no fatality, injury, harassment, or reduction in fitness of hawksbill turtles around Guam, the impacts of the proposed action are not expected to reduce the reproduction or abundance of hawksbill turtles there, or to impede the recovery of that species around the island. As described in the status of the Status of Listed Species, the hawksbill turtles found in Guam's waters represent a very small proportion of hawksbill turtles across Oceania. They originate from multiple NAs, the number and locations of which are currently unknown, but the population trends at those NAs could be decreasing. Given that the proposed action is expected to result in no injury or reduction in fitness or reproduction of hawksbill turtles at the level of the individual, we expect that the impacts of the proposed action would not reduce the reproduction, abundance, or distribution, or recovery of the affected hawksbill turtle NAs. As such, the proposed action is not expected to negatively affect the survival or recovery of hawksbill turtles in Oceania. Therefore, when taken in context with the status of the species, the environmental baseline, cumulative impacts and effects, the proposed action is not likely to appreciably reduce the likelihood of survival and recovery of this species, as listed under the ESA.

8 Conclusion

After reviewing the current status of ESA-listed green and hawksbill sea turtles, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is NMFS' Opinion that the Navy's proposed Sumay Cove Repair and Modernization in Apra Harbor, Guam is not likely to jeopardize the continued existence of green sea turtles or hawksbill sea turtles.

As described above in Section 3, no critical habitat has been designated or proposed for designation for any ESA-listed marine species in the action area or elsewhere in the Mariana Archipelago. Therefore, the proposed action would have no effect on designated or proposed critical habitat under NMFS jurisdiction.

9 Incidental Take Statement

Section 9 of the ESA and protective regulations pursuant to Section 4(d) of the ESA prohibit the take of endangered and threatened species without a special exemption. "Take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, collect, or attempt to engage in any such conduct. "Incidental take" is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of Section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with the reasonable and prudent measures and terms and conditions of the Incidental Take Statement (ITS).

Based on the best information available, implementation of the proposed action is expected to adversely affect an indeterminable number of green and hawksbill sea turtles over a period of 30 weeks, through some level of areal avoidance. Although NMFS has determined that these impacts constitute adverse effects for green and hawksbill sea turtles, we have also determined that the expected effects would not rise to the level of take because the turtles' expected response to the stressors are expected to cause no measurable harm to or harassment of those animals. Because no take is expected, no ITS is necessary, nor can an ITS be issued for this action.

10 Conservation Recommendations

Section 7(a)(1) of the ESA directs Federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or develop information.

The following conservation recommendations are provided pursuant to Section 7(a)(1) of the ESA:

1. The Navy is strongly encouraged to use acoustic attenuation devices, such as bubble curtains, to reduce the acoustic impacts of pile driving on ESA-listed species in their marine habitats.
2. The Navy is strongly encouraged to perform comprehensive debris and trash removal at the project site and nearby areas, beyond that of construction-related materials to improve turtle habitats (i.e. Spanish Steps Beach).
3. The Navy is strongly encouraged to use outreach, such as signage and educational programs, to improve the awareness of military personnel on Guam of the status of sea turtles, including their vulnerability vessel collision and habitat loss, and measures that can be taken to reduce impacts.

11 Reinitiation Notice

This concludes formal consultation on the U.S. Navy' proposed Sumay Cove Repair and Modernization, Naval Base Guam. As provided in 50 CFR 402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained or is authorized by law, and if:

1. The amount or extent of anticipated incidental take is exceeded;
2. New information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this Opinion;
3. The agency action is subsequently modified in a manner that may affect listed species or critical habitat to an extent, or in a manner not considered in this Opinion; or
4. A new species is listed or critical habitat designated that may be affected by the action.

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United States Department of the Interior

FISH AND WILDLIFE SERVICE
Pacific Islands Fish and Wildlife Office
300 Ala Moana Boulevard, Room 3-122
Honolulu, Hawaii 96850

In Reply Refer To:
01EPIF00-2018-F-0103

Mr. John F. Salas, Professional Engineer
Department of the Navy
Naval Facilities Engineering Command, Marianas
PSC 455, Box 195
FPO AP 96540-2937

Subject: Biological Opinion for Brown Tree Snake Control in the Habitat Management Unit, Andersen Air Force Base, Guam

Dear Mr. Salas:

This letter transmits the U.S. Fish and Wildlife Service's (Service) Biological Opinion on the Department of the Navy's (DON) proposed brown tree snake (*Boiga irregularis*) (brown treesnake, BTS) control in the Habitat Management Unit (HMU), Andersen Air Force Base, Guam on the threatened Mariana fruit bat (Fanihi, *Pteropus mariannus mariannus*). Formal consultation on the proposed action was conducted in accordance with section 7 of the Endangered Species Act of 1973 [16 U.S.C. 1531-1544 *et seq*.], as amended (Act). Your request for formal consultation and Biological Assessment were received on December 15, 2017.

Your December 15, 2017, letter and Biological Assessment included a request for Service concurrence with the DON's determination the proposed action may affect but is not likely to adversely affect four threatened plant species (Fadang (*Cycas micronesica*), *Tabernaemontana rotensis*, Cebello halumtano (Siboyas halumtano, *Bulbophyllum guamense*), and *Tuberolabium guamense*)) and three endangered tree snails (Fragile tree snail (*Samoana fragilis*), Guam tree snail (*Partula radiolata*), and Humped tree snail (*Partula gibba*) (tree snails). Our concurrence with the DON's not likely to adversely affect determinations for the four threatened plant species and three endangered tree snail species in addition to the rationale for these concurrences is located in **Appendix A**.

The enclosed Biological Opinion is based on information provided in the December 2017, Biological Assessment and information provided by DON Natural Resource staff, and telephone conversations, field investigations, and other sources of information cited in this Biological Opinion. A complete record of this consultation is on file at the Pacific Islands Fish and Wildlife Office.

CONSULTATION HISTORY

The following is a summary of important events associated with this consultation:

September 1, 2017: Department of the Navy (DON) personnel (Jim Watkins, M. J. Mazurek, and Paula Hartzell) met with the USFWS biologists (Catherine Brunson and Toni Mizerek) in Hagatna, Guam to discuss the Proposed Action, Action Area, actions that may affect listed species, best management practices, and the timeline for formal consultation.

September 25, 28, and 02, October 2017: Emails were exchanged among the USFWS and DON, on the potential for listed tree snails to be present in the Proposed Action Area and conservation measures to avoid tree snails, if present.

December 15, 2017: The Service received your letter requesting initiation of formal section 7 consultation pursuant to the Act and the project's December 2017 Biological Assessment. The Biological Assessment indicated the proposed action was likely to adversely affect all Mariana fruit bats within and immediately adjacent to the HMU in the form of: (1) harassment as a result of low-level helicopter flights used to apply BTS baits, (2) harassment in the from biological ground-monitoring activities, or (3) death or injury associated with potential helicopter strike. The Biological Assessment concluded the proposed action was not likely to adversely affect the Guam tree snail, the humped tree snail, the fragile tree snail, *Cycas micronesica*, *Bulbophyllum guamense*, *Tabernaemontana rotensis*, or *Tuberolabium guamense*.

December 29, 2017: Department of the Navy Natural Resource Specialist M.J. Mazurek confirmed via telephone the Department of Defense's plans to control rodents in the project site to ensure the suppression of brown treesnake population does not result in increased predation of listed tree snails and plants should an increase in rodent population occur as a result of suppression of the BTS or as part of implementation of the Andersen Air Force Base, Habitat Management Unit Restoration Plan (Siers and Savidge 2017).

January 10, 2018: The Service confirmed formal consultation was initiated on December 15, 2017.

January 19 – February 14, 2018: Service biologists Dawn Bruns and Toni Mizerek and DON Natural Resource Specialist M.J. Mazurek coordinated with endangered plant and tree snail specialists to refine the following project conservation measures: general biosecurity measures, endangered plant offset distances, and refined bait drop timing measures to minimize the potential for tree snails to be dislodged from trees by bait drop operations.

February 21, 2018: Service biologist Dawn Bruns provided DON Natural Resource Specialist M.J. Mazurek with a draft assessment of the potential for bait drops to dislodge tree snails and for tree snails on the ground to be inadvertently crushed by personnel implementing the proposed BTS and rodent control actions.

March 13, April 5, and April 11, 2018: Department of the Navy Natural Resource Specialist, M.J. Mazurek, and Senior Natural Resources Specialist, Coralie Cobb, and the USFWS

biologists, Dawn Bruns and Toni Mizerek, discussed modifications to the project duration to minimize the potential for adverse effects to tree snails.

April 11, 2018: Department of the Navy Natural Resource Specialist, M.J. Mazurek, and Senior Natural Resources Specialist, Coralie Cobb, agreed to reduce the amount of field staff off-trail walking from the 536 "events" (an "event" is two people traversing 26 trackless transects approximately 656.2 ft in length) which would entail and estimated 1,575 miles of off-trail walking proposed in the Biological Assessment, to 406 "events" (approximately 1,195 miles of off-trail walking) to minimize the potential for field staff to trample a tree snail were integrated into the project.

April 19, 2018: Department of the Navy Natural Resource Specialist, M.J. Mazurek, and Senior Natural Resources Specialist, Coralie Cobb, confirmed by phone the proposed action would be put on hold during any period when a rodent control response was not available.

April 23, 2018: Department of the Navy Natural Resource Specialist, M.J. Mazurek transmitted the text of the project description of this Biological Opinion to the Service.

April 29, 2018: Department of the Navy Natural Resource Specialist, M.J. Mazurek confirmed the Service's request for an extension to the completion date of the Biological Opinion to May 22, 2018 to accommodate the interagency effort that had been undertaken to compile new information about tree snail abundance and distribution to inform the analysis of project effects.

May 5, 2018: The Service provided the Department of the Navy with a Draft Biological Opinion.

May 10, 2018: The Department of the Navy transmitted the Draft Biological Opinion back to the Service.

BIOLOGICAL OPINION

Proposed Action

The BTS is a non-native invasive species that has caused the steep decline of native vertebrates on Guam. Development and implementation of landscape-scale suppression methods is necessary for recovery of listed Guam vertebrates and to minimize the likelihood the snake will be inadvertently moved from Guam to other locations. The proposed action is a high priority of the interagency Brown Treesnake Technical Working Group, the Service, the Department of Defense, and partner agencies, because it further develops landscape-scale BTS suppression methods and it further reduces snake numbers to enable the HMU to provide habitat for the Mariana fruit bat, Mariana crow (*Corvus kubaryi*), and Guam Micronesian kingfisher (*Todiramphus* [=*Halcyon*] *cinnamominus cinnamominus*), Guam rail (*Gallirallus owstoni*), and other federally-listed species. Information obtained during project implementation will guide design of long-term landscape-scale BTS and rodent detection, monitoring, and control rodent control actions within the HMU and elsewhere on Guam.

The Proposed Action entails the aerial application of acetaminophen for BTS suppression in the HMU, Andersen Air Force Base (AAFB), Guam and associated ground-based field work. The HMU is a 135 ac interagency test site established for biological resource studies, including pilot control and monitoring programs for invasive species and forest restoration. BTS bait containing acetaminophen will be delivered over the HMU via the helicopter-mounted automated aerial delivery system. Ground-based BTS and rodent monitoring will occur up to two months prior to the aerial bait application operations. In addition, ground crews will monitor and implement ground-based BTS and rodent monitoring during aerial bait applications and for approximately one year following aerial BTS baiting operations. Loaded bait cartridges weigh approximately 0.5 oz and they will be dropped during daylight periods, between 0900 and 1800 hours. The automated bait dispensing module delivers baits at a rate of up to four per second. The allowable labeled rate is 50 baits/ac per application, with a minimum interval of three days between drops, no more than 150 baits per acre within a four-month period, and no more than 450 baits per acre within a single year (USEPA Registration # 56228-34, EPA Est. No. 56228-CO-01, "Acetaminophen for brown treesnake control"). BTS and rodent ground-based monitoring would occur during various daylight hours and BTS visual surveys would be conducted between 1800 (6:00 PM) and midnight.

Aerial bait applications will be conducted using a rotary-winged aircraft similar to a Hughes MD 500, or similar, helicopter. Calibration bait drops will be conducted to calibrate bait deployment procedures and equipment along the road bounding the northeast edge of the HMU (shown in yellow on Figure 4). The calibration bait equipment is identical to that used in the HMU. The calibration baits will not be recovered. Bait will consist of an acetaminophen tablet attached to a dead neonatal mouse. Bait cartridges (Figure 1) are automatically dispensed at the prescribed application rate using the automated delivery system dispensing system module. Helicopter flights dispensing bait would be made flying along georeferenced transects loaded in the onboard helicopter navigation system. Flights would occur at approximately 82 to 328 ft above the forest canopy in the HMU at an average flight speed of 50 to 70 knots. Flight transects are separated by 29.5 ft. A single application of bait to the entirety of the HMU at the above described application rate would take approximately two hours of helicopter flight time to complete.

Bait cartridges consist of a dead neonatal mouse (DNM) weighing 0.17 to 0.25 oz, with a 0.0028 oz acetaminophen tablet glued to the exterior surface of the DNM. The DNM/acetaminophen tablet is glued to the interior surface of a pulp paper 'clamshell' which closes over the mouse. A biodegradable ribbon is wrapped around and glued to the clamshell and a pulp paper endcap. The bait/clamshell/ ribbon/endcap assemblage is inserted into the cardboard tube for a completed bait cartridge (see Figure 1). A complete bait cartridge weight is approximately 0.55 ounces. The bait cartridge is ejected from the dispensing system module (DSM) such that it spins; the inertia of the bait cartridge assembly causes the clamshell to slide out of the spinning tube, deploying the ribbon as the bait assembly falls through the air. The ribbon then becomes entangled in the forest canopy, thus causing the assembly to be suspended above the ground (see Figure 1). All components of the cartridge assembly are biodegradable. The ribbon and bait cartridges should degrade within a day during heavy rains but could persist for a week or more during dry seasons. The bait generally degrades within 3 to 4 days of application.



Figure 1. Depiction of the deployed bait cartridge entangled in vegetation (photo credit: M.J. Mazurek).

Monitoring

Aerial bait application efficacy will be evaluated on the day of and/or first day following aerial bait applications. Two observers will traverse the HMU on 20 trackless transects (see below), approximately 1,575 ft in length and record the number of opened and unopened cartridges and height above ground relative to the canopy. The Proposed Action includes pre- and post-drop ground-based monitoring of BTS and their prey using a variety of established survey methods. Ground-based monitoring would occur up to two months prior to the first bait application and for up to one year following each bait drop. BTS would be monitored using visual surveys, bait tube monitoring, and radio-telemetry of snakes. Non-target species would be monitored using several non-invasive methods.

Two types of survey approaches would be utilized for ground-based surveys within the HMU, including fixed maintained transects and randomly placed trackless transects. The fixed transect survey method would require maintaining passable marked monitoring transects with limited pruning of vegetation using non-powered hand tools. Maintained transects will be no greater than 3.3 ft in width. Transect lengths would vary dependent on survey method.

Trackless surveys begin at a randomly chosen location and proceed for a pre-determined distance (depending on survey method) along a randomly-chosen compass bearing. Trackless surveys do not require the creation and maintenance of pruned and marked transects. Trackless transects

reduce permanent damage to vegetation at discrete locations since survey routes are not maintained. Field personnel engaged in monitoring activities on trackless transects would be instructed to move carefully and purposefully through the vegetation, avoiding contact with listed plant species and maintaining an awareness for listed tree snails and butterfly host plants.

BTS bait tube monitoring would occur along trackless transects with randomly located starting points. Ten bait tubes (Figure 2) would be placed every 65.6 ft for a total of 656 ft along a random compass bearing. Four to ten temporary transects would be set and baited weekly; two days later they would be checked and the baits removed.

Visual surveys for BTS are conducted by pairs of trained observers walking at a consistent rate, and visually scanning vegetation for snakes using high-powered headlamps. Surveys are conducted after sunset and last typically four to five hours. Once snakes are located they are hand-captured, morphometric data is collected, and snakes are marked and released at the location of capture. Visual surveys would be conducted using both trackless and maintained transects survey methodology:

- 26 fixed maintained transects at approximately 262.5 ft spacing, dependent upon avoidance of listed species if present, each 656.2 ft in length. Maintained transects would be no greater than 3.3 ft in width.
- 26 trackless transects at 262.5 ft intervals and 656.2 ft in length; placement dependent on location of maintained transects. Observers would walk parallel and not in single file formation.

Traps and visual surveys would be used to capture 50 to 60 BTS within the HMU to be radio-marked. Traps would ideally be placed along maintained transects and the forest edges. If maintained transects are unavailable then traps would be placed along trackless transects and marked with flagging tape. Traps would not be affixed to listed species and all material and flagging would be removed after trapping surveys are completed. Radio-transmitters would be externally attached to the snakes. Those snakes would be returned to the site prior to the application of the bait.

Telemetry monitoring consists of survey personnel traversing the HMU to locate telemetered-snakes. Telemetered snakes would be monitored every other day, for 4 to 6 weeks prior to the first aerial bait application. Following bait applications, snakes would be monitored daily for two weeks to determine the proportion of known snakes that were effectively targeted by the treatment. Dead telemetered snakes would be necropsied and those that survive would be followed to determine movement activity and microhabitat selection. Surviving snakes would be located every other day for an additional 4 to 6 weeks to evaluate behavioral changes following BTS population suppression. At the close of the study, any remaining telemetered snakes would be removed and euthanized.



Figure 2. Brown tree snake PVC bait tubes with cameras mounted to view the bait tubes (Photo credit: USDA NWRC).

Rodents would be monitored to assess changes in abundance from snake suppression. Rodent abundance would be monitored using a combination of mark-recapture trapping, track tunnels, and chew tags. Track tunnels and chew tag methods have been widely used to assess island rodent eradication efforts and eradication efforts within predator-fenced areas (Sweetapple and Nugent 2011; Reardon et al. 2012; Young et al. 2013). Eleven trackless transects would form a trapping grid of 121 traps. Traps and track tunnels would be placed on the ground and chew tags would be suspended in vegetation. Ground disturbance associated with rodent monitoring methods would include only placement of live-traps, which would be removed immediately upon the close of the sampling event. Rodent stations would occur on a monitoring grid of 11 trackless transects, at 41 ft intervals of 451.1 ft in length. Four replicated grids would be placed within the HMU for rodent monitoring.

Conservation Measures

The proposed action has the potential to directly and indirectly result in adverse effects to listed plants and animals. To minimize these potential effects, the conservation measures outlined in the Biological Assessment, in addition to conservation measures drafted during the formal consultation coordination, are incorporated into the project design.

Conservation measures in the Biological Assessment: The conservation measures in Table 1 will be implemented to minimize adverse effects to non-target species.

Locations of federally-listed plant species within the HMU have been determined based on systematic surveys conducted in 2015 (GPEPP 2015). Listed plant locations were recorded and input into a geographic information systems (GIS) data base. BTS monitoring teams would use GPS units with listed plant species location data to avoid locations occupied by listed plants.

While there are currently no known records of listed snails in the Action Area, survey data are incomplete and potential exists that the habitat may be suitable for some of these species. The risk minimization measures specified below would lessen impacts to these species if they do exist undiscovered in the Action Area (USDA NWRC 2017).

Table 1. Conservation measures included in the Biological Assessment.

Conservation Measures	Description	Impacts Reduced/Avoided
Mariana Fruit Bat Surveys on Bait Application Days	Fruit bat surveys would be conducted at dawn around the HMU perimeter on the morning of helicopter bait applications. Methods would follow established survey methods for fruit bats (DON 2016).	Establish fruit bat presence in the HMU on the intended date of bait application to inform helicopter crew of potential strike risk to fruit bats.
Helicopter Bait Application Schedule Restrictions*	Helicopter bait applications would occur after 0900 hours.	Fruit bats activity has been observed to decrease after 0900 (Wheeler 1979).
Bio-monitors for Mariana Fruit Bat Bait Application Behavioral Response Documentation*	Fruit bat monitors would be present at the HMU perimeter during helicopter bait applications and document any disturbance and behavioral response of fruit bats (if present) resulting from the bait application.	Information would be compiled to inform future similar actions that may occur in bat occupied sites and document if any incidental take occurs.
Mariana Fruit Bat Ground Monitoring Documentation	If fruit bats are observed within the HMU by biological monitoring teams, the location and number of individuals would be recorded and reported to the DON within 24 hours. Survey personnel would record bat behavior on standardized data forms.	Information would be compiled to inform future similar actions that may occur in bat occupied sites and documented in annual reports to the Service in accordance with an incidental take statement.
Maintained Transects Bio-monitor	Qualified biologist/Bio-monitor* would inspect vegetation that would be pruned in the creation of maintained transects to confirm the plant is not a federally-listed species. Plant matter to be clipped would be inspected for listed tree snail presence and there would be a prohibition against trimming or damaging plants or tree limbs occupied by listed tree snails. Transects would be modified to avoid occupied plants and tree limbs, and field staff would avoid disturbing snails while working along transects in tree snail occupied areas.	Avoid impacts to listed species.
Listed Plant Species Avoidance Protocol	All listed plant species that are ground accessible would be flagged adjacent to the individual with a unique color to denote status as protected. GPS locations would be loaded into biological monitoring team GPS units for additional awareness. No traps, bait tubes, or other monitoring devices would be placed on listed plant species.	Avoid impacts to listed plant species.

*Qualified biologist/Bio-monitor would have experience in the identification of and survey methods for federally listed species.

For maintained transects, the following protocols and conservation measures outlined in the BA would be implemented:

- A qualified biologist/biomonitor would inspect vegetation that would be pruned in the creation of maintained transects to confirm the plant is not a federally-listed species and to confirm the vegetation is not occupied by a listed tree snail. Vegetation needing to be modified by pruning would be flagged. Listed species would not be flagged.
    - If listed species is detected, the transect location would be altered to avoid contact with the individual.
    - Plant matter to be clipped would be inspected for listed tree snail presence and there would be a prohibition against trimming or damaging plants or tree limbs occupied by listed tree snails.
    - Transects would be modified to avoid occupied plants and tree limbs, and field staff would avoid disturbing snails while working along transects in tree snail occupied areas.
- No whole plants would be removed.
- Pruning of vegetation would be minimized to the extent practicable. All green material would remain on site.
- Known listed plants and butterfly host plants in the treatment area would be identified with flagging attached to adjacent non-listed plants to aid field personnel in identification and notification of avoidance.
- Only common plants of known identity and non-protected status would be trimmed.
- No survey gear would be affixed or come into contact with any listed species.
- No use of power tools for pruning vegetation.

Best Management Practices (BMPs) are policies and measures that would be implemented to minimize environmental impacts from the proposed action (Table 2). Best Management Practices are those that may not be unique to this proposed action but also implemented into other project descriptions.

Table 2. Best Management Practices from Biological Assessment.

Best Management Practice	Description
Biologist Federally-listed Species Identification Training Program	All biological monitoring personnel would be required to attend a federally-listed species training program conducted by a qualified professional biologist(s)*. Training would include classroom and field identification training and personnel would be provided species identification cards for use in the field during survey efforts. Standardized recording methods and data forms would be required for use by survey teams if newly listed species are discovered as a result of BTS monitoring efforts.
Notification of Federally- listed Tree Snail Presence	If federally-listed tree snails are discovered by teams conducting scientific biological field studies, the DON would be notified within 24 hours of discovery. Delineation of the distribution of the tree snails would be conducted by qualified biologists and those areas would be avoided.

*Qualified biologist/Bio-monitor would have experience in the identification of and surveys for federally listed species.

Refinements to Conservation Measures Developed After Initiation of Formal Consultation:

General Biosecurity Measures: Standard biosecurity measures will be implemented to minimize the potential for the introduction or movement of non-native invasive weeds and invertebrates. Boots, clothing, field gear (packs, rain gear, etc.), equipment, and materials will be inspected for seeds, eggs, larvae, etc., prior to delivery and/or entry into the project area, and these items will be cleaned prior to entering the HMU. Helicopter landing zones will be monitored for weed species, invasive ants, and other invasive invertebrates that may be dispersed into the HMU on the helicopter landing gear. Helicopter landing sites will be kept free of those weed and invertebrate species that are not already established within the HMU.

Buffer Distances: To minimize the likelihood of trampling or dislodging a tree snail, project staff will not walk within 33 ft of a marked tree snail area (if identified) and no vegetation will be cut or removed within 200 ft of the occupied area.

To minimize potential damage to listed plants when activities may result in soil compaction or vegetation disturbance, the buffer distances in Table 3 will be implemented. In addition, native trees will not be removed during project implementation.

Table 3. Plant buffer distances.

Type of Action: Nature and Extent of Soil or Vegetation Disturbance	**Listed Plants: Buffer Distance: Project Activity Will Not Be Conducted Closer Than Distance Note**		
	Listed Epiphyte	**Listed Herb/Shrub**	**Listed Tree**
Weeding/removing non-native understory vegetation by hand or using non-mechanized hand tools.	0 feet	3 feet	3 feet
Removal of less than 10-foot width and less than five acres (project total) of native understory vegetation with hand tools (weeding, chainsaw, weed eater). No project-related mortality of over story native vegetation. Trails through understory vegetation. Less than three feet width of bare mineral soil.	0 feet	20 feet	2x diameter of the crown of the listed tree

Field Work Following Typhoon: Because tree snails are likely to be dislodged from the vegetation during a typhoon, ground crews will not work within the HMU during a seven day period following a typhoon category 3 or higher recorded on AAFB.

Rodent Control: The Proposed Action does not control for rodents and is designed to study rodent population response to BTS suppression. Continuation of the BTS project will be reliant on rodent control implementation: during any period when the rodent control action becomes unavailable, the proposed BTS control action will be halted.

Action Area

The Action Area is defined as all areas to be affected directly or indirectly by the federal action and not merely the immediate area involved in the action (50 CFR 402.02). In delineating the Action Area, we evaluated the farthest reaching physical, chemical, and biotic effects of the action on the environment. Aerial application of the BTS toxicant will occur on the 135 ac HMU in northern Guam (Figures 1 and 2). The Action Area consists of the proposed treatment area within the HMU, the areas affected by noise and disturbance from helicopter flights between the landing zones and helicopter ground support operations areas (locations to be determined). The landing zone and ground support operations areas may be on AAFB (at the interior of the Detachment-2 gate; off of Route 3A or off Route 1 at Andersen South, in Dededo) or elsewhere in cleared areas in north Guam. The Action Area for this proposed federal action is based on the geographic extent of helicopter noise at the HMU project site and in north Guam areas that may be traversed by project helicopters. Project-related aircraft will transit among north Guam airfields, staging areas, and bait drop sites. Areas used by project helicopters will land at a landing zone in a ground support operations area to the interior of the DET 2 gate (Detachment-2 gate; off of Route 3A) or off Route 1 at Andersen South (AltLZ), AAFB in Dededo.

There is designated critical habitat in the northern portion of Guam at the Ritidian Unit of the Guam National Wildlife Refuge (GNWR), but it is not within the Action Area of this Biological Opinion, as the area would not be directly or indirectly affected by the proposed action.

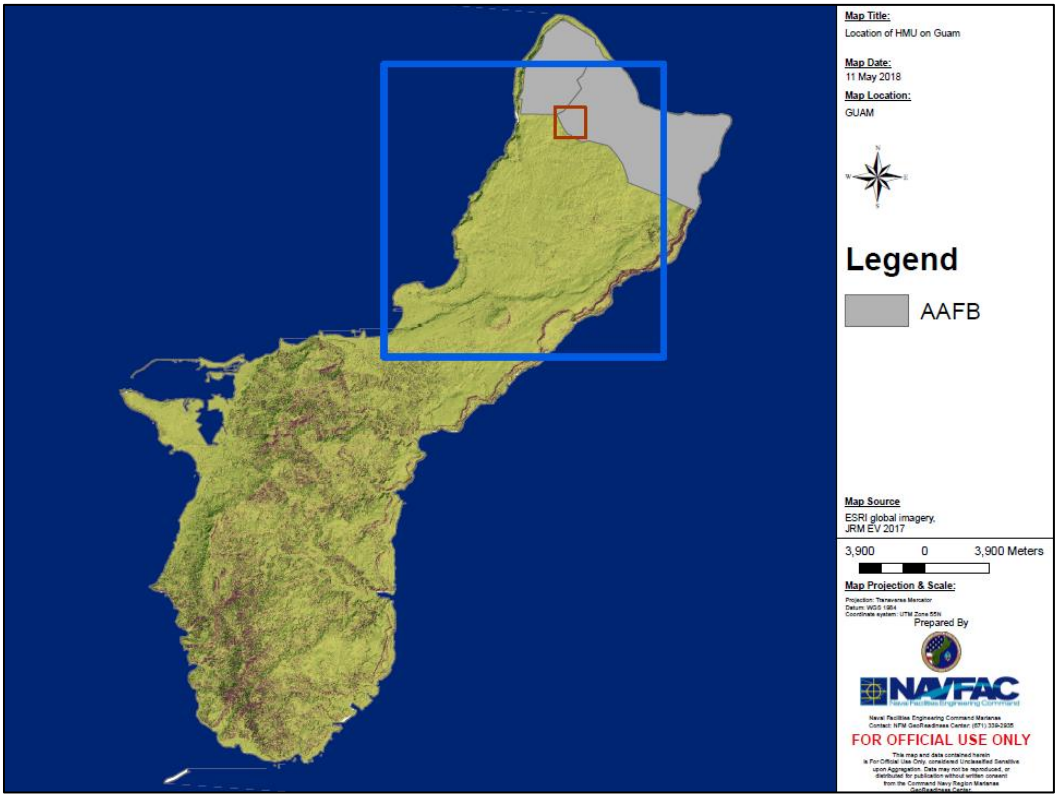

Figure 3. The proposed BTS suppression work will target the HMU (within the red box, see Figure 4) and helicopters working on the proposed BTS bait drop actions may land and overfly additional areas within the blue box.



Figure 4. The HMU conservation area (outlined in red) on Andersen Air Force Base, Guam and the helicopter flight path for calibration of the automated delivery system (shown in yellow dashed line).

ANALYTICAL FRAMEWORK FOR THE JEOPARDY DETERMINATIONS

Jeopardy Determination

The following analysis relies on the following four components: (1) the *Status of the Species*, which evaluates the range-wide condition of the listed species addressed, the factors responsible for that condition, and the species' survival and recovery needs; (2) the *Environmental Baseline*, which evaluates the condition of the species in the action area, the factors responsible for that condition, and the relationship of the Action Area to the survival and recovery of the species; (3) the *Effects of the Action*, which determines the direct and indirect impacts of the proposed Federal action and the effects of any interrelated or interdependent activities on the species; and (4) *Cumulative Effects*, which evaluates the effects of future, non-federal activities in the action area on the species.

In accordance with policy and regulation, the jeopardy determination is made by evaluating the effects of the proposed federal action in the context of the species' current status, taking into account any cumulative effects, to determine if implementation of the proposed paction is likely

to cause an appreciable reduction in the likelihood of both the survival and recovery of listed species in the wild.

The jeopardy analysis in this Biological Opinion emphasizes the range wide survival and recovery needs of the listed species and the role of the action area in providing for those needs. It is within this context that we evaluate the significance of the proposed Federal action, taken together with cumulative effects, for purposes of making the jeopardy determination.

STATUS OF THE SPECIES

Species Description

The Mariana fruit bat was listed as endangered in 1984, but was reclassified to threatened on January 6, 2005, when it was determined that all fruit bats on Guam and throughout the Commonwealth of the Northern Mariana Islands (CNMI) comprise a single subspecies (70 FR 1190). The Mariana fruit bat is the only fruit bat species under U.S. jurisdiction. In 2004, critical habitat for the fruit bat was designated at the GNWR in the Ritidian Unit (69 FR 62944).

The Mariana fruit bat is a medium-sized fruit bat in the family Pteropodidae, and weighs between 0.73 lb to 1.27 lb (331 g to 577 g). Male Mariana fruit bats are slightly larger than females. The underside (abdomen) is black to brown with gray hair interspersed that creates a grizzled appearance. The shoulders (mantle) and sides of the neck are bright golden brown, but may be paler in some individuals. The head varies from brown to dark brown. The well-formed, rounded ears and large eyes give the face a canine appearance (USFWS 2010 p. 4).

The paleotropical genus *Pteropus* is represented by approximately 63 species distributed across the Indian Ocean, Southern Asia, Australia, and in Oceania as far east as the Cook Islands (Almeida et al. 2014 p. 83). Most species in the genus *Pteropus* occur on islands or in coastal areas (Almeida et al. 2014 p. 84). Four species in the genus *Pteropus* are extinct and 38 species (60 percent of the genus) are considered critically endangered, endangered, threatened, near threatened, or vulnerable under the definitions of the IUCN (IUCN 2017). One of the four extinct species, *P. tokudae*, occurred only on Guam and has not been detected since 1968 (Bonaccorso et al. 2008; USFWS 2010).

Flannery (1995) and Simmons (2005) consider the Mariana fruit bat as one of two subspecies of fruit bats restricted to the Mariana Archipelago, with the Mariana fruit bat inhabiting the islands from Guam to Saipan and *P. mariannus paganensis* occurring on Pagan and Alamagan islands. However, subsequent genetic analysis conducted by Brown et al. (2011) indicate no genetic differentiation among islands within the Mariana Archipelago and that the bats on these islands, currently classified as two subspecies, should be managed as a single subspecies, *P. mariannus mariannus* (p. 940). In addition to the Mariana fruit bat, there are several other subspecies of *P. mariannus* endemic to other archipelagos, including the Caroline Islands and the Palau Archipelago (Brown et al. 2011 p. 934).

Life History

Mariana fruit bats, similar to other bats in the Pteropodidae family, do not use laryngeal echolocation, instead relying primarily on vision and smell to avoid obstacles and locate food sources (Almeida et al. 2014). Mariana fruit bats vocalize readily within colonies and when roosting. The diet of the Mariana fruit bat is comprised of fruits, nectar, pollen, and some leaves from at least 45 different plant species (Mildenstein & Johnson 2017). Rapid digestion and metabolism of food makes these animals reliant on forest habitat with diverse food resources available throughout the year (USFWS 2010 p. vi). Mariana fruit bats use several forest types for foraging, roosting, and breeding, including native primary and secondary limestone forest, volcanic (or ravine) forest, old coconut plantations, and groves of *Casuarina equisetifolia* (Rice & Taisacan 1988; Worthington et al. 2001 p. 137; Wiles & Johnson 2004 p. 589,591). Most Mariana fruit bats roost during the day in maternity colonies at sites to which they show a high level of fidelity (unless disturbed). A small proportion of Mariana fruit bats, usually males, roost alone or in small groups called bachelor colonies. Within colonies, Mariana fruit bats typically group themselves into harems (one male and 2-15 females) or bachelor groups (predominantly males) (Wiles 1987a).

Population Dynamics

Population demographic information for the Mariana fruit bat is limited. Based on three-years of field observations on Guam similar to other Pteropodidae species, female Mariana fruit bats rear up to one pup annually (USFWS 2010) and likely have a gestation period of approximately 4.6 to 6.3 months (Pierson & Rainey 1992 pp. 1–17). Many *Pteropus* species typically do not give birth until 18 months of age (Pierson & Rainey 1992 pp. 1–17; McIlwee & Martin 2002 p. 76). Lifespan of substantially larger species, *P. alecto*, in Australia is four to five years, with a maximum of eight years (Vardon & Tidemann 2000).

Based on this demographic information, several authors have suggested that *Pteropus* bats have a low maximum population growth rate and thus a slow rate of recovery when a population is diminished (Pierson & Rainey 1992 p. 76; McIlwee & Martin 2002). Table 4 provides current population estimates per island and other demographic data (Mildenstein & Johnson 2017 p. 20).

Table 4. Mariana fruit bat population estimates and density by island.

Island	Forest Habitat (ha)	No. of Bats	Density
Andersen, N. Guam	25,711	45	0.00
Rota	6,663	4,149	0.62
Aguiguan	302	50	0.17
Tinian	6,481	< 25	0.00
Saipan	5,355	< 50	0.01
Farallon de Medinilla	< 1	< 5	--
Anatahan	N/A	150	--
Sarigan	169	157	0.93
Guguan	170	226	1.33
Alamagan	485	86	0.18
Pagan	1,971	1,017	0.52

Island	Forest Habitat (ha)	No. of Bats	Density
Agrihan	2,336	858	0.37
Asuncion	316	573	1.81
Maug	48	11[1]	

[1]Insufficient data available.

Status and Distribution

The Mariana fruit bat is endemic to the Mariana Archipelago. The Mariana Archipelago extends across 459 nautical miles (nmi) and is comprised of the U.S. Territory of Guam and 14 islands constituting the CNMI. The Mariana fruit bat is found on all 15 islands within the Marianas, except for Uracas, the northernmost island (Wiles et al. 1989 p. 69). The Mariana fruit bat is currently thought to be extirpated from Tinian (USFWS 2014 p. 3). A single Mariana fruit bat was photographed on Farallon de Medinilla on two occasions, in 1996 and in 2008 (DON 2013 pp. 4–123).

Mariana fruit bats in general are strong fliers and highly mobile and small groups have been observed flying over the ocean between islands (Wiles & Glass 1990 p. 2; Wiles & Johnson 2004 p. 593). Distances between are: Guam to Rota, 32.3 NM; Rota to Aguijan, 42.1 NM; Aguijan to Tinian, 4.9 NM; Tinian to Saipan, 2.7 NM; Saipan to Farallon de Medinilla, 45.9 NM; and Saipan to Anatahan, 64.3 NM. In the remaining northern Marianas, interisland distances range from 15.7 NM to 54.0 NM. All islands have a maximum elevation ranging from 551 ft to 3,166 ft with the exception of Farallon de Medinilla, which has a maximum elevation of 266 ft. All islands are visible in clear weather from the tops of adjacent islands (Wiles & Glass 1990 p. 1).

Distribution of occupied Mariana fruit bat roost sites have fluctuated sharply in the southern islands and are thought to be due to variations in survey methods, coverage, and movements of Mariana fruit bats between islands (USFWS 2010 p. 9). Initial observations of Mariana fruit bats in the southern islands (Aguiguan, Tinian, and Saipan) in 1983 and 1984 revealed populations of less than 25 to 50 Mariana fruit bats on each island. Mariana fruit bat numbers increased to about 75 to 100 individuals on Saipan in 1986 and to about 300 individuals on Aguiguan by 1988 (Wiles & Glass 1990 p. 2). Mariana fruit bats on Rota are believed to move periodically among the southern islands, and thus Rota is considered to be important to the long-term stability of the species in the southern part of the Marianas (Wiles & Glass 1990 p. 2; Wiles et al. 1995). Historic numbers of Mariana fruit bats on Guam have been between 400 and 800 since 1984, but have since been decreasing. By the early 1980s nearly all Mariana fruit bats on Guam lived in Northern Guam in a single colony, which occasionally divided into several smaller aggregations (Wiles & Glass 1990 p. 2; Mildenstein & Johnson 2017 p. 25).

Survey data in the northern islands (Anatahan, Sarigan, Guguan, Alamagan, Pagan, and Agrihan; excluding Asuncion and Maug, which were not surveyed during this time period), indicate a 40 percent decline in Mariana fruit bat numbers between 1983 and 2000 (USFWS 2010 p. 11). In the Service's 2014 5-year review, Mariana fruit bats were found to be stable or declining throughout most of their range; the only exception being on Rota where populations were increasing since 2008 due to increased enforcement of wildlife regulations (USFWS 2014).

Threats

Illegal hunting, loss of native forest, predation by the BTS on Guam, and the increased risk of extirpation or extinction faced by small, fragmented populations are the most significant threats to the survival of the Mariana fruit bat (USFWS 2014). These current known and potential threats are discussed below.

Threats:

- Loss or Degradation of Habitat:
    - Human development is a factor in habitat loss on all inhabited southern islands and on northern islands with military activity.
    - Feral ungulates and Philippine sambar deer (*Rusa marianna*) degrade habitat on many of the islands in the Marianas Archipelago. The successful eradication of feral ungulates from Sarigan and Anatahan suggests that similar projects may succeed on other islands. However, once grazing and browsing pressure is removed, the potential invasion of native forest by alien plants may be a more difficult and long-term recovery issue.
- Human Disturbance:
    - Illegal hunting is a threat to Mariana fruit bats throughout its range. Although law enforcement activity has increased since 2009 (CNMI -DLNR 2008; CNMI-DLNR 2009a, 2009b, 2010), illegal hunting of Mariana fruit bats on Rota continues and will likely resume to historical levels unless consistent, effective law enforcement efforts in tandem with education and outreach programs continue. Mariana fruit bats appear to be declining on Tinian, Saipan and Guam, and illegal hunting is thought to have greatly contributed to the decimation or decline of those populations (Wiles & Payne 1986; Wiles & Glass 1990; Sheeline 1991; Stinson et al. 1992; Esselstyn et al. 2006). As with Rota, recovery of the Mariana fruit bat on human-inhabited islands will not likely be possible without strong education programs combined with effective control of illegal hunting.
- Nonnative Snake Predation:
    - BTS prey on non-volant young left at the roost during the night, thus preventing the recruitment of young bats into the breeding population. Effective control of BTS is among the actions that must be achieved before the Mariana fruit bat population on Guam can recover. The interdiction, control, and ultimate eradication of BTS on Guam are the focus of major, ongoing projects, and the Mariana fruit bat is likely to benefit from these efforts in the long term across the archipelago. This prognosis would change drastically if the BTS were to become established widely throughout the archipelago.
- Stochastic Events:
    - Typhoons and volcanic eruptions result in mortality, reduced population viability, and habitat loss. Natural disasters can be especially damaging to the viability of smaller Mariana fruit bat populations (e.g., on Guam, Saipan, Aguiguan, and Maug). The significant loss of habitat on Anatahan after the volcanic eruption in 2003 resulted in the loss of a substantial Mariana fruit bat population that has not yet recovered.

Mariana Fruit Bat Recovery Criteria

A draft revised recovery plan for the Mariana fruit bat (USFWS 2010) addressed actions needed for the survival and recovery needs of the Mariana fruit bat. Since publication of the draft revised recovery plan, new information on the Mariana fruit bat has resulted in changes to how we look at recovery for the species. We now consider recovery in terms of stable or increasing subpopulations of sufficient size distributed across Guam and the CNMI. To meet recovery objectives, stable or increasing fruit bat subpopulations should, at a minimum, be distributed on the islands that currently have extant populations (USFWS 2010). Actions that reduce or eliminate the potential for self-sustaining populations of resident Mariana fruit bats on Guam may hamper or preclude recovery of the species. The reduction or elimination of this potential may take many forms: degradation or loss of habitat and resources required by the fruit bat for foraging, roosting, and reproduction; increased exposure of fruit bats to illegal hunting and other sources of human disturbance; and introduction of non-native predators that prey upon fruit bats. In order for the Mariana fruit bat's population to recover on Guam, sufficient amounts of functional habitat will need to be protected and restored on Guam (USFWS 2010).

Guam contains a large proportion of the remaining native limestone forest in the southern inhabited Mariana Islands, and most of that habitat is located within Department of Defense (DoD) lands. Habitat loss and degradation, illegal hunting, predation by non-native predators, and human disturbance currently impact fruit bats within the action area, outside the HMU. If threat levels increase within Mariana fruit bat habitat in the Action Area, it may further inhibit the potential for the species to recover.

Survival and Recovery Needs

Before the Mariana fruit bat is considered for delisting, the Service proposes that stable or increasing populations should exist on three of the five southern islands (Saipan, Tinian, Aguiguan, Rota, and Guam), and six of the northern islands where Mariana fruit bats have persisted historically (Anatahan, Sarigan, Guguan, Alamagan, Pagan, Agrihan, Asuncion, and Maug; (USFWS 2010 pp. 40–41). Of the six northern islands that require stable or increasing numbers, two of these must include Pagan, Anatahan, or Agrihan. Since publication of the draft revised recovery plan in 2009 (USFWS 2010), new information on the Mariana fruit bat has resulted in changes to how we look at recovery for the species. We now consider recovery in terms of stable or increasing subpopulations of sufficient size distributed across Guam and the Mariana Islands. To meet recovery objectives, stable or increasing Mariana fruit bat subpopulations should at a minimum be distributed on the islands that currently have extant populations (USFWS 2010). The final version of the Mariana fruit bat recovery plan is currently in review, and recovery criteria stated here may change upon completion of the final plan.

Of the six northern islands, the only evidence for a possibly increasing population is on Asuncion (USGS 2010 p. 33). Of the five southern islands, only Rota has achieved an increasing population. Although a conservation area containing some important habitat for Mariana fruit bats was established on Rota (USFWS 2011 p. 1), there is not currently enough protected Mariana fruit bat habitat on Rota, Guam, Tinian, or Saipan to support substantial population recovery on any of those islands. Even if sufficient habitat is set aside in conservation to support

recovery of populations, controlling illegal hunting may continue to be a challenge that limits recovery of the species (USFWS 2014 p. 5).

ENVIRONMENTAL BASELINE

Regulations implementing the Act (50 CFR 402.02) define the environmental baseline as the past and present impacts of all Federal, State, or private actions and other human activities in the action area. Also included in the environmental baseline are the anticipated impacts of all proposed federal projects in the action area that have undergone section 7 consultation, and the impacts of state and private actions which are contemporaneous with the consultation in progress.

General Environmental Baseline

A general overview of the status of, and threats to, limestone forest habitat within the Action Area, followed by species-specific environmental baseline sections, are presented below. This overview reflects the important role of forest habitat in the conservation of all the listed species addressed in this Biological Opinion.

Overview of Limestone Forest in Northern Guam

Guam is the largest and southernmost island of the Marianas Archipelago. It is almost 30 mi long and from 4.3 mi to 9.3 mi wide. The northern part of Guam is a limestone plateau interrupted by a few low hills that are volcanic in nature and other hills that are exclusively coralline (formed from coral). The original forest on limestone was of large trees, with a thick canopy overhead (see below for further description). The northern part of the island gently slopes to the southward from about 656 ft to about 328 ft at the narrow waist of the island. There is no surface water in the northern part of the island (Fosberg 1960, pp. 51-52). Only in the southern and central parts of Guam are there permanent streams (Stone 1970, p. 12). The central part of Guam includes a mixture of volcanic and limestone substrate. The southern part of Guam is hilly, largely of volcanic origin (*e.g.*, basalts) but in several places the hills are capped with a layer of limestone (Stone 1970, p. 12). The southern half of the island is made up of deeply weathered volcanic material with patches of limestone and numerous streams (Fosberg 1960, p. 52). Forest habitat is broken up by ridges and flats covered by grass. The forests in these areas tend to resemble that on limestone; however, the forest is thicker and is dominated by lower stature trees (Fosberg 1960, p. 53; Stone 1970, p. 18). At lower elevations, forest occurs primarily in ravines, valley bottoms, and on steep slopes.

Limestone Karst Forests on Guam

Limestone karsts are sedimentary rock outcroppings consisting primarily of calcium carbonate and are recognized as important ecosystems with high species diversity (Mueller-Dombois and Fosberg 1998, p. 217; Clements et al. 2006, pp. 733-734). The high species diversity on karst arises from the numerous ecological niches created by complex terrains and variable micro-climatic conditions (Clements et al. 2006, p. 734). On Guam, karst is found on an uplifted plateau located on the northern half of the island and on uplifted weathered volcanic terrain in the southern half (Fosberg 1960, p. 54; Stone 1970, p. 12; Mueller-Dombois and Fosberg 1998,

p. 241). The limestone soils of north and south Guam were historically forested (Stone 1970, p. 14; Mueller-Dombois and Fosberg 1998, p. 270; Guam Department of Agriculture 2010, p. 7), and limestone forest on Guam is composed primarily of mature growth of native trees and plants with a moderately dense canopy 33 ft to 98 ft in height (DAWR 2006, p. 19). We define primary limestone forest as forest with vegetation that was never cleared and is dominated by native species (Fosberg 1960, p. 56; DAWR 2006, p. 218).

Primary limestone forests are critically important to Guam's native flora and fauna (Stone 1970, p. 22; USFWS 2005, p. iv; DAWR 2006, p. 28; DON 2014b, p. 3-40). They retain key functional components of native forests such as large native trees and high canopy cover (Fosberg 1960, p. 56; Mueller-Dombois and Fosberg 1998, p. 217 and 270; DON 2014b, p. 3-40), and are necessary for the recovery of Guam's terrestrial native species (DAWR 2006, p. 27; Jenkins 1983, p. 22; Michael 1987; Morton et al. 1999, p. 22). Intact primary limestone forests harbor greater tree species diversity than degraded habitat (Stone 1970, p. 22) and provide habitat for a broad diversity of wildlife. These forests are also highly productive and often store more carbon than degraded forests (Caves et al. 2013, p. 7). The primary limestone forest on AAFB is considered some of the highest quality native limestone forest left on Guam to serve as habitat for listed species (Morton 1996, p. 69).

Threats to Guam's Limestone Forests

Over the past several centuries, Guam has lost much of the native forest to agriculture, a growing human population, economic development, and military activities (Mueller-Dombois and Fosberg 1998, p. 270; USFWS 2010, p. 27). The distribution of primary limestone forest on Guam has been steadily declining (Fosberg 1960, p. 54; DAWR 2006, p. 28). Although little is known about the nature of Guam's vegetation before World War II, progressive alteration of the island's vegetation clearly began with human colonization (Fosberg 1960, p. 54). On limestone soils, native forest was cleared and replaced by coconut plantations, open fields and gardens, pasture, and secondary forest (Mueller-Dombois and Fosberg 1998, p. 242). During World War II, large areas were cleared and some habitat was destroyed during heavy fighting (Fosberg 1960, p. 54).

Currently, the remaining limestone forests on Guam face numerous threats including habitat fragmentation and loss, lack of management, introduced ungulates, invasive species, typhoons, forest conversion, and loss of seed dispersers (USFWS 2005, p. 27; DAWR 2006, p. 28; USFWS 2008, p. 17-18). These combined threats are degrading the habitat quality of remaining limestone forests and limiting the acres of high quality primary limestone forest habitat available to recover listed species on Guam. Currently, forested areas cover approximately 48 percent of Guam (DAWR 2006, p. 31). Of this, about 13 percent consists of limestone forest habitat (Brown 2005 as cited in DAWR 2006, p. 28).

Forest Habitat Fragmentation, Degradation, and Loss

Habitat fragmentation is a change in habitat configuration caused by clearing, development, invasive species, typhoons, and ungulates that result in the remaining habitat to occur in patches intermixed with areas of non-habitat (Noss et al. 2006, p. 213). Habitat fragmentation creates edges that have different properties than the habitat itself. For example, edges often have

different microclimate patterns that are drier, less shaded, and warmer than forest interiors. They are often areas with increased predation and serve as entry points into native habitats for invasive vegetation, pests, and pathogens (Noss et al. 2006, p. 228). Habitat fragmentation and edges can result in localized extirpations of species, shifts in community composition, increases in invasive species, increased predation, and in suitable habitat becoming unsuitable due to pollution, invasive species, physical size, or barriers blocking access to habitats (Groom and Vynne 2006, p. 174; Noss et al. 2006, 38 pp). Habitat fragmentation has been implicated in reduced species richness, avian abundance, productivity, and food supply (Blake and Karr 1987, VanderWerf 1993, Burke and Nol 1998, Trine 1998, Porneluzi and Faaborg 1999). Overall, edges may have adverse effects to some wildlife populations and ecological processes (Murcia 1995, p. 58; Laurance 2000, p. 134) and may affect forests at larger landscape scales (Laurance 2000, p. 134).

Habitat degradation and loss on Guam has been caused by various human activities including agriculture, mining, forestry, fires, infrastructure development, military training, urbanization, industry, pollution (including light, noise, and toxic chemicals), and changes in community and ecosystem structure due to invasive species (Groom and Vynne 2006, p. 164; USFWS 2008, p. 17). Habitat loss and degradation from human activities is a threat to the recovery of many listed species on Guam (USFWS 2008, p. 17; USFWS 2012c, p. 3).

Feral Ungulates

Feral non-native ungulate species that occur on Guam include pigs (*Sus scrofa*), Philippine deer (*Rusa marianna*), and the Asiatic water buffalo (*Bubalis bubalis*). Feral ungulates have caused severe damage to Guam's forests by browsing on plants, causing erosion, inhibiting plant growth and regeneration, and facilitating the establishment of invasive plants, which can impede forest regeneration by displacing or smothering native species (USFWS 2010, p. 27). For example, deer and pigs foraging on fallen fruits and seedlings of the native breadfruit (*Artocarpus mariannensis*), an important Mariana fruit bat food, in combination with impacts from typhoons, have resulted in a decline in the number of native breadfruit trees on Guam (Wiles 2005, p. 509).

Feral pigs are extremely destructive and have both direct and indirect effects on native plant communities. While rooting in the soil in search of invertebrates and plant material, pigs directly affect native plants by disturbing and destroying vegetative cover and trampling plants and seedlings. They may also reduce or eliminate plant regeneration by damaging or eating seeds and seedlings. Pigs are a major vector for the establishment and spread of competing invasive non-native plant species, by dispersing plant seeds on their hooves and coats as well as through the spread of their feces (Matson 1990, p. 245; Siemann et al. 2009, p. 547). Feral pigs feed preferentially on the fruits of many non-native invasive plants, spreading the seeds of these species through their feces as they travel in search of food. In addition, rooting pigs contribute to erosion by clearing vegetation and creating large areas of disturbed soil, especially along hillsides (Smith 1985, pp. 190, 192, 196, 200, 204, 230–231; Stone 1985, pp. 254–255, 262–264; Medeiros et al. 1986, pp. 27–28; Scott et al. 1986, pp. 360–361; Tomich 1986, pp. 120–126; Cuddihy and Stone 1990, pp. 64–65; Aplet et al. 1991, p. 56; Gagne and Cuddihy 1999, p. 52).

On Guam, feral pigs were introduced in the 1600's, established a population by 1772, and were distributed island-wide by the early 1900's (Conry 1988, p. 26). As documented in other locations, wallowing, rooting, and trampling are common in most forested areas and can be

locally severe (Conry 1988, p. 27). A large complex of wallows and feeding sites in Tarague Basin on AAFB measured over 5.7 ac (2.3 ha), and was stripped of all ground cover with no tree regeneration (Conry 1988, p. 27). On AAFB, densities of Philippine deer and feral pigs were estimated at 0.8 deer per acre (ac) and 0.2 pigs per ac, which are some of the highest densities recorded in the world (Knutson and Vogt 2003, unpubl. manuscript).

Philippine deer were introduced to Guam in the 1770's (Safford 1905, p. 76), and are distributed throughout the island (Conry 1988, p. 27). Heavy browsing pressure has been documented and browse lines are common (Conry 1988, p. 27). Deer populations in the 1990s appeared to be expanding (Wiles et al. 1999, p. 193), and may be the largest in Micronesia (p. 200). Philippine deer have caused significant changes in forest structure and species composition in native ecosystems on Guam, and are not considered compatible with conservation of native ecosystems and recovery of endangered species (Wiles et al. 1999, p. 193).

The Asiatic water buffalo was introduced to Guam in the 1600's from the Philippines (Conry 1988, p. 27). High densities, and the gregarious habits of Asiatic water buffalo, have resulted in habitat damage such as mud wallows, broad trails, vegetation trampling, and tracks, with some areas so heavily trampled that ground cover has been denuded and soil erosion scars and slumping are evident (Conry 1988, pp. 27-28). The Asiatic water buffalo occurs primarily on the Ordnance Annex and surrounding non-Navy lands in southern Guam, with a population estimated at 50-60 animals (USFWS 2008, p. 18).

Habitat Destruction and Modification by Typhoons

Guam has been affected by typhoons in 37 of the last 50 years (USFWS 2005, p. 32). Super-typhoons (with wind gusts of over 150 mi per hour) occur approximately once every 13.5 years (the last one, Pongsona, occurred in 2002). Typhoons destroy native vegetation by opening the canopy and modifying the availability of light, and create disturbed areas conducive to invasion by non-native pest species (Asner and Goldstein 1997, p. 148; Harrington et al. 1997, pp. 539-540). Typhoons also can cause defoliation (loss of leaves), uprooting of trees, and breakage of stems, branches, and trunks of trees depending on the severity and duration of the storm and its point of impact (Brokaw and Walker 1991, p.442). Super-typhoons fragment and decrease the suitability of existing habitat, and exacerbate the effects of introduced plants and ungulates (USFWS 2005, p. 34). Climate models indicate that typhoons in the northwestern Pacific are expected to increase in intensity, frequency, and duration by 2200 (Emanuel et al. 2008, p. 360).

Climate Change

Climate change is an atmospheric response to high carbon dioxide levels caused by Federal and non-Federal actions that has significant implications on weather that will likely influence the condition of species and alter magnify the effects of human proposed actions on species. Climate change is expected to increase the number and intensity of habitat-altering typhoons and wildfire threat may increase as a result of increased frequency and intensity of drought on Guam.

Loss of Pollinators, Seed Dispersers, and Frugivores

The loss of forest birds on Guam caused by BTS predation has caused a disruption in the ecosystem services provided by birds as pollinators, seed dispersers, and frugivores (Mortenson et al. 2008, p. 2146; Caves et al. 2013, p. 7). Seeds are dispersed significantly farther from parent trees on islands with birds compared to Guam, and seed ingestion by birds doubles to quadruples the chance of germination for plant species (Rogers 2011, p. 2). The combination of loss of seed dispersal and reduced germination can produce major changes in the spatial pattern, abundance, and diversity of Guam's forests (Rogers 2011, p. 2). In addition, seed set and seedling recruitment were significantly higher on Saipan (where the BTS is absent) than Guam for bird pollinated trees (Mortensen et al. 2008, p. 2146). These studies concluded that the loss of ecosystem services provided by birds will result in the loss of species diversity, distribution, and abundance; slow regeneration of degraded forests; and a reduction of plant species recruitment (Mortensen et al. 2008, p. 2146 and 2153; Rogers 2011, p. 2; Caves et al. 2013, p. 5).

Human Disturbance

The listed species on Guam are also threatened by disturbance from human activities including, but not limited to, noise from military training (aircraft, munitions, firing ranges, vehicles, etc.), noise from recreational pursuits (hiking, and hunting), and construction noises. These disturbances not only negatively affect species, but reach into forested interiors and degrade the quality of habitat for listed species. The Mariana fruit bat is sensitive to human disturbance, and as development continues on Guam, disturbance-free forested habitats are increasingly rare on Guam.

The Service's 2017, Biological Opinion on the Department of the Navy's Relocation of U.S. Marine Corps from Okinawa to Guam and Associated Activities on Guam addressed take of all Mariana fruit bats using 2,136 ac of roosting and foraging habitat surrounding the construction and operation addressed in that consultation. Take is expected in the form of harm or harassment due to exposure to loud aircraft noise, and to noise, light, and human disturbance associated with construction and operation of the LFTRC. This includes approximately 1,817 ac in northern Guam and approximately 319 ac in southern Guam due to noise effects from military aircraft flights and training exercises. The biological impact of that taking on the fruit bat is likely to cause a significant disruption of their breeding, feeding, and sheltering behavior.

Land Management on DoD Lands

The majority of remaining limestone forests on Guam occurs on DoD lands. As noted above, the primary limestone forest on AAFB is considered some of the best native limestone forest remaining that provides habitat for threatened and endangered species (Morton 1996, p. 69). The Service and the DoD (United States Air Force (USAF), DON, and JRM) have worked together over the past 20 years to manage DoD lands for threatened and endangered species. In 1994, a Cooperative Agreement (Agreement) was established between the USAF, DON, and the Service for purposes of establishing and managing the GNWR Overlay on DoD lands (USFWS 1994). The GNWR includes approximately 376 ac (152 ha) of fee simple Service-owned land and 22,501 ac of Overlay Refuge areas on land owned by DoD. The Agreement, which is still in effect, affirms the signatory parties commitment for a "coordinated program centered on the

protection of endangered and threatened species and other native flora and fauna, maintenance of native ecosystems, and the conservation of native biological diversity in cooperation with the Guam's DAWR, consistent with the national defense mission of the Navy." Notably, all signatory parties to agreed that DON lands included within the GNWR shall be managed and administered, consistent with the national defense mission of the DON and the requirements of section 7(a)(2) of the Act, and other laws as applicable.

Management of listed species habitat on DoD lands has occurred with some success. The approximately 180 ac Haputo ERA and the 30 ac Orote Point ERA, both on NBG are two examples. Both were established in 1984, prior to the Agreement, as mitigation for the Kilo Wharf project. The 133 ac HMU was developed as a conservation measure under the 2006, informal consultation on the Beddown of Training and Support Initiative at the NWF (USFWS 2006, p. 2), and currently serves as an experimental site for BTS research and control.

Habitat Within the HMU

The once historically native-dominated limestone forest of the HMU has been replaced with degraded scrub and disturbed limestone forest with a canopy dominated by non-native *Vitex parviflora* (DAWR 2006; NAFVACPAC 2009; GPEPP 2015; NAVFACMAR 2016; Siers and Savidge 2017). The understory in the northern portion of the HMU consists of a variety of native vegetation in addition to *Vitex*; whereas, the native fern, *Nephrolepis hirsitula*, dominates the understory in the southern third of the site (Figure 5; GPEPP 2015; Siers and Savidge 2017).

The Conservation Role of the HMU

The could HMU serve a critical role in re-establishing listed vertebrates. The HMU is an interagency test site established for biological resource studies, including pilot control and monitoring programs for invasive species and forest restoration within the overlay refuge (Siers and Savidge 2017). Management and operation of the HMU were established in a partnering relationship (i.e., Adaptive Management Team) among AAFB, the Service, and the Division of Aquatic and Wildlife Resources (DAWR) within the Guam Department of Agriculture. The HMU is managed as a special use conservation area to improve Mariana fruit bat and Mariana crow habitat (USFWS 2009). Overall, the HMU management and restoration planning is occurring at the ecosystem level through the removal and exclusion of introduced species and the re-establishment and propagation of native species. A management focus is on the reintroduction of native forest bird species and management for federally-listed and other sensitive species. The HMU Restoration Plan provides guidelines for activities to assess and restore the native flora and fauna and the site is targeted for the release of native bird species no longer present on Guam due to the BTS (Siers and Savidge 2017).



Figure 5. Photo depicting typical disturbed limestone forest habitat consisting primarily of Vitex parviflora overstory and *Nephrolepis hirsutula* understory within the southern 1/3 portion of the Habitat Management Unit on Andersen Air Force Base, Guam (GPEPP 2015).

Environmental Baseline for the Mariana Fruit Bat

Other than a few isolated periods of increase, Mariana fruit bats have been declining on Guam since the early 1900s (Wiles 1987b, p. 1; USFWS 2010, pp. 6 - 7). Although the decline of the Mariana fruit bat was likely initiated by the introduction of firearms and increased hunting efficiency in the early 1900s, predation by the BTS has contributed to the continued decline (Lemke 1992, p. 137; Wiles et al. 1995, p. 32; Janeke 2006, p. 3; Brooke 2008, p. 2). By 1995, nearly all of Guam's remaining Mariana fruit bats were located on AAFB (Wiles et al. 1995, p. 39). In 2006, the only known maternity colony on Guam was located on AAFB at Pati Point and had less than 100 individuals (Janeke 2006, p. 4). By 2010 the Pati Point colony no longer existed, and no other colonies were known to exist on Guam (SWCA 2012, p. 20, DON 2014, p. 2).

From 1981 to 2008, fruit bat population estimates on AAFB were conducted by DAWR via opportunistic counts at known roosting locations (Wiles et al. 1995; Mildenstein and Johnson 2017), which, by 1994, was exclusively at Pati Point, the sole remaining maternal colony (Wiles 1994). Bat abundance at Pati Point has declined since annual surveys were undertaken

in 2005, and, by 2010, regular clustering of bats at this roosting site became unreliable (Figure 6). Consequently, from 2010 to 2013, SWCA was contracted to conduct surveys on AAFB (SWCA 2012, 2013). SWCA fruit bat surveys consisted of pre-dawn, timed (2 to 3 hour) visual surveys at 83 forested locations following methods described in the USFWS (2009) and Utzurrum et al. (2003), and direct colony counts at historical colony locations within AAFB. Surveys conducted between December of 2010 and December of 2011 produced conservative fruit bat population estimates on AAFB of approximately 25 animals (JRM et al. 2012). From March 2012 through March of 2013, a total of 50 bat detections were made in non-simultaneous counts across 84 survey locations on AAFB, although no overall fruit bat population estimate was produced for AAFB (JRM et al. 2012).

From 2014 to 2017, a collaborative fruit bat monitoring effort between University of Guam (UOG) and AAFB produced simultaneous, multi-observer (>80), base-wide counts yielding annual abundance estimates of fruit bats on AAFB (Table 5; Mildenstein et al. 2014).

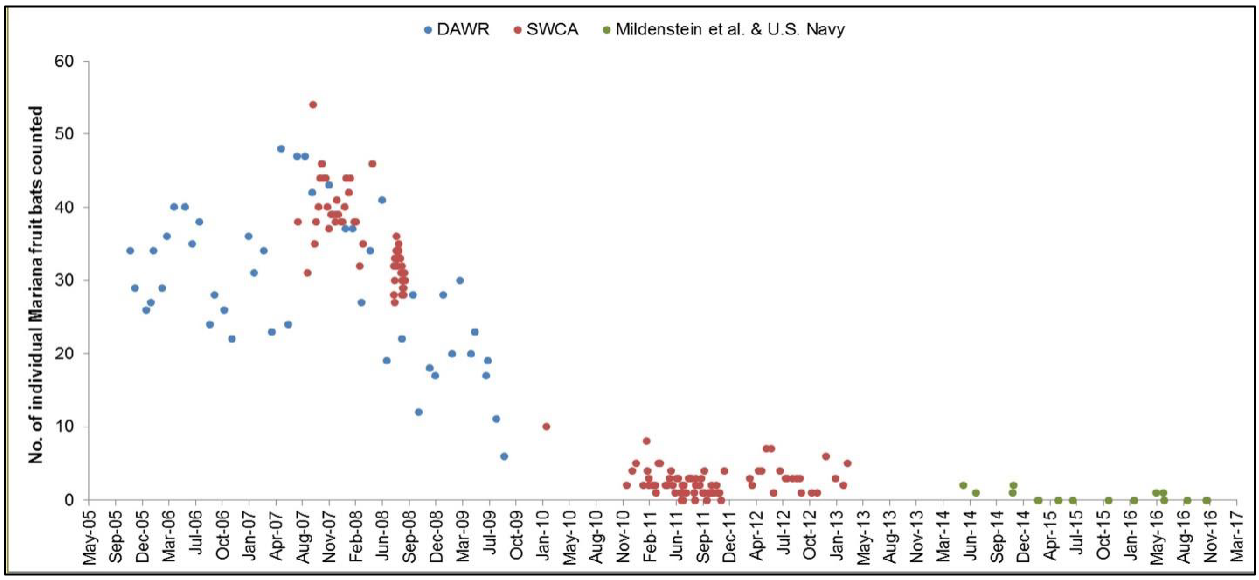

Figure 6. Mariana Fruit Bat Direct Colony Counts at the Historic Pati Point Colony Site1, Andersen Air Force Base, Guam: October 2005 to September 2009; December 2010 to December 2011; March 2012 to March 2013; and May 2014 to November 2016. Data from SWCA (2008, 2012, 2013); Mildenstein et al. (2015); DON (2017); DAWR, unpublished data. From 2017 Andersen Air Force Base Fruit Bat Management Plan (Mildenstein and Johnson 2017).

Observations of fruit bats within or near the HMU have been both incidental (e.g., as part of other fieldwork) and deliberate on surveys at designated observation stations. Therefore, methodologies by which fruit bats were documented have varied markedly in the HMU. For instance, an incidental observer documented a single fruit bat flying between Finegayan and the HMU in 2010 (USFWS 2017b). From 2011 to 2015, annual fruit bat surveys within the HMU and the surrounding area yielded annual detections of 0 to 10 fruit bats in flight, which may not have been independent observations (Table 6). From 2006 to 2017, there have been varying numbers of bats detected flying over, roosting in, or in proximity to the HMU (Table 7).

Table 5. Decadal and, when available, annual estimates of Mariana fruit bat population size on Andersen Air Force Base (and Guam when parenthetical) from the 1950s to 2016. Beginning in the 1980s, survey effort is mostly or entirely concentrated on Andersen Air Force Base, Guam. Adopted from Mildenstein and Johnson (2017).

Decade	Survey Year(s)	Estimate	Method	Source
1950s	1958	<3000* (Guam)	Roost counts	Woodside, in USFWS 2010
1960s	1961-1968	~500 (Guam)	Station/Roost counts	Perez 1972; Wheeler and Aguon 1978
1970s	1973-1977	500 (Guam)	Roost counts	DAWR 1973-1976, unpublished data
	1974-1977	<100* (Guam)	Roost counts	Kami et al. 1976
	1975	<100 (Guam)	Station/Roost counts	Wheeler and Aguon 1978
	1978	<50 (Guam)	Station/Roost counts	Wiles et al. 1989
1980s	1980-1982	850-1000 (Guam)	Roost counts	Wiles et al. 1989
	1984	425-500 (Guam)	Roost counts	Wiles 1987a,b; Wiles et al. 1989
1990s		173-980 (Guam)	Roost counts	Wiles 1994
2000s	2006	<100	Roost counts	Janeke 2006
	2007-2008	31-54	Station/Roost counts	SWCA 2008
	2009	<50	Roost counts	USFWS 2009
	2010-2011	25	Station counts	SWCA 2011
	2012-2013	50 seen; No estimate	Station counts	SWCA 2012
	2014	15	Base-wide count	Mildenstein et al. 2014
	2015	24	Base-wide count	Mildenstein et al. 2015
	2016	45	Base-wide count	DON 2016

* The methodology is not clear for this estimation.

Table 6. Maximum Mariana fruit bat sightings in or within proximity of the Habitat Management Unit (HMU) on Andersen Air Force Base in Guam for years 2010-2016. Sightings do not represent independent observations unless noted.

Year	Sightings	Method	Source
2010	1	Visual	USFWS 2017
2011	10	Station count	SWCA 2012
2012	8*	Station count	SWCA 2013
2013	2	Station count	SWCA 2013
2014	0	Station count	Mildenstein et al. 2014
2015	0	Transect count	Mildenstein et al. 2015
2016	112**	Station count	DON 2016

* Detections of individual bats in flight on or near the HMU, but only 4 likely to be unique individuals
** An estimated maximum of 112 (no more than 124) transient bats found roosting in HMU

Experimental BTS suppression was conducted at the HMU pursuant to 01EPIF00-2011-F-0211 and 01EPIF00-2011-I-0270 *Formal Consultation on the Aerial Application of Acetaminophen for Brown Tree Snake Control on Guam.* Between November 2015 and February 2016, a larger than historically-documented number of fruit bats (maximum of 112

observed) were observed within the HMU by USGS/USDA personnel conducting BTS monitoring surveys as part of a snake suppression demonstration project, and were later confirmed by AAFB natural resources personnel.

Subsequent to the observation of this influx of fruit bats into the HMU, all ground-based BTS survey efforts were suspended on 4 December 2015, and focused surveys for fruit bats were initiated in January 2016 (Lujan, 2017). Various locations in the HMU were monitored for fruit bat presence, both opportunistically and with systematic perimeter and interior forest survey methods, on 21 occasions from December 7, 2015 through August 26, 2016 (Table 7). The largest grouping of at least 112 individuals was observed on February 14, 2016 (DON 2016).

From April 7 through August 26, 2016, fruit bat numbers in the HMU declined to as few as 0 to 7 observations (DON 2016). At the time of the 2016 annual simultaneous base-wide survey (conducted on June 3, 2016), a single bat was seen from five observation stations around the HMU. Since August 2016, fruit bat aggregates have not been observed within the HMU by USDA WS fence maintenance personnel (J. Dixon personal communication November 7, 2017). Observations of fruit bat individuals in the HMU occurred daily from November 11 – 14, 2017. A pair was observed near Potts Junction on November 12, 2017 (J. Horeg personal communication December 10, 2017).

The increased occupancy of the HMU by Mariana fruit bats may have been related to the period when BTS numbers were reduced by the BTS control effort. The temporary move from Rota to Guam may also have been related to weather events such as a storm north of Guam. The HMU is not currently a known roosting site (SWCA 2012, 2013; Mildenstein et al. 2014, 2015; DON 2016).

Fecal samples (n=114) from the group of at least 112 fruit bats within the HMU in early 2016 were collected for molecular analysis to evaluate the origin of the individuals. Of the 114 fecal collections, mitochondrial DNA was successfully amplified and sequenced from 53 samples, and 42 produced microsatellite results adequate for analysis (DON 2016). From the molecular analysis, it was determined that the eruption of fruit bats found in the HMU were of the *P. mariannus mariannus* subspecies from the southern Marianas, a distinct population segment different from fruit bats from Palau or Ulithi. Results from an analysis of mitochondrial DNA weakly suggested that the fruit bats were possibly from Rota (DON 2016).

Table 7. Observations of Mariana fruit bats from opportunistic sightings (†) and surveys conducted in or near the Habitat Management Area from November 15, 2015 to August 26, 2016.

Date	Detections	Behavior	Observer	Fecal Samples*
15-Nov-15	"several"	unknown	USGS field technicians†	
22-Nov-15	3	in flight	USGS field technician†	
23-Nov-15	1	in flight	USGS field technician†	
25-Nov-15	1	in flight	USGS field technician†	
4-Dec-15	30-50	roosting/flight	USGS field technicians†	
7-Dec-15	30-50	flushed	D. Lujan and USDA	
6-Jan-16	2	in flight	VCO†	
11-Jan-16	"hundreds"	unknown	USDA†	
14-Jan-16	<50	unknown	AAFB, USFWS, USDA	
18-Jan-16	2	in flight	USDA†	
25-Jan-16	4	unknown	D. Lujan	
27-Jan-16	10	in flight	USDA, USFWS	
10-Feb-16	50-60	roosting	AAFB	
11-Feb-16	4	in flight	AAFB	18
12-Feb-16	0		S. Garcia, T. Mildenstein	
13-Feb-16	0		J. Calaor, T. Mildenstein	
14-Feb-16	112	roosting	J. Calaor, T. Mildenstein	
15-Feb-16	0		AAFB	>40
16-Feb-16	35	roosting/flight	AAFB	>40
7-Apr-16	7	unknown	AAFB, DPRI, USFWS, USDA	
7-May-16	0		J. Horeg, T. Mildenstein	
9-May-16	1	unknown	J. Watkins	
10-May-16	5	unknown	N. Johnson, T. Mildenstein	
29-May-16	3	unknown	T. Mildenstein	
30-May-16	5	unknown	T. Mildenstein	
31-May-16	6	unknown	T. Mildenstein	
3-Jun-16	1	in flight	S. Garcia	
3-Jun-16	0		Base-wide count	
Date	Detections	Behavior	Observer	Fecal Samples*
26-Aug-16	0		AAFB	

* Fecal samples collected beneath roosting bat colony within the HMU.
† Denotes opportunistic observations (not targeted surveys for bats).

Threats to the Mariana Fruit Bat in the Action Area

In addition to the threats described in the General Environmental Baseline section, the following threats also affect Mariana fruit bat populations in North Guam.

Hunting

Humans have been using Mariana fruit bats as a food source since human arrival in the Marianas. Consumption of Mariana fruit bats represents a significant Chamorro cultural tradition (Lemke 1992, p. 135; Sheeline 1991, p. 14). Demand for Mariana fruit bats for human consumption is demonstrated by the large commercial trade in Mariana fruit bats that existed in the Marianas in the late 1960s until it became illegal through the Convention on International Trade of Endangered Species of Wild Fauna and Flora (CITES) (Wiles and Payne 1986, p. 143; Stinson et al. 1992, p. 63-66; CITES 2017). It is estimated that approximately 221,000 Mariana fruit bats were imported to Guam between 1975 and 1989 (Wiles 1992, p. 54). Illegal hunting appears to be the key reason for the Mariana fruit bat's dramatic decline on Guam (Wiles 1987b, p. 154; Wiles and Brooke 2009; USFWS 2010, p. vii).

Even though Mariana fruit bats are protected by Guam and Federal law, they are likely still hunted opportunistically on private property when they transit the island and by hunters on AAFB (GNWR, unpublished data, 2005). The number of Mariana fruit bats at the colony declined from 55 (summer 2007) to 21 (December 4, 2008 survey) (PEER 2009).

Noise

Air traffic is the primary source of noise disturbance for Mariana fruit bats on Guam (SWCA 2008, p. 2-3; SWCA 2012, p. 23, 37). The first known study examining the effects of aircraft overflights on Mariana fruit bats on AAFB was conducted at Pati Point, where a colony of approximately 400 Mariana fruit bats roosted (Morton 1996). During this study, roosting Mariana fruit bats responded to some low-altitude aircraft overflights with distress and flushing, which increased time spent in alert, aggression, and maintenance behaviors. Four-engine carriers and bombers generally elicited a greater response from roosting Mariana fruit bats than fighter aircraft. Morton (1996, p. iii) suggested that higher levels of air-traffic volume would result in increased energy expenditure and perhaps roost abandonment by some or all of the Mariana fruit bats present at AAFB.

In 2006, the effects on Mariana fruit bats from noise resulting from increased jet aircraft and helicopter use at AAFB were analyzed in the ISR-Strike BO (USFWS 2006). In that consultation, noise effects were expected to adversely affect the Mariana fruit bat to the extent that the nearby Pati Point colony would be abandoned, and Mariana fruit bats would relocate from Pati Point to other, less-protected areas on the island (USFWS 2006, p. 49). In the ISR-Strike BO, we concluded that Mariana fruit bats on Guam would be taken as a result of the proposed action, but that action would not jeopardize the continued overall existence of the Mariana fruit bat (USFWS 2006, pp. 49-52).

In 2007-2008, another study was conducted to document potential effects of aircraft noise on fruit bats at AAFB (SWCA 2008). During this period, the number of fruit bats at the Pati Point colony had decreased from 55 to 21 by the end of the surveys (PEER 2009). Aircraft noise affected the Mariana fruit bats by increasing alertness behaviors, preventing Mariana fruit bats from resting and sheltering in place, compared to surveys with no overflights occurring. However, the proportion of bats displaying alertness behaviors following an overflight was

variable. Overflights did not appear to affect active thermoregulation (a fruit bat hanging head down with at least one wing flapping). Six percent of overflights resulted in flushing events, and all flushing events were at noise levels exceeding 106 dB, the highest reading being 122.6 dB (SWCA 2008, pp. 2-3).

In 2010, another study was funded to assess the effects of aircraft noise on Mariana fruit bats at AAFB (SWCA 2012); however, the colony at Pati Point no longer existed. Although up to eight individual Mariana fruit bats were observed roosting there at any one time, most departed the site by the end of each sampling period, indicating the site was no longer used as a colonial roost (SWCA 2012, p. 2). Increases in active thermoregulation (32 percent), maintenance (14 percent), locomotion (74 percent), and alertness (62 percent) were recorded during aircraft overflights. All flush events were at recorded peak noise levels above 90 dBA/101 dBc; the highest reading at 124.9 dBA/125.5 dBc (two F-15 aircraft). The observed flush events were associated with fighter, bomber, transport, and helicopter aircraft overflights (SWCA 2012, p. 23, 37).

Typhoons

Mariana fruit bats evolved in the presence of typhoons, the principal natural disturbance in the archipelago, but today these storms are a threat to the species because they can exacerbate the effects of the anthropogenic threats listed above (USFWS 2010, p. 34). Evidence from Rota suggests that typhoons may not be a substantial source of direct mortality for Mariana fruit bats (Stinson et al. 1992, p. 65; Esselstyn et al. 2006, p. 536). However, the synergistic effect of illegal hunting and severe storms on Mariana fruit bats is documented on Rota (e.g., Stinson et al. 1992; Esselstyn et al. 2006). Severe storms can alter Mariana fruit bats foraging and roosting behavior by decimating food resources, removing protective foliage cover, temporarily modifying forest structure, and changing vegetation composition, especially by facilitating encroachment of non-native species. Loss of food resources can drive Mariana fruit bats to forage on the ground, during daylight hours, and closer to areas of human activity; thereby increasing their vulnerability to illegal hunting (Stinson et al. 1992, p. 65; Esselstyn et al. 2006, p. 532).

Mariana Fruit Bat Survival and Recovery Habitat

Although Mariana fruit bats have been observed in a variety of habitat types, they are more likely to occur in native primary or secondary limestone forest (see Status of the Species above). Mariana fruit bat populations that have been subject to intense hunting pressure (e.g., populations on Saipan, Tinian, Rota, and Guam) are sensitive to human presence, and in recent history, maternity roosts are not known to occur in close proximity to areas inhabited by humans (Wiles 1987b, p. 151; J. Boland, unpublished data 2008-2015). However, Mariana fruit bats may forage on or near human-inhabited lands, in spite of hunting pressure (Wiles 2006, pers. comm. as cited in USFWS 2006; Boland 2008-2015, pers. obs.). Therefore, for this Biological Opinion, we assume that all areas identified as limestone and ravine forests on the 2006 Forest Service landcover maps (Liu and Fisher 2006a) are potential habitat for the fruit bat on Guam. We then updated the amount of available habitat on Guam by removing all forested areas cleared since the landcover map was completed using 2011 satellite imagery of Guam (Metevier 2014, unpubl. data). Although primary limestone forest is higher quality habitat that secondary limestone forest habitat, we did not account for habitat quality in these calculations due to our inability to

differentiate between these forest categories using imagery alone. Similarly, we were unable to account for other aspects of habitat quality such as hunting and predation threats. As such, our estimate of available survival and recovery habitat (hereafter, referred to as habitat) on Guam is likely an oversetimate.

Using the methods above, the total area of Mariana fruit bat habitat on Guam was estimated to be 27,096 ac (10,965 ha). Based on our estimate of 27,096 ac (10,965 ha) of existing survival and recovery habitat for the Mariana fruit bat (Metevier 2014, unpubl. data), the estimated carrying capacity for Mariana fruit bats on Guam is 19,847 bats (DON 2013, p. 26, 45). In order for native limestone forest to serve as habitat for the Mariana fruit bat, it will need to be managed to reduce threats to the species, including the BTS, illegal hunting, invasive plant species, and feral ungulates (USFWS 2010, pp. 42-43). Only 576 ac (233 ha) of this habitat is designated for the purposes of conservation. Because much of the land set aside for conservation is not currently managed to reduce threats, protection and management of Guam's forest habitat is among the greatest conservation needs of the Mariana fruit bat.

EFFECTS OF THE ACTION

The effects of the action refers to the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action, that will be added to the environmental baseline (50 CFR 402.02). Indirect effects are those that are caused by the proposed action and are later in time, but still are reasonably certain to occur.

Aircraft and Human Disturbance

Aircraft noise and ground-based human activity associated with the proposed action are likely to result in harassment of all of the Mariana fruit bats at the project site. Although none of the bats observed at the HMU were accompanied by young (Mildenstein and Johnson 2017), reproductive effort and reproductive success may be reduced as a result of project-related noise and disturbance within and outside the HMU. All bats roosting or foraging within the study sites may abandon the study site and relocate to areas on Guam or on other islands where they will be exposed to BTS predation and human disturbance.

As detailed below, human activity can negatively impact bats, through disturbance from roosting and feeding sites. One or more bats may use the HMU as a roost site during project implementation. Aircraft operations will occur over the HMU roost site during 2 to 14 days for up to nine bait drop operations annually and long-term ground-based monitoring will occur up to daily on weekdays during the two month period prior to the aerial drop and for up to one year after aerial applications are completed. Operations by ground-based field personnel tracking baits following application or conducting ground operations including vegetation and fence maintenance and monitoring activities may disturb roosting bats within the project site. Low-level aircraft flights are likely to disturb roosting or transiting bats. All bats at the HMU, if present during bait drop operations, are likely to be startled and alarmed by aircraft noise. Bats exposed to high levels of noise disturbance, and to human disturbance may abandon their roost site at the HMU. They may move to other areas on Guam where habitat quality may not be as good, where BTS densities are likely to be higher, and where they are likely to be exposed to

more disturbances. The project may cause them to move to Rota or to another location where they may be exposed to high levels of hunting and decreased food and habitat availability.

Neonatal bats may be dropped by mothers when disturbed, leading to mortality. Because the HMU has not historically been known to be used by breeding bats, the risk of mortaility to juveniles due to project implementation is reduced.

Noise

Most of the bat species in the genus *Pteropus* do not echolocate, and less information is available about their hearing than for bats that do echolocate. We have no specific information on hearing for the Mariana fruit bat. The available literature indicates that fruit bats are most sensitive to noise frequencies between 10 and 20 kHz, insensitive to frequencies below one kHz, and able to detect frequencies 40 kHz or greater (DON 2014a, p. 64 and references within). From approximately four kHz to just under 20 kHz the fruit bats have more sensitive hearing than humans (DON 2014a, p. 64). Overall, fruit bat audiograms are similar to humans (DON 2014a, p. 64), and it is possible that noise from the proposed action would be heard by fruit bats as it would be heard by humans.

There is limited understanding of what sound levels may adversely affect Mariana fruit bats, and most information is from observations of fruit bat reactions to aircraft overflights. The following reactions to aircraft noise have been reported:

- Fruit bats have been reported to flush at noise levels exceeding 106 dBC (SWCA 2008, pp. 2-3) and at peak noise levels above 90 dBA/101 dBC (SWCA 2012, p. 23, 37).
- Fruit bats at a maternity colony on Rota flushed when a helicopter was within 200 m and a military jet aircraft (type unknown) flew overhead within 300 m (J. Boland, pers. obs., 2009 and 2010).
- Successive launches of F-14 repeatedly flushed 50 bats from a roost site and F-14s (95, 106 dBA) also caused agitated vocalization and flushing (Grout 1993 in Morton 1996, p. 67).
- Increases in active thermoregulation (32 percent), maintenance (14 percent), locomotion (74 percent), and alertness (62 percent) of Mariana fruit bats were recorded after aircraft overflights (SWCA 2012, p. 23, 37).

Based on this information, aircraft overflights resulting in noise over 90 dB may flush roosting Mariana fruit bats. However, flush rates may not adequately reflect a species' sensitivity to human disturbance. Effects to individual Mariana fruit bats are only documented in the SWCA (2012) study, which occurred after the Pati Point colony site was no longer used; however, this study did not report noise levels of overflights that may have disturbed (other than flushing) individual fruit bats. Therefore, we do not have direct data on how an individual fruit bat on Guam will react to noise disturbance from the proposed action. For the purposes of this consultation, we will assume that, at a minimum, noise over 90 dB may flush a roosting Mariana fruit bat.

Ambient noise levels in the HMU have not been studied, but the site is within 3.3 mi of the runways at AAFB and the most often used aircraft landing approach to the runways is within 1.6 mi. of the HMU. The HMU is also exposed to vehicle noise from Route 3A. Data is available for

the average daily noise level (ADNL) measured at three sampling sites near the proposed live-fire training range complex in Northwest Field (NWF LFTRC) 3 mi from the HMU. In this study, ambient noise was not recorded to be less than 50 dB and was often above 65 dB (DON 2014b; DON 2015).

Regardless of the size or type of aircraft used in implementation of the proposed action, the aircraft is likely to cause sound levels to exceed 90 dBA in areas occupied by roosting and foraging bats. A small Bell 206/MD900 noise level is 94 dBA (at 100 ft distance, in A-weighted decibels) (Falzarano and Levy, 2007). The MD-600 helicopter is likely to produce a sound level of 72.7 dBA during an overflight at 123 m (400 ft) altitude (Falzarano and Levy 2007), which would correspond to a sound level of approximately 79.7 dBA at 200 ft and 86.7 dBA at 100 ft (assuming 7 dB sound reduction per doubling of distance from noise source), within the proposed 82- to 246- ft offset distances of the proposed helicopter flights.

Noise levels above ambient levels and below 90 dB are likely to cause other stress reactions, including increases in active thermoregulation, maintenance, locomotion, and alertness. Stress reactions caused by human disturbance can have an adverse effect on fruit bats by increasing energetic demands, disrupting hormonal balance, and forcing relocation to lower quality habitat (Klose et al. 2006, p. 347, and references therein; CNMI 2010, p. 7). All of these factors can lead to reduced time foraging, sheltering, or breeding and adversely affect survival. When a disturbance is experienced by a Mariana fruit bat colony, individuals may disperse on their own or in smaller groups (CNMI 2010, p.6). In some cases, the degree of colony dispersal (i.e., how many individuals leave the main colony) may be related to the degree and/or type of human disturbance. For example, if hunters are frequently targeting bats along commuter flyways near the colony roost site, some individuals may disperse away from the roost site temporarily, but eventually return. However, if hunters fire directly into a colony at their day roost, the entire colony abandons the site (CNMI 2010, p. 7). When fruit bats on Rota are forced to disperse from colonies as a result of human disturbance, infant mortality may increase because dependent, non-volant pups that are too big for the mother to carry are likely abandoned. Forced dispersal may negatively affect the reproductive potential of the population because access to mates is compromised (CNMI 2010, p. 7). Even without dispersal, high levels of stress from any disturbance can disrupt reproductive cycles and/or lead to miscarriage (Wingfield et al. 1998, p. 192-193, Heideman 2000, p. 169-199, Klose et al. 2006, p. 347).

Other Human Disturbance

Transect maintenance and ground-based monitoring activities will result in an increase in noise and other human disturbance at the study sites. In many parts of their range, bats are exposed to poaching, so bats may be sensitive to the scent of humans conducting ground operations below their roost sites. Solitary bats flushed as a result of project disturbance may travel to another area where the likelihood of harassment and snake predation are greater overall than it is at the HMU. Human activity can also impact fruit bats thus increasing energetic demands (Wiles et al. 1995; SWCA 2012). BTS ground monitoring crews would be in the HMU weekly for up to two months prior to the first bait applications, and then again weekly or monthly for up to one year following the last bait drop.

Mariana fruit bats are likely to be disturbed by project-related noise and disturbance. Low-level aircraft flights are likely to disturb roosting or transiting bats. All bats at the HMU during bait drop operations are likely to be startled and alarmed by aircraft noise. Bats exposed to high levels of noise disturbance, and to human disturbance may abandon their roost site at the HMU. They may move to other areas on Guam where habitat quality may not be as good, where BTS densities are likely to be higher, and where they are likely to be exposed to more disturbance. Project-related disturbance may cause any bat roosting or foraging within the north-Guam Action Area to relocate to Rota or to another island where they may be exposed to high levels of hunting and decreased food and habitat availability.

Direct injury or mortality due to aircraft strike or cartridges

Bats may be struck and injured or killed at their roost or in flight by falling bait cartridges or they may be struck in flight by bait-dispensing aircraft. In addition, the streamer connecting the internal and external components of the bait chamber may pose an entanglement hazard. There is no evidence of this type of interaction from any prior helicopter BTS baiting operations in areas that were also unoccupied by bats. The maximum application rate (120 baits/ha; 49 baits/ac) amounts to a spacing of 30 ft along each flight path, with 30-ft spacing between flight paths, or one bait for every 81 square meters. Loaded bait cartridges weigh approximately 0.5 oz and they will be dropped during daylight periods, after 0900, when bats may be roosting. In addition, bats are likely to relocate from the application area when noisy helicopter operations approach.

Air Strike and Rotor Wash Risk

Aerial application of baits will be made using an aircraft flying at approximately 82-246 ft at an air speed of approximately 50 to 70 knots. This low altitude could potentially result in collisions between the aircraft and bats and rotor wash disturbance of roosting bats. To minimize the likelihood of a bat aircraft strike, flights will be scheduled between 0900 and 1800, when bats may be roosting within the Action Area. While there remains a paucity of research on flight characteristics specific to Mariana fruit bats, related species of *Pteropus* bats are known to regularly travel at heights of 492 ft above the ground (Parsons et al. 2008). Documented flight speeds for *Pteropus* range between 27 to 15 to 35 knots (Epstein et al. 2009; Roberts et al. 2012); flight speeds average 18 knots in Madagascan flying foxes *P. rufus*, a slightly larger congener of the Mariana fruit bat (Oleksy et al. 2015). Downwash from the helicopter's spinning rotors can result in wind speeds in the upper tree canopy of 62 mph (Ryan, 2018).

Streamers and Cartridge Risks

Baits will be dropped along tight, GPS mapped 30-ft wide transects after 0900 when bat density within the HMU is expected to be very low. The 0.5 oz bait cartridges weigh approximately three to five percent of the 11.6 to 20.4 oz fruit bat body weight (Wiles 1987a). The cartridges are ejected horizontally, and fall only with the force of gravity. Streamers attached to the cartridge slow the cartridge's descent rate. The likelihood of a cartridge striking a bat is very low. In addition, because bats have relatively large bodies in relation to the small cartridge size and mass, a direct strike to a bat's body is unlikely to cause injury, reduced reproduction, or reduced survival. Because of the relatively light weight of the cartridges in relation to the bat's body size,

and the sparseness of the application, it is unlikely that direct strike of a bat by a bait cartridge would occur and cause injury or mortality. The likelihood of direct injury or mortality resulting from the proposed action is discountable.

The streamers may temporarily confuse bats bat because the bat may mistake the streamer for a leaf or branch. Because bats are large-bodied, the streamers are not expected to entangle bats or cause any other long-term adverse effects to the bat.

Injury or Mortality Due to Acetaminophen Bait Consumption

Extensive research and evaluation was required to develop and register acetaminophen as an oral toxicant for BTS (Brooks et al. 1998, p. 427; Savarie and Bruggers 1999, p. 417; Savarie et al. 2001, p. 356; Johnston et al. 2002, p. 3827). Acetaminophen is a commonly used human analgesic and is available without a prescription. Laboratory and field testing determined that 80 mg of acetaminophen (the equivalent of a human children's dose) is lethal to BTS (Johnston et al. 2002, p. 3828). DNM are suitable medium to house the toxicant and proved to be palatable to BTS (Savarie et al. 2001, p. 356; Shivik et al. 2002, p. 1062). Substantial information regarding environmental and human risk has been published (Bessems and Vermeulen 2001, p. 55; Johnston et al. 2002, p. 3827; Larson et al. 2005, p. 1364). In 2003, acetaminophen was registered by the EPA for use in controlling BTS on Guam (EPA Registration Number 56228-34). Use of acetaminophen under this label is regulated by the Federal Insecticide, Fungicide, and Rodenticide Act.

Acetaminophen has the potential to impact non-target wildlife species. Johnston et al. (2002) assessed the risks for primary and secondary poisoning of non-target wildlife associated with acetaminophen use in controlling BTS populations on Guam. Table 8 summarizes LD_{50} doses for non-target species (LD_{50} is the dose at which 50% of those organisms exposed to a chemical are expected to suffer mortality). Acute toxicity estimates greater than 0.5 exceed EPA's acute hazard threshold. The table provides an estimate of the number of acetaminophen baits a given species would need to consume in order to reach an LD_{50}-dose.

Toxicant baits will be dropped attached to DNM). Mariana fruit bats are frugivorous (fruit-eaters) and are thus inherently unlikely to attempt to ingest carrion (mouse carcass) baits. Further, acetaminophen baits are effective because BTS ingest the whole bait and therefore the entire tablet, and are terminally intoxicated before the bait can be regurgitated; even when baits are regurgitated, most BTS die (Nafus and Siers pers. comm.). The bats possess a highly developed sense of smell, so the smell of the bait is likely to ward them away from it. But, if a fruit bat were to orally investigate a bait, it would likely masticate the bait and encounter the bitter acetaminophen tablet, leading to refusal to ingest the toxicant (Yarmolinsky et al. 2009). Therefore the risk of Mariana fruit bat ingestion of acetaminophen and harm to the bats is reduced.

Table 8. Primary and secondary hazards to non-target wildlife associated with acetaminophen baits for controlling BTS (Johnson et al.2002, p. 3828).

species	acute toxicity estimate[a] (mg/kg)	food consumption rate (g of food/ g of body wt)	primary hazard		secondary hazard	
			acetaminophen dose[b] (μg/g)	hazard quotients[c]	acetaminophen dose[d] (μg/g)	hazard quotients[c]
Mammals						
house mouse (*Mus musculus*)	LD_{50} = 338[e]	0.15[m]	2400	7.12	132.2	0.39
Norway rat (*Rattus norvegicus*)	LD_{50} = 1944[f]	0.10[m]	1600	0.80	88.1	0.05
guinea pig (*Cavia cobaya*)	LD_{50} = 2620[g]	0.10[n]	1600	0.61	88.1	0.03
domestic dog (*Canis familiaris*)	LD_{50} > 2000[h]	0.06[o]	960	<0.48	52.9	<0.03
domestic cat (*Felis catus*)	LD_{50} = 361[i]	0.07[n]	1005	2.78	61.7	0.17
pig (*Sus scrafa*)	LD_{50} > 1000[j]	0.08[p]	800	<0.8	44.1	<0.04
Birds						
northern bobwhite (*Colinus virginianus*)	LD_{50} > 2250[k]	0.08[q]	1280	<0.57	70.5	<0.03
fish crow (*Corvus ossifragus*)	LD_{50} > 560[l]	0.08[r]	1280	<2.29	70.5	<0.10

[a] LD_{50}, lethal dose, 50% kill. [b] Based on the nominal acetaminophen concentration found in mouse baits, 80 mg of acetaminophen/5 g of mouse (16 000 μg/g). [c] Hazard quotient = acetaminophen dose/acute toxicity estimate. [d] Based on the calculated theoretical highest acetaminophen concentration in a snake killed by acetaminophen, 881 μg/g. [e] Ref 43. [f] Ref 44. [g] Ref 45. [h] Ref 33. [i] Ref 32. [j] Ref 40. [k] Ref 35. [l] Ref 34. [m] Ref 46. [n] Ref 29. [o] Ref 47. [p] Refs 41 and 48. [q] Ref 31. [r] Ref 41.

Beneficial Effects of the Proposed Action

The BTS is among the primary causes of the decline of Mariana fruit bats on Guam. In the absence of the proposed action, a population of Mariana fruit bats is not likely to persist at the HMU or on Guam. In the absence of the proposed action, BTS numbers will remain high on Guam and at the HMU bat roost site. The proposed action hopefully will facilitate the development and implementation of landscape-scale BTS suppression. By monitoring Mariana fruit bat responses to the experimental BTS control and monitoring activities, this project will assist in the refinement of bait drop procedures including seasonal and weather-related timing of drops. Future landscape-level implementation of BTS suppression, facilitated by the proposed action is likely to result in increases in the Mariana fruit bat population on Guam.

CUMULATIVE EFFECTS

Cumulative effects include the effects of future state, tribal, local, or private actions that are reasonably certain to occur in the action area considered in this Opinion. Future federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA. Ongoing development of private lands on Guam is resulting in permanent reduction in habitat for the Mariana fruit bat.

CONCLUSION

The Conclusion section is the final step in assessing the risk posed to species and critical habitat as a result of implementing the proposed action. In this section, we add the effects of the action and the cumulative effects to the status of the species and critical habitat, and the environmental baseline, to formulate our Biological Opinion as to whether the Proposed Action is likely to: (1) appreciably reduce the likelihood of both survival and recovery of the species in the wild by reducing its numbers, reproduction, or distribution; or (2) reduce the value of designated critical habitat for the conservation of the species.

Mariana fruit bats will be harassed as a result of aircraft noise and ground-operations of monitoring staff, but this adverse effect will be minimized because operations will be scheduled for daylight periods after 0900 when bats may be roosting within the action area. Because in many parts of their range, bats are exposed to poaching, the bats may be sensitive to the scent of humans conducting ground operations below their roost sites, even if humans are not working at the site at night when the bats are at their roost.

Each bat occupying the Action Area is likely to be adversely affected by one or more instances of non-lethal harassment due to aircraft and human disturbance resulting from the proposed action and they may abandon the HMU roost site during project implementation. Although the HMU project site is not currently known to be occupied by any roosting Mariana fruit bats (Mildenstein and Johnson 2017), the reduced BTS population may result in Mariana fruit bat preferential use of the HMU after project implementation begins. When these roosting Mariana fruit bats are forced to disperse from the HMU as a result of human disturbance, infant mortality may increase because dependent, non-volant pups that are too big for the mother to carry are likely to be abandoned. Forced dispersal may also negatively affect the reproductive potential of the population because access to mates is compromised (CNMI 2010, p. 7). Even without dispersal, high levels of stress from disturbance can disrupt reproductive cycles and lead to pregnancy miscarriage. Mariana fruit bats relocating to sites elsewhere on Guam and to sites on other islands may be exposed to lower habitat quality and greater human disturbance. However, in the absence of the proposed action, BTS would continue to occupy the HMU and harm any vertebrates, including Mariana fruit bats, occupying the conservation area.

Mariana fruit bats may be roosting within the Action Area where they may be exposed to noise and rotor wash from the project helicopter. There is a low risk Mariana fruit bats may be injured or killed by collision with the project helicopter, entanglement in bait cartridge streamers, and ingestion of acetaminophen. Although Mariana fruit bats are not scavengers, should a fruit bat orally investigate a bait, it would encounter the bitter acetaminophen tablet and refuse to ingest the toxicant.

The proposed action will reduce BTS densities in the HMU and facilitate future landscape-scale BTS suppression efforts on Guam. The proposed action and actions similar to it are necessary for the future recovery of Mariana fruit bats within the HMU, and on Guam. If aircraft delivery of BTS baits and ground crew actions become a common practice in the HMU and future snake-suppressed areas, the Mariana fruit bats could become habituated to the human disturbances so future population recovery would be expected to occur. Although few Mariana fruit bats currently occupy the HMU project site, there is the potential for Mariana fruit bats to preferentially roost at the HMU when BTS density is reduced as a result of the proposed action.

After reviewing the current status of the Mariana fruit bat, the environmental baseline of this species in the proposed project area, and the effects of the proposed action, including cumulative effects, it is the Service's Biological Opinion that the proposed aerial toxicant research project on AAFB, Guam is not likely to appreciably reduce the likelihood of the survival and recovery of the Mariana fruit bat in the wild. If successful, the BTS bait drop project may be expanded to other habitats in Guam, reducing BTS numbers and benefitting the Mariana fruit bat and other listed species impacted by BTS presence on Guam.

There is no designated critical habitat for the Mariana fruit bat within the Action Area of this project; therefore, critical habitat will not be destroyed or adversely affected.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act and Federal regulations promulgated pursuant to section 4(d) of the Act prohibit the take of endangered or threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct. Harm is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavior patterns which include, but are not limited to, breeding, feeding, or sheltering. Harass is defined by the Service as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, carrying out an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2) of the Act, taking that is incidental to and not intended as part of the agency action is not considered a prohibited taking under the Act provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The measures described below are non-discretionary, and will be undertaken by the DON so that they become binding conditions in order for the exemption in section 7(o)(2) of the Act to apply. The Service has a continuing duty to regulate the activity covered by this incidental take statement. If the DON (1) fails to assume and implement the terms and conditions; or (2) fails to require any contractors to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to any permit or contract, then the protective coverage of section 7(o)(2) of the Act may lapse. In order to monitor the impact of incidental take, the Department of the Navy must report the progress of the action and its impact on the species to the Service as specified in the incidental take statement [50 CFR § 402.14(i)(3)].

Amount or Extent of Take

Incidental take in the form of harassment, injury and mortality of all Mariana fruit bats within the HMU and in the Action Area of northern Guam may occur as a result of the implementation of the proposed action. Due to the mobile nature of the fruit bats and the fact there is no confirmed roost site within the HMU or Action Area, it is not possible to quantify a specific number of Mariana fruit bats that would be incidentally taken. Therefore, the Service anticipates that all Mariana fruit bats that occur within, or transit through, the Action Area during project implementation may be incidentally taken in the form of harm or harassment, due to direct injury, disturbance during roosting or feeding activities, and possibly reduced reproductive success if disturbed during the pupping season.

Effect of the Take

In the accompanying Biological Opinion, the Service determined that this level of anticipated take is not likely to jeopardize the continued existence of the Mariana fruit bat in the wild. Because the control of the BTS is necessary for the conservation of the Mariana fruit bat, and

other listed species on Guam, the proposed action is expected to result in long-term benefits, with minimal short-term adverse effects.

Reasonable and Prudent Measures

The Service believes the following reasonable and prudent measures are necessary and appropriate to minimize impacts of incidental take of the Mariana fruit bat:

1. In order to avoid unauthorized effects, all personnel working on this project will be provided information on the Mariana fruit bat and its life history, as well as any other listed species that may occur in the project's Action Area.
2. Mariana fruit bat behavior, and any disturbance or injury to bats resulting from aerial and ground-based operations will be monitored to determine project-related take of the Mariana fruit bat and reported to the Service.

Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the Act, the DON must comply with the following terms and conditions, which implement the Reasonable and Prudent Measure number one, described above and specified reporting requirements. These terms and conditions are nondiscretionary. In order to implement the Reasonable and Prudent Measures above, the DON will monitor incidental take resulting from the proposed project.

1. The DON must hold a meet with its employees prior to their field work on this project. The DON must provide specific instruction on the implementation of the proposed Conservation Measures and the Service's Reasonable and Prudent Measures, included in this Incidental Take Statement. Instructions specific to project personnel related to implementation of the Conservation Measures and Reasonable and Prudent Measures must be documented in writing. The DON is ultimately responsible for informing anyone working on this project of these requirements.

2. The DON will coordinate with the United States Air Force, the Service, Government of Guam vertebrate biologists, and United States Geological Survey natural resources personnel and subject matter experts to devise monitoring protocols to assess effects of air- and ground-based operations on bat activity. The DON must monitor and report to the Service the amount of incidental take that occurs in association with this project. This must be done through sufficient on-site inspections to determine if project related impacts have or would occur outside of the HMU bait drop area, as described in this BO. Monitoring reports must be submitted in January of each year during project implementation and a final report one year after the project is completed. The monitoring reports must include a summary of project actions implemented during the previous monitoring period, any unanticipated actions or delays in project completion, and any known incidental take of the Mariana fruit bat that has occurred and the circumstances of that take.

Upon locating a dead or injured Mariana fruit bat, during project implementation, the DON must immediately notify Service Law Enforcement at (671) 647-6064 and the Mariana's Island Team

at (671) 989-6743. The listed species should not be handled unless instructed to do so by Law Enforcement. If authorized, care must be taken in handling sick or injured specimens to ensure effective treatment and care and in handling dead specimens to preserve biological materials in the best possible state for later analysis of cause of death. In conjunction with the care of sick or injured endangered or threatened species or preservation of biological materials from a dead animal, the finder has the responsibility to ensure that evidence intrinsic to the specimen is not unnecessarily disturbed.

The Service believes that it would be impossible to detect and quantify the number of Mariana fruit bat individuals that may be incidentally taken as a result of the proposed project due to their mobile nature and lack of known roosting locations within the Action Area. Therefore, incidental take is authorized for all Mariana fruit bats within the boundaries of the HMU and other project related locations within the Action Area. The incidental take would be in the form of harm or harassment. The Reasonable and Prudent Measures, with their implementing Terms and Conditions, are designed to minimize the impact of the incidental take that might otherwise result from the proposed action. If, during the course of the action, the project affects a fruit bat in a manner that has not been anticipated in this Biological Opinion or if an unanticipated affect occurs outside of the Action Area, such incidental take represents new information requiring reinitiation of consultation and review of the reasonable and prudent measures provided. The DON must immediately halt project related activities and provide an explanation of the unanticipated causes of the taking to the Service in order to determine if reinitiation of this consultation is necessary.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs the DON, as well as other federal agencies, to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

The Service has no conservation recommendations for the DON concerning the conservation of the Mariana fruit bat at this time. In order for the Service to be kept informed of actions minimizing or avoiding adverse effects or benefitting listed species or their habitats, the Service requests notification of the implementation of any conservation recommendations by the DON.

REINITIATION STATEMENT

This concludes formal section 7 consultation on this action. As required in 50 CFR § 402.16, reinitiation of consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by this action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

Thank you for your ongoing efforts to conserve threatened and endangered species. If you have any questions concerning this Biological Opinion, please contact Jacqueline Flores, Mariana Islands Team Manager at Jacqueline_Flores@fws.gov or (671) 787-6094.

Sincerely,

MICHELLE BOGARDUS

Digitally signed by MICHELLE BOGARDUS
Date: 2018.05.16 13:43:27 -10'00'

Michelle Bogardus
Acting Field Supervisor

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(67 FR 63738-63772) Endangered and threatened wildlife and plants; determinations of the prudency for two mammal and four bird species in Guam and the Commonwealth of the Northern Mariana Islands and proposed designations of critical habitat for one mammal and two bird species. Department of the Interior, Fish and Wildlife Service, 50 CFR part 17, Ocboter 15, 2002. Federal Register Volume 67 (199): 63738-63772.

(69 FR 62944- 62987) Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for the Mariana Fruit Bat and Guam Micronesian Kingfisher on Guam and the Mariana Crow on Guam and in the Commonwealth of the Northern Mariana Islands

(70 FR 1190- 1210) Endangered and Threatened Wildlife and Plants; Mariana Fruit Bat (*Pteropus mariannus mariannus*): Reclassification From Endangered to Threatened in the Territory of Guam and Listing as Threatened in the Commonwealth of the Northern Mariana Islands. January 6, 2005.

Appendix A

Biological Opinion for BTS Control in the Habitat Management Unit, Andersen Air Force Base, Guam - Service concurrence with the Department of the Navy's not likely to adversely affect determinations for four threatened plant species: Fadang (*Cycas micronesica*), Cebello halumtano (Siboyas halumtano, *Bulbophyllum guamense*), *Tabernaemontana rotensis*, and *Tuberolabium guamense*) and three endangered tree snails ((Fragile tree snail (*Samoana fragilis*), Guam tree snail (*Partula radiolata*), and Humped tree snail (*Partula gibba*)).

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Pacific Islands Fish and Wildlife Office
300 Ala Moana Boulevard, Room 3-122
Honolulu, Hawaii 96850

In Reply Refer To:
01EPIF00-2018-F-0103

Mr. John F. Salas, Professional Engineer
Department of the Navy
Naval Facilities Engineering Command Marianas
PSC 455, Box 195
FPO AP 96540-2937

Dear Mr. Salas:

The U.S. Fish and Wildlife Service (Service) received your December 15, 2017 request for our concurrence with the your determination the proposed brown tree snake (BTS) (*Boiga irregularis*) control in the Habitat Management Unit (HMU), Andersen Air Force Base (AAFB), Guam may affect, but is not likely to adversely affect four threatened plant species (Fadang (*Cycas micronesica*), *Tabernaemontana rotensis*, Cebello halumtano (Siboyas halumtano, *Bulbophyllum guamense*), and *Tuberolabium guamense*) and three endangered tree snails ((Fragile tree snail (*Samoana fragilis*), Guam tree snail (*Partula radiolata*), and Humped tree snail (*Partula gibba*) (collectively, tree snails).

The Proposed Action entails the aerial application of acetaminophen for BTS suppression in the HMU, AAFB, Guam and associated ground-based field work. The HMU is a 135 ac interagency test site established for biological resource studies, including pilot control and monitoring programs for invasive species and forest restoration. BTS bait containing acetaminophen will be delivered over the HMU via the helicopter-mounted automated aerial delivery system. Ground-based BTS and rodent monitoring will occur up to two months prior to the aerial bait application operations. In addition, ground crews will monitor and implement ground-based BTS and rodent monitoring during aerial bait applications and for approximately one year following aerial BTS baiting operations. A complete description of the project is in the Project Description section of the accompanying Biological Opinion for BTS Control in the HMU, AAFB, Guam. The project's conservation measures including field staff education, surveys, markings, and implementation of buffer distances to avoid listed plants and tree snails outlined in the BA and incorporated into the project description by the DON during the section 7 consultation at the Service's recommendation, are designed to minimize the potential for the project to adversely affect the four endangered plants and three endangered tree snails.

Threatened Plants

Cycas micronesica plants usually grow in palm-like unbranched trunks with apical pinnate leaves (Hill 1994). *Cycas micronesica* is the only native gymnosperm in the Mariana Islands. Cycads are dioecious, and both sexes bear reproductive structures that are relatively massive amongst gymnosperms. *Cycas micronesica* occurs in limestone forests in Guam and Rota, with fewer occurrences in volcanic soils typical of southern Guam (Stone 1970 p. 65; Hill 1994). *Cycas micronesica* is threatened by a non-native insect, the cycad aulacaspis scale (*Aulacaspis yasumatsui*), that is thought to have been introduced on non-native horticultural nursery stock for landscape use (Terry and Marler 2005). The cycad aulacaspis scale has caused mortality of all life stages in *C. micronesica*, leading to reduced reproduction and recruitment into the population (Marler and Muniappan 2006). Additional threats include other pest species, loss and degradation of habitat, feral ungulate trampling, rooting, and herbivory, stochastic typhoon events, and the long-term effects of drought and climate change (USFWS 2015a). Within the HMU, *C. micronesica* occurs in small numbers with only eight individuals recorded and many recorded dead during plant surveys to document rare and valuable plants on Joint Region Marianas administered lands (GPEPP 2015).

Tabernaemontana rotensis occurs in forests with crevices of rough limestone (Raulerson and Rinehart 1991). Currently 23,325 individuals, many of which were at six locations on DoD properties are known to occur, including four occurrences in the HMU (GPEPP 2015; DON 2017). The *T. rotensis* in the HMU were individual trees with few or no seedlings found around the individuals (GPEPP 2015). On Guam, where frugivorous forest birds are extirpated or extinct, the distribution of *T. rotensis* seeds is limited and seedling establishment occurs within the vicinity of mature individuals, resulting in increased seedling competition, distribution of the plants is generally clumped. Clusters of the species on Guam are often comprised of a single adult and numerous seedlings (DON 2017). Threats to *T. rotensis* include habitat loss, non-native plants, herbivory, trampling, and rooting by invasive ungulates, typhoons, and limited spatial distribution and gene flow in the absence of frugivorous forest birds. Locations of *T. rotensis*, within the HMU are shown in Figure 1.

Bulbophyllum guamense is an epiphytic orchid which occurs in large mat-like formations high on branches of big trees, as well as on smaller trees of coastal lowland/limestone forests. Flowers are single, fleshy, and greenish-yellow in color (Raulerson & Rinehart 1992 p. 90). On Guam, *B. guamense* was found in the lower canopy of closed forests (about 10 ft or less) (Zarones et al. 2015). *Bulbophyllum guamense* has been observed in many native and non-native host tree species including: *Hernandia labyrinthica, Elaeocarpus joga, Premna serratifolia, Heritiera longipetiolata, Pisonia umbellifera, Persea americana, Vitex parviflora, Areca catechu, Eugenia* spp., *Ficus* spp., *Dypsis* spp. or *Pandanus tetorius,* as well as in dead trees (Zarones et al. 2015; JRM 2016; DON 2017). Typical to orchids in this genus, *B. guamense* has a carrion-like scent (Raulerson & Rinehart 1992 p. 90), and it is almost ever-blooming, as one flower drops, another replaces it until one is pollinated. Within the HMU, two occurrences of *B. guamense* have been recorded (see Figure 1).

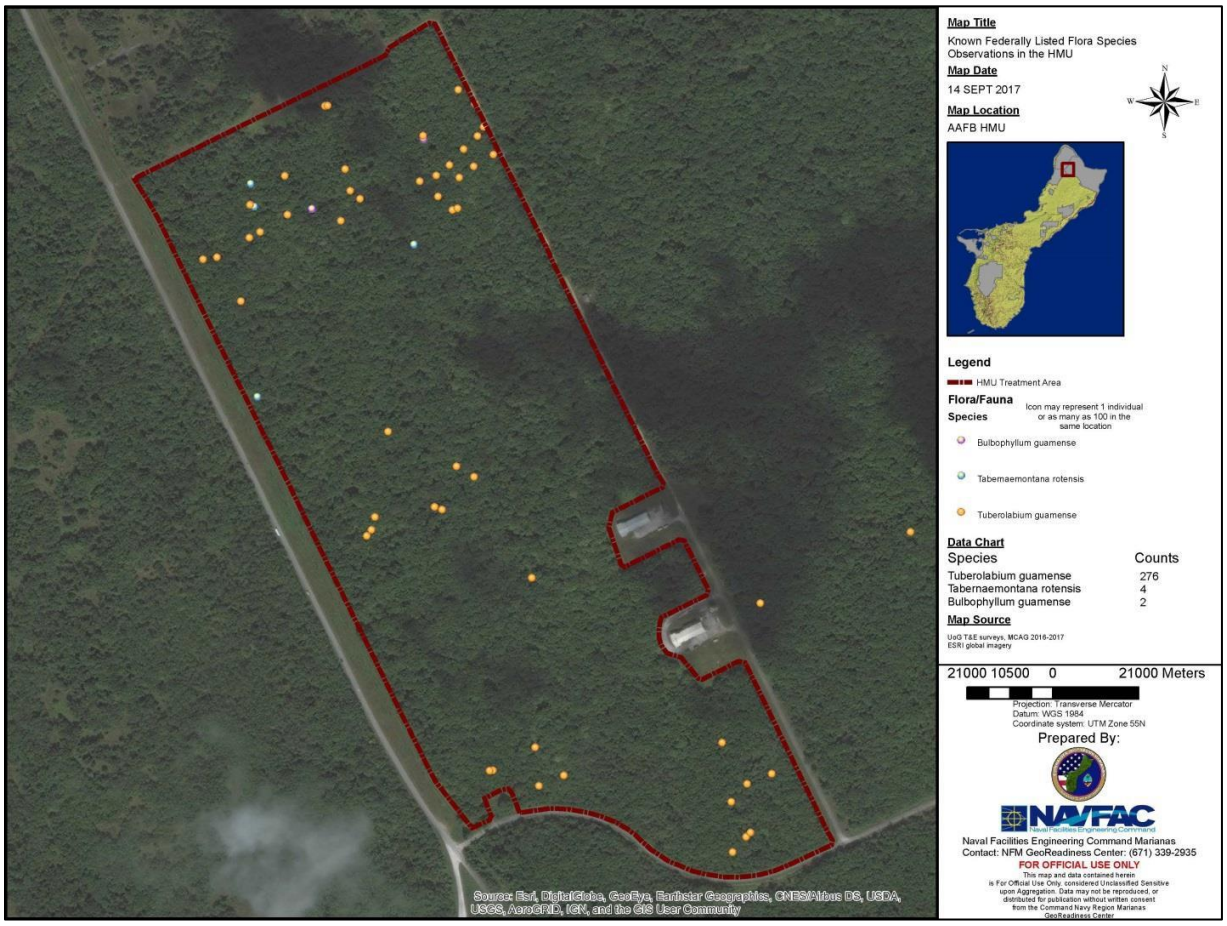

Figure 1. Locations of threatened plants within the Habitat Management Unit on Andersen Air Force Base, Guam (GPEPP 2015).

Tuberolabium guamense is a small orchid. Similar to other epiphytic orchids, *T. guamense* grows slowly and requires specific microclimates, which are found on the trunk, lower branches, and under the forest canopy. *Tuberolabium guamense* clings onto their host trees with a strong developed root system and uses the moisture in the air and organic debris caught in the crevices and bark of the host for nourishment (Tibbs 2008). At the time of listing in 2015, *T. guamense* was known from seven occurrences: one occurrence of one individual on Guam and six occurrences on Rota, in the forest ecosystem (Harrington et al. 2012, in litt.; Zarones et al. 2015) however, recent surveys for *T. guamense* on Guam DoD land parcels have revealed 12,595 occurrences, including 278 within the HMU (GPEPP 2015; DON 2017; see Figure 1). Within the HMU, *T. guamense* was most often found anywhere from 3 to 20 ft on *Vitex parviflora*. Of the surveys conducted on Guam, 82% occurred within secondary limestone forest and 17% within primary limestone forest (DON 2017). Threats to the species include habitat loss and degradation, impacts from invasive vines, and stochastic storm events (e.g., typhoons).

Effects of the Action to the Threatened Plants

Because the DON proposes to avoid field work within specified buffer distances around threatened plants, the proposed action's affect to a threatened plant's transpiration, growth rate, reproduction, and survival are expected to be insignificant. *Cycas micronesica* has a distinctive

growth form which is easily distinguished from other plants. *Tabernaemontana rotensis*, when not in bloom, may be difficult to distinguish from *Morinda citrifolia*, *Ficus prolixa*, *Ficus tinctoria*, and *Ochrosia oppositifolia*, which are all species known to occur in the HMU (GPEPP 2015, Mildenstein and Johnson 2017). However, when fruiting, *M. citrifolia* and *F. tinctoria* are easily distinguished from *T. rotensis* by their distinctive fruiting bodies. Pruning risks to *T. rotensis* would be avoided during transect establishment through the conservation measure requiring inspection of all vegetation to determine species status prior to pruning. Currently known locations of *T. rotensis* are available via spatial coordinates, and all personnel are required to be aware of these locations.

The risk of trampling *Tabernaemontana rotensis* seedlings during ground-based surveys using trackless transects would be minimized by the training and caution implemented during off-trail movements. *Tuberolabium guamense* and *B. guamense* are epiphytic orchids that are generally easy to identify and particularly so when in bloom. Orchids would be avoided during transect establishment and maintenance. Orchids also grow at a height that may naturally minimize impacts from ground-survey monitoring, in particular *B. guamense* is generally found 7 ft above the ground. *T. guamense* grows lower to the ground between two and 30 ft (L. Guttierez personal communication, 19 October 2017) but the identification training conservation measures would reduce the chance field personnel would contact or disturb these orchids. BTS bait streamers and canisters could brush against or land on the threatened plants; however, it is unknown if the weight of the bait could affect orchids or other species, and it is unlikely that the contact would cause reduced reproduction or survival above the level that would be considered significant. Rodents may be seed predators, feeding on the fruit of the threatened plants. Because the proposed action would not be conducted if rodent control response were unavailable, the proposed action is not expected to result in increased rodent damage to seeds of the threatened plants.

Because *Tabernaemontana rotensis* seeds are dispersed by frugivorous forest birds that were extirpated from Guam by the BTS, the proposed research project has the potential to contribute to the conservation of this tree species by facilitating future long-term BTS control and native bird reintroductions at the HMU (Siers and Savidge 2017) and in landscape-scale project sites on Guam. Because effects of the proposed action to the threatened plants are expected to be insignificant, and because the project has the potential to benefit *T. rotensis*, we concur with the DON's determination that the proposed action may affect, but is not likely to adversely affect *C. micronesica*, *T. rotensis*, *B. guamense*, or *Tuberolabium guamense*.

Tree Snails

The family Partulidae consists of approximately 120 species of snails in three genera (*Eua*, *Samoana* and *Partula*) endemic to the high islands of Oceania, many of which are restricted to a single island. *Partula* is the most diverse genus with approximately 92 species described; there are 23 *Samoana* species and four *Eua* species (Lee et al. 2014). Of the six partulid snail species described from the Mariana Islands, only three species remain: the Guam tree snail (*Partula radiolata*), humped tree snail (*Partula gibba*), and the fragile tree snail (*Samoana fragilis*). The three species were listed as endangered on October 1, 2015 (80 FR 59423). The Guam tree snail, humped tree snail, and fragile tree snail share similar life history characteristics and co-occur. Species in the Partulidae family are predominantly nocturnal, arboreal, herbivorous, slow

reproducing, and are relatively long-lived (Cowie 1992). Partulids feed primarily on a range of living, dead or decaying plant material (Cowie 1992 p. 167) and there is no clear obligate relationship with any particular type of tree or bush. The alien carnivorous flatworm (i.e. manokwari flatworm (*Platydemus manokwari*), predatory snail (i.e. rosy wolf snail (*Euglandina rosea*) and *Gonaxis* spp.) and rodent (particularly rat) predation significantly threaten tree snail persistence.

Partula radiolata shells are pale straw colored with darker axial rays and brown lines. Adults are 0.5 - 0.7 in. long, and 0.3 - 0.5 in. wide (Smith et al. 2008). Juveniles can be mistaken for the fragile tree snail. *Partula gibba* shells are chestnut brown to whitish-yellow, or purple with whorls of various shades of white or brown. Adults are 0.55 – 0.7 inches long and 0.39 - 0.7 inches wide (Smith et al. 2008). *Samoana fragilis* adults are 0.47 - 0.63 inches long and 0.39 - 0.47 inches wide. (Smith et al. 2008). Adults can be mistaken for juvenile Guam tree snails.

No listed tree snails were detected during a 4.5-hour survey for tree snails conducted along a 3,792-foot transect south down the center of the HMU on June 19, 2017, during a DON natural resources personnel exercise to train personnel in tree snail survey methods. During this training, the first 656 ft of the reconnaissance walk was dedicated to actively searching for snails spanning 30 to 40 minutes. The focus of the remainder of the transect was limited to observing and locating suitable snail habitat in the HMU (L. Gutierrez personal communication, October 18, 2017). A single weathered shell of *P. radiolata* was found (Figure 2). A previous BTS suppression effort at the HMU did not result in a measurable increase in the rodent population. However, if an undetected rodent increase occurred at the HMU in the past, prior to the listing of the tree snails, as a result of the previous BTS suppression effort, the HMU tree snail population may have been affected.

The HMU project site has not been thoroughly surveyed for tree snails, however biological field crews have been working in the area since 2013. USGS has conducted BTS visual surveys (2013-2015), bait tube surveys and rodent trapping were conducted by USDA WS from 2012-2015 (same crew responsible for discovery of tree snails at Andersen South) and GPEPP has conducted surveys for proposed (at the time) listed plant in 2015 at 33-ft intervals.
The HMU contains the type of native forest vegetation known to support the listed tree snails, so our assessment of potential project effects assumes the tree snails may be present at the project site. Tree snails occur in high-density clusters separated by unoccupied habitat. Fiedler (pers. comm, 2018) recorded what he considered to be an exceptionally high density of tree snails at Ritidian Point: 181 tree snails within a 538 square ft, and he reported 90 tree snails at another site.

In August 2016, Guam tree snails were discovered at Andersen South during field work for BTS bait tube monitoring for an experimental BTS suppression project conducted by USDA WS personnel (S. Siers personal communication; Siers 2016). Specimens were positively identified by University of Guam personnel, Dr. Curt Fiedler in February 2017 (DON 2017). In surveys conducted later in February 2017, DON personnel identified 36 live Guam tree snails (a density of 0.83 snails per ac) and 51 dead shells at the Andersen South location (Gutierrez and Quinata 2017). From July 2017 to May 2018, targeted surveys for listed tree snails on Guam resulted in at least five occurrences of inhabited forest edge sites including vines. (T. Mizerek pers. comm. 2018). The forest vegetation at Andersen South and at the sites surveyed is degraded, less intact

native forest than the forest habitat at the HMU project site. Variations in tree snail density and tree snail habitat preference are unknown. Because it is the only landscape-scale tree snail density information available, tree snail density known from the Andersen South project site was used to assess tree snail population size within the HMU. At a density of 0.83 snails/ac, the 135 ac HMU would be occupied by 113 listed tree snails (an average of one tree snail per 229.089 sq ft).



Figure 2. Known listed tree snail locations in the vicinity of the HMU, where a single weathered shell of *Partula radiolata* was found (DON 2017).

Vertical distribution of *Partula* species is likely to vary by species, snail age, and moisture as it does on Moorea, French Polynesia (Murray et al 1982). Surveys at Asan Memorial Park, Guam, indicated most *P. radiolata* were situated in vegetation above a height of 9.8 ft and average tree snail height ranged from 4.9 ft to 12.8 ft; *S. fragilis* and *P. radiolata* occurred at similar heights at Lost Pond (Fiedler 2018). *Partula radiolata* were measured up as high as 29.5 ft on a breadfruit tree and one *S. fragilis* was detected at 45.9 ft on Rota (Fiedler 2018). *Partula gibba* occur in the sub-canopy of mixed native forests with good understory and ground cover (Hopper & Smith 1992; Smith et al. 2008; Hadfield 2010).

The DON gathered the following information about the occurrence of tree snails on the ground from six local biologists who have worked with the local tree snails. University of Guam's Dr. Curt Fiedler estimated, based on his observations during the candidate species survey project, fewer than one percent of tree snails occupy the ground. Dusty Janeke, HDR, estimated one to two percent of tree snails may be on the ground at a given time. Jessica Gross, Lauren Gutierrez, Christiana Quinata, and Wien Winner have not observed tree snails on the ground (C. Cobb pers. comm. April 9, 2018).

Effects of the Action to the Endangered Tree Snails

Although tree snails may be dislodged from vegetation by falling BTS bait cartridges and ground crew movements, the fall to the ground is not expected to adversely affect tree snails because they regularly fall uninjured from vegetation. The two greatest project-related risks to tree snails are 1) the potential for BTS suppression to result in an increased rodent population (Wiewel et al. 2009), which would be expected to result in increased rodent predation of the tree snails (Hadfield et al. 1993; Hadfield and Saufler 2009); and 2) the trampling and crushing risk associated with project monitoring activities.

Within the Closed Population study area, a 12.4 ac site in NWF, an experimental BTS eradication conducted by USGS has been underway since March 2017. Rat sightings data (rats sighted per km surveyed), indicated an immediate rat increase following the first three toxicant applications in April – June 2017. This rat sighting increase also coinciding with the onset of the wet season. Rat sightings declined to zero in November 2017 and remained similar to pre-toxicant application sightings for the remainder of the survey period through January 2018 (Nafus et al. 2018).

The DON biologists agreed to implement the following conservation measures to support their determination that the proposed action may affect, but is not likely to adversely affect listed tree snails. If these measures are not implemented, the proposed action should be addressed in a formal consultation addressing adverse effects that could occur due to project-related rodent predation and field staff trampling:

1. The December 29, 2017, confirmation that rodent control would be conducted at the HMU if the BTS suppression action results in an increase in the rodent population and the April 19, 2018, confirmation that the proposed BTS control project would be put on hold if, for some reason, rodent control response operations became unavailable and;
2. The April 11, 2018, reduction of off-trail ground crew "events" from the 536 "events" (which would entail an estimated 1,574 miles of off-trail walking) proposed in the Biological Assessment to 406 "events" (an estimated 1,195 miles of off-trail walking) to minimize the potential for field staff foot falls to crush a tree snail.

These two aspects of the project, in addition to the DON's commitment to educate field staff to be vigilant for tree snails to minimize dislodging them or stepping on them during field work and to delineate and avoid any clusters of tree snails detected during project implementation are the primary basis for our assessment of project effects to the listed tree snails.

Dislodging tree snails from vegetation

Tree snails may be dislodged when field crews or falling bait canisters brush against or move leaves or stems occupied by a tree snail. Tree snails are known to fall when the leaf they are adhered to is dislodged from the tree or when, under stronger wind conditions such as a typhoon, the leaves or branches they are occupying are torn from the tree (Fiedler, 2018). The risk of tree snail exposure to non-native carnivorous flatworms, predatory snails, and rodents would be increased during periods when they are on the ground. Although feeding, breeding, and sheltering habitat is available on the ground, the tree snails are not known to spend a lot of time on the ground; any tree snail grounded by the proposed action would be expected to quickly return to the vegetation canopy, particularly during periods when the environment is moist. Guam's relatively high year-round humidity and rainfall is expected to facilitate tree snail movements. Because most grounded tree snails that have been observed to date are still adhered to the leaf or branch that fell from the tree and vegetation will not be cut or removed without a thorough search of the leaves and branches for tree snails, the project poses a low risk of grounding tree snails. Dislodged tree snails at the HMU or adjacent to the HMU, for instance, in the bait canister calibration drop area are not expected to be injured or killed by impact with the ground because dense vegetation, leaf litter, and soil are likely to cushion their fall. A tree snail grounded by project-related actions is expected to return uninjured to the vegetation.

Field staff will walk carefully through vegetation to minimize the likelihood of dislodging a tree snail, and if a tree snail is detected, the extent of the tree snail cluster will be delineated and the area will be avoided to further minimize the risk of ground personnel dislodging a tree snail. The risk ground personnel will dislodge tree snails is reduced because most tree snails occupy mid-story vegetation, above shoulder-height. Because tree snail surveys will be conducted prior to cutting any vegetation and vegetation occupied by a tree snail will not be cut, tree snails are not expected to be grounded on vegetation cut during project implementation.

Because the tree snails are less likely to occupy the upper tree canopy, and most snails occur below that zone, the tree snails are at a reduced risk of being dislodged by a falling bait canister. At the Andersen South BTS bait application site, 70 percent of baits lodged in the upper canopy, above the height where most tree snails occur, 20 percent fell to the mid-canopy, five percent fell to the ground, and five percent of the cartridges did not open successfully (Siers 2016). There is a low risk that a small number of tree snails (one, possibly more) may be dislodged from the tree canopy by falling BTS bait.

Trampling by Ground Personnel

The proposed field work will entail field personnel walking an estimated 1,195 miles conducting project work outside established trails or established transects. Because field personnel working outside of permanent transects and trails will walk parallel to each other, rather than single-file, the risk of trampling a dislodged tree snail is reduced. Based on the information gathered from local biologists (above), we conservatively assumed up to two percent of listed tree snails may occur on the ground. Because an estimated two percent or fewer of the estimated 113 listed tree snails that may occur in the HMU may occur on the ground and because field staff walking off-trail and off established transects will be limited to approximately 1,195 miles of off-trail walking, the likelihood of a tree snail being trampled as a result of the proposed action is

insignificant. The DON's commitment to survey any area where a tree snail is detected and to delineate the perimeter of the occupied area and avoid field work within the area known to be occupied by tree snails, the likelihood of trampling a tree snail is minimized.

The two greatest project-related risks to tree snails are the potential for BTS suppression to result in an increased rodent population, which would result in increased rodent predation of the tree snails, and the trampling and crushing risk associated with foot traffic of off-trail field work. The DON's commitment to put the proposed BTS control project on hold if rodent control response at the HMU became unavailable assures the project will not cause rodent predation of tree snails to increase. The DON's minimization of off-trail ground crew movements and commitment to survey and avoid any area where a tree snail is detected reduces the likelihood the project will result in trampling and crushing of a tree snail to a level that is insignificant. Although tree snails may be dislodged from vegetation by the proposed aerial application of BTS bait or by field staff movements, falls from the vegetation are a normal part of tree snail biology and the fall is not expected to result in tree snail injury or reduction in tree snail feeding, breeding, sheltering, or survival. The fall would have an insignificant effect on the tree snail. Therefore, we concur with DON's determination that the proposed action may affect, but is not likely to adversely affect *S. fragilis*, *P. radiolata*, or *P. gibba*.

As required in 50 CFR § 402.16, reinitiation of consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) if new information reveals effects of the agency action that may affect listed species in a manner or to an extent not considered in this informal consultation; if the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in this informal consultation; or if a new species is listed or critical habitat designated that may be affected by this action.

Thank you for your ongoing efforts to conserve listed species. If you have any questions or would like additional information, please contact Jacqueline Flores, Mariana Islands Team Manager (phone: (671) 989-6744, email: Jacqueline_Flores@fws.gov).

Sincerely,

MICHELLE BOGARDUS Digitally signed by MICHELLE BOGARDUS Date: 2018.05.16 13:43:58 -10'00'

Michelle Bogardus
Acting Field Supervisor

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FEDERAL REGISTER PUBLICATION

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F1R BO for the Removal of Ungulates from Haputo Ecological Reserve Area, Marine Corps Base Camp Blaz, Guam (May 2022)

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United States Department of the Interior

FISH AND WILDLIFE SERVICE
Pacific Islands Fish and Wildlife Office
300 Ala Moana Boulevard, Room 3-122
Honolulu, Hawaii 96850

In Reply Refer To:
01EPIF00-2022-F-0029451

May 25, 2022

Mr. Albert T. Borja
Installation Environmental Program Director
United States Marine Corps
Marine Corps Base Camp Blaz
PSC 488 Box 105
FPO AP 96537-0149

Subject: Biological Opinion for the Removal of Ungulates from Haputo Ecological Reserve Area, Marine Corps Base Camp Blaz, Guam

Dear Mr Borja:

This document transmits the U.S. Fish and Wildlife Service's (Service) biological opinion (BO) based on our review of the proposed removal of Philippine deer (*Rusa mariana*) and feral pigs (*Sus scrofa*) from the Haputo Ecological Reserve Area (ERA), Marine Corps Base Camp Blaz (MCBCB), Guam, and effects of the action on the endangered Guam tree snail (*Partula radiolata*, akaleha') in accordance with section 7 of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 et seq.). We received the request for consultation March 10, 2022, via email from Senior Natural Resources Specialist Coralie Cobb, on behalf of the United States Marine Corps (USMC). The consultation addresses the possible effects of USDA APHIS Wildlife Services control of non-native invasive ungulates from Haputo ERA, at MCBCB, Guam, that is being conducted to conserve limestone forest habitat pursuant to the 2015 Guam Micronesian Kingfisher Memorandum of Agreement (GMK MOA).

This BO is based on information provided in your December 20, 2021, *Biological Evaluation for Ungulate Eradication at Haputo Ecological Reserve Area, Marine Corps Base Camp Blaz* and in meetings, telephone conversations, field investigations, and other sources of information. A complete record of this consultation is on file at the Pacific Islands Fish and Wildlife Office.

Additionally, in a December 20, 2021, letter, which we received January 4, 2022, you requested informal consultation for the eradication of ungulates at the Haputo ERA at MCBCB, Guam. In this letter you requested our concurrence with your determination the proposed action is not likely to adversely affect listed species including the threatened Mariana fruit bat (*Pteropus mariannus mariannus*, fanihi), *Bulbophyllum guamense* (wild onion, siboyas halumtanu, siboyan halom tano), *Cycas micronesica* (fadang), *Dendrobium guamense*, *Tabernaemontana rotensis*, *Tuberolabium guamense* and the endangered Mariana eight-spot butterfly (*Hypolimnas octocula marianensis*, ababbang, Libweibwogh), humped tree snail (*Partula gibba*, akaleha'), fragile tree snail (*Samoana fragilis*, akaleha' dogas), *Eugenia bryanii*, and *Heritiera longipetiolata* (ufa halumtanu, ufa halom tano), pursuant to section 7 of the ESA of 1973, as amended (16 U.S.C. 1531 et seq.). We concur with your determinations for these species. Our concurrence with your determination is detailed in Appendix A of this BO.

Consultation History

October 1, 2021: Naval Facilities Engineering Systems Command, Pacific (NAVFAC PAC) Senior Natural Resources Specialist Coralie Cobb, acting on behalf of the USMC, requested a meeting with the Service to discuss the project.

October 14, 2021: NAVFAC PAC Senior Natural Resources Specialist Coralie Cobb emailed a draft project biological evaluation to the Service. A call was held between Coralie Cobb, USDA APHIS Wildlife Services (Aaron Collins and Nicole Taylor), and the Service (Mariana Islands Geographic Team Leader Jacqueline Flores) to discuss the project and a second call was held with Coralie Cobb, Adrienne Loerzel, and Jacqueline Flores. The Service recommended minimization and avoidance measures, including biological surveys of the entire project site, and requested additional information about the project design.

October 20, 2021: Via email, the Service recommended additional avoidance and minimization measures, including surveys, be incorporated into project plans.

October 22, 2021: Via telephone, the Service's Fish and Wildlife Biologist Toni Mizerek and NAVFAC PAC Senior Natural Resources Specialist Coralie Cobb discussed the Service's recommended avoidance and minimization measures, including surveys.

November 1, 2021: NAVFAC PAC Senior Natural Resources Specialist Coralie Cobb, on behalf of the USMC, emailed a second draft project biological evaluation to the Service.

November 22, 2021: The Service emailed Mr. Albert T. Borja and NAVFAC PAC Senior Natural Resources Specialist Coralie Cobb to express concerns the project may affect and would be likely to adversely affect listed tree snails, the Mariana fruit bat, and the Mariana eight-spot butterfly.

January 4, 2022: The Service received, via email, a December 20, 2021- dated letter, from Mr. Albert T. Borja, requesting initiation of informal consultation for the eradication of ungulates at the Haputo ERA at MCBCB, Guam. The *Biological Evaluation of Ungulate Eradication at*

Haputo Ecological Reserve Area, Marine Corps Base Camp Blaz, dated December 20, 2021, was enclosed with the letter.

January 13, 2022: The Service (Fish and Wildlife Biologist Toni Mizerek) notified Mr. Albert T. Borja via email that we anticipated being unable to concur with the USMC's determination the proposed action was not likely to adversely affect the threatened and endangered species and inviting the USMC to coordinate with us to further refine the project design to minimize or avoid project effects to the listed tree snails and the Mariana fruit bat.

January 18 – February 16, 2022: The Service (Marianas Islands Geographic Team Manager Jacqueline Flores and Fish and Wildlife Biologists Toni Mizerek, Dawn Bruns and Lauren Taylor) attended several Microsoft Teams meetings and corresponded in email exchanges with the NAVFAC PAC Senior Natural Resources Specialist Coralie Cobb to discuss the potential for adverse project consequences to listed tree snails and to the Mariana fruit bat because the project design did not include pre-work surveys and the Service's recommended buffer distances for work near these species.

February 17, 2022: The Service recommended the U.S. Marine Corps provide an updated description of the proposed action, rescind the January 4, 2022 request for informal consultation, and request initiation of consultation.

February 18 – March 10, 2022: The Service's Fish and Wildlife Biologist Dawn Bruns and NAVFAC PAC Senior Natural Resources Specialist Coralie Cobb corresponded via Microsoft Teams, email, and telephone to further refine the project design to incorporate measures to minimize the potential for the project to affect the Mariana fruit bat and the tree snail species. Additional discussions entailed tree snail detection probabilities and the prevalence of tree snails in the lower vegetation and on the ground.

March 10, 2022: The Service received Senior Natural Resources Specialist Coralie Cobb's email on behalf of the USMC, requesting the January 4, 2022, request for initiation of consultation, be rescinded, and requesting initiation of section 7 consultation pursuant to the Endangered Species Act (ESA) of 1973 [16 U.S.C. 1531-1544 *et seq*.], as amended, to addresses the possible effects of ungulate removal from Haputo ERA, Guam, to threatened and endangered species.

March 11 - April 5, 2022: The Service's Fish and Wildlife Biologist Dawn Bruns and NAVFAC PAC Senior Natural Resources Specialist Coralie Cobb corresponded via Microsoft Teams, email, and telephone to further refine the project design to minimize potential project impacts to the Mariana fruit bat and the tree snail species, and to discuss new information about the occurrence of tree snails on the ground.

April 5, 2022: NAVFAC PAC Senior Natural Resources Specialist Coralie Cobb provided the Service's Fish and Wildlife Biologist Dawn Bruns with an updated description of the measures the project would incorporate to minimize potential project impacts to the Mariana fruit bat and listed tree snails.

April 11, 2022: The Service acknowledges initiation of formal consultation with the U. S. Marine Corps.

BIOLOGICAL OPINION

PROJECT DESCRIPTION

The approximately 346 invasive Philippine deer and 48 feral pigs within Haputo ERA, MCBCB, Guam, will be killed and removed from the site to stop them from trampling and feeding on native plant and animal species. The 284-acre (ac) (115-hectare (ha)) Haputo ERA, situated on the western edge of MCBCB, Guam (Figure 1), is dominated by native limestone forest. The site spans steep limestone cliffs between the sandy and cliff-faced shoreline and the upper plateau of northern Guam. Access to the lower areas of the site is primarily via a switchback hiking trail through a break in the cliff. Project activities will be conducted by U.S. Marine Corps civilian employees and Department of Defense (DoD) contractors, including U.S. Department of Agriculture, Wildlife Services. Ungulate eradication work is expected to take six months to complete and is planned to be completed prior to April 2023.

Ungulate eradication crews will subdivide the Haputo ERA with netting and capture or hunt out the ungulates from these areas while implementing measures to minimize project impacts to listed tree snails. In preparation for ungulate removal, crews will subdivide the ERA into smaller sections by attaching temporary netting (up to one meter (six feet) tall, with a lower lip to prevent ungulates from burrowing underneath) to existing trees. Project work will also include attaching 60 trail cameras to trees using nylon straps, and installation of traps (including coral traps and pig brig traps) and leg and neck snares baited with feed or scent lures. Ungulate control will be completed by driving the animals, using one to five people walking in parallel lines, through the sub-divided pockets. Each pocket will be checked with the assistance of trained hunting dogs, at least once, to verify the pocket is cleared of ungulates. Ungulates captured by snare, trap, or dog, will be dispatched by sharpshooters using quiet suppressed firearm or pneumatic rifles. Crews may use hand tools to cut understory vegetation where needed to create access where existing game trails and open spaces are not available. Spotlighting with bright lights may be used along the top of the cliff line to detect and shoot the deer at night. Portions of the temporary netting will be left in place until the entire site is cleared of ungulates to minimize re-colonization of previously-cleared pockets in the event another net fence fails during project implementation.

Tree Snail Avoidance Measures:

To reduce the potential for the eradication activities to result in the trampling and crushing of tree snails, tree snail survey and avoidance measures will be implemented as detailed below. All project field staff will undergo both classroom and field identification training for all listed species including listed tree snails. As detailed below, the majority of project work (all walking trails, vegetation removal, and areas for installation of equipment - netting/temporary fencing, cameras, snares, and traps) will be conducted with tree snail survey and avoidance protocols. Because tree snails may be downed and moved to new locations by strong winds, project activity, other than snail survey work, will not occur within the 7-day period after the project site

is affected by strong winds from a typhoon and the tree snail survey and avoidance measures will be re-done to detect and avoid tree snails in their new locations. As detailed below, hunting and ungulate removal will occur with care within areas known to be occupied by tree snails and limited walking by hunters and hunting dogs will occur where surveys for tree snails have not been done.

Project Activity Using Tree Snail Avoidance Measures: All areas that would be used for the project activities, including walking (other than hunts), vegetation removal, and installation of netting/temporary fencing, cameras, snares, and traps, will be surveyed, prior to commencement of field work, for tree snails. MCBCB bio monitors will conduct tree snail detection surveys using the standard prioritized search procedure (Fiedler 2019, entire) within all areas proposed for these project activities prior to the project work occurring in the area. Snail surveys will include 33-foot (ft) (10-meter (m)) buffers around these project work areas including adjacent areas where the project may result in vegetation or soil disturbance.

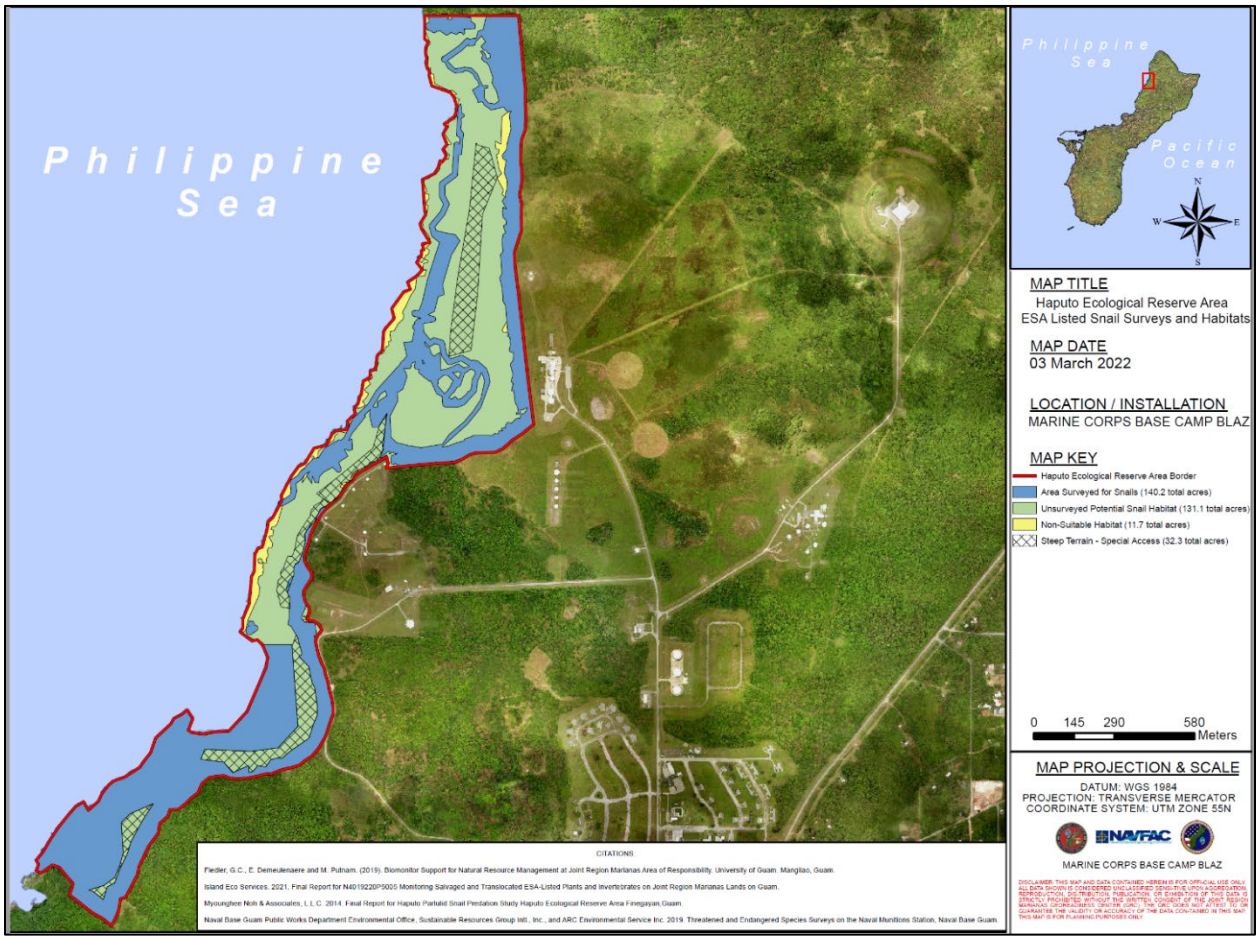

Figure 1. Haputo ERA, Guam map provided by NAVFAC (2022).

All areas occupied by a listed tree snail (including those detected in previous surveys with its edges confirmed by MCBCB bio monitors, new occupied areas found during the project snail surveys, and any new areas detected by other project staff during other project activity) will be cordoned off with temporary netting installed and maintained for the duration of the project at a

33-ft (10-m) distance from the occupied area (see below). All project work, with the limited exception detailed below, would be designed, or re-designed so it would occur outside the 33-ft (10-m) buffer protecting the tree-snail occupied area. None of the walking trails, vegetation removal, and areas for installation of equipment - netting/temporary fencing, cameras, snares, and trap project work or project vegetation or ground disturbance will occur within 33 ft (10 m) of any area known to, or found to, be occupied by a listed tree snail. In steep areas of cliff inaccessible for snail surveys (Figure 1), ungulates will be removed utilizing a snare or trap. The trap or snare location, and surrounding buffer areas will be surveyed by a MCBCB bio monitor prior to placement to ensure all activity related to the project, including ground disturbance resulting from the trap or snare, would not occur within 33-ft (10-m) of an area occupied by a listed tree snail.

Buffer netting details: Temporary project netting will be installed along a 33-ft (10-m) buffer around all areas known to or found to be occupied by tree snails to delineate the areas and prevent project activities from occurring near the tree snails. These nets will cordon off all areas previously known to be occupied by federally listed tree snails and any new areas found by MCBCB bio monitors to be occupied by federally listed tree snails. MCBCB bio monitors will accompany the eradication teams during the site preparation activities to assist them in delineating off areas that will be temporarily netted/fenced off to prevent trampling of snails.

Limited Ungulate Control Activities that Will Occur in Areas Occupied by Tree Snails and In Areas Not Surveyed for Tree Snails: Ungulate eradication personnel will take special care to avoid trampling tree snails in their work removing the ungulates from the areas known to be occupied by tree snails. In areas where the temporary project netting for tree snail-occupied areas are larger than an acre, the eradication team will install three sides of the temporary project netting and, with care given to each footstep, walk through the snail occupied space on a dry day to push ungulates out before securing the fourth side of the exclosure. In smaller areas, the smaller fences will not be closed until the area is confirmed to be free of ungulates.

Specific limited activity will occur within the portions of the site that remain unsurveyed for tree snails. The only project activities not implementing the tree snail surveys will be the off-trail, overland, ungulate shooting activities by eradication personnel and dogs. Ungulate shooting will occur in areas that are not pre-determined that will depend on the movements of the ungulates. The shooting and movement activities by eradication personnel and dogs that occurs where no tree snail surveys have been conducted would entail a maximum of 325 miles of human walking and 210 miles of dog movements. Ungulate drives, entailing 325 miles of hunters walking in unsurveyed areas, would be conducted slowly and methodically during daylight hours, to increase the likelihood hunting personnel may detect new tree snail colonies. Should a new tree snail colony be detected, the standard tree snail surveys would be conducted to delineate the perimeter of the new colony and the tree snail avoidance measures would be implemented to protect the newly-discovered tree snails. The total area that would be trampled by footfalls of hunters and dogs during the hunting activity in previously-unsurveyed areas would be less than four acres. To minimize footfalls in un-surveyed areas and to reduce impacts to native species, existing game trails that crisscross the project area and the project trails and fence lines previously surveyed for tree snails would be favored during this eradication work.

ACTION AREA

The action area is defined at (50 CFR 402.02) as "all areas to be affected directly or indirectly by the federal action and not merely the immediate area involved in the action." The Service has determined that the action area for this project is the Haputo ERA (see Figure 1).

ANALYTICAL FRAMEWORK FOR THE JEOPARDY ANALYSIS

Jeopardy Analysis Framework

In accordance with regulation (see 84 FR 44976), the jeopardy determination in this BO relies on the following four components:

1. The *Status of the Species*, which evaluates the species' current range-wide condition relative to its reproduction, numbers, and distribution; the factors responsible for that condition; its survival and recovery needs; and explains if the species' current range-wide population is likely to persist while retaining the potential for recovery or is not viable;

2. The *Environmental Baseline*, which evaluates the current condition of the species in the action area relative to its reproduction, numbers, and distribution absent the consequences of the proposed action; the factors responsible for that condition; and the relationship of the action area to the survival and recovery of the species;

3. The *Effects of the Action*, which evaluates all future consequences to the species that are reasonably certain to be caused by the proposed action, including the consequences of other activities that are caused by the proposed action, and how those impacts are likely to influence the survival and recovery role of the action area for the species; and

4. *Cumulative Effects*, which evaluates the consequences of future, non-Federal activities reasonably certain to occur in the action area on the species, and how those impacts are likely to influence the survival and recovery role of the action area for the species.

In accordance with policy and regulation, the jeopardy determination is made by evaluating the consequences of the proposed Federal action in the context of the species' current range-wide status, taking into account any cumulative effects, to determine if implementation of the proposed action is likely to cause an appreciable reduction in the likelihood of both the survival and recovery of the species in the wild. The key to making this finding is clearly establishing the role of the action area in the conservation of the species as a whole, and how the effects of the proposed action, taken together with cumulative effects, are likely to alter that role and the continued existence (i.e., survival) of the species.

STATUS OF THE SPECIES AND ENVIRONMENTAL BASELINE

Species Description

The Guam tree snail was federally listed as endangered on October 1, 2015 (80 FR 59423). Critical habitat designation for the species is in preparation. The Guam tree snail is a small land snail endemic to Guam. The shell is dextral with an obtuse spire and five whorls, and a pale straw color with darker axial rays and brown lines. The peristome is simple, thin, and white. Adult length is 0.5 to 0.7 inches (13 to 18 millimeters), and width 0.3 to 0.5 inches (8 to 13 millimeters) (Smith et al. 2008).

The Guam tree snail is part of the Partulidae family, which contains over 120 species distributed throughout the high volcanic islands of the tropical Pacific (Cowie 1992). Much of the family is extinct, and nearly all the extant species are considered critically endangered, endangered, or vulnerable under the definitions of the International Union for Conservation of Nature (IUCN 2022). The Guam tree snail was first described as *Bulimus (Partula) radiolatus* in 1846 and later renamed *Partula radiolata* in 1849 (Crampton 1925), which remains the accepted taxonomy for the species.

Life History

Little is known about the life history of the Guam tree snail. Land snails of the Partulidae family are generally slow-growing, long-lived, and slow-reproducing, producing between one and 10 eggs or juveniles in the brood pouch (Cowie 1992). Partulids are simultaneous hermaphrodites, having both male and female reproductive organs that are functional at the same time, and breeding may occur between unrelated individuals (outbreeding) or by self-fertilization (selfing) (Cowie 1992).

The Guam tree snail has historically been the most widespread and frequently encountered Partulid in Guam, and one hundred years ago Crampton noted the species occurred “almost everywhere in the island where suitable vegetation exists.” In Crampton’s (1925) study, colony size varied, even among uniform habitats; in the northern half of Guam, the species was more abundant in the west and relatively scarce in the east, while in the southern half of the island it was as abundant in the east as in the west. More than 2,000 individuals were collected across 37 sites in the 1920s (Crampton 1925). In 1989, resurveys found the Guam tree snail at only 9 of 34 of these sites, as well as at 7 of 13 new sites surveyed (Hopper and Smith 1992).

Partulids feed on live and decaying plant material, fungi, and microalgae (USFWS 2020). No clear obligate relationship with any vegetation has been identified for the Guam tree snail. No natural predators are known, but now extinct bird species of Guam may have fed on the Guam tree snail (Cowie 1992). The Guam tree snail lives primarily on the undersides of the leaves of many species of large-leaved plants including trees, shrubs, herbaceous plants, and occasionally ferns. The species’ preferred habitat is cool, shaded forest with high humidity and reduced air movement that prevents excessive water loss, and surveys have found individuals on both native and introduced plants (Smith et al. 2008; Lindstrom and Benedict 2014). The Guam tree snail typically is found in shaded vegetation including tree canopies more than 12 m (40 ft) high, degraded forests, and margins of forests or near water sources (Crampton 1925; Hopper and Smith 1992; Lindstrom and Benedict 2014). Increased mobility is associated with greater

humidity and precipitation. Tree snail movement is also facilitated by typhoons, which dislodge the leaves and branches carrying tree snails to adjacent locations (Fiedler pers. comm., 2018). When tree snails are dislodged from the host tree they retreat from the ground to return to the vegetation canopy (Fiedler pers. comm. 2018 and Holland, pers. comm. 2022). With the exception of post-typhoon periods when tree snails are found on leaves and branches dislodged by high winds, and when the leaf the snail is on dies and falls on the ground (Fiedler pers. comm. 2018), Guam tree snails are not known to spend time on the ground (Loerzel pers. comm. 2022, Holland pers. comm. 2022, Sischo pers. comm. 2022). A 325 acre survey in the Tarague Basin in 2020/2021 counted 5,760 *Partula radiolata* within a 9 acre portion of the Tarague (windward) site. The host plant on which *Partula radiolata* were observed was also recorded. Of the 2,458 host counts, only two observations were recorded on the ground (0.08 percent of the time)Rucinski (2021 (Table 2). No other survey has found a tree snail on the ground, though documentation of tree snail shells on the ground is common (Loerzel pers. comm. 2022, Holland pers. comm. 2022, Sischo pers. comm. 2022).

Sampled Guam tree snail populations have shown a very low degree of genetic heterogeneity, with no discernible colony specific or geographic patterns (Lindstrom and Benedict 2014). This indicates that Guam tree snails have limited ability to move between colonies, or that the sampled colonies have not been isolated long enough to form subpopulations (Lindstrom and Benedict 2014).

Status and Distribution

At the time of listing in 2015, there were no more than 26 colonies of Guam tree snails known, with between 10 and 150 individuals per colony. In 2020, the Guam tree snail was distributed across Guam in more than 50 locations, but populations at specific locations have likely fluctuated over the past century, and systematic comparisons of abundance over time has not been possible (USFWS 2020).

Threats

The following threats to the Guam tree snail contributed to its listing and continue to impact the ability of the species to recover.

Invasive Species Predation and Habitat Alteration: Persistence of the Guam tree snail is threatened by exposure to predation by ground-dwelling invertebrates, in particular the predatory invasive manokwari flatworm (*Platydemus manokwari*) (Holland 2014) and the arboreal little fire ant (*Wasmannia auropunctata*) (Vanderwoude, pers. comm. 2022; Richardson pers. comm. 2022; and Hawaii Invasive Species Council 2022). The non-native predatory land snails *Gonaxis quadriliteralis*, *G. kibwensiensi*, and *Euglandina rosea*, which are known to kill tree snails elsewhere in the Pacific, have also been documented on Guam (Holland 2014). The tree snail is also vulnerable to predation by arboreal rodents (less on Guam where rodent populations are suppressed by the brown treesnake), and trampling and predation by ungulates (Hopper and Smith 1992; USFWS 2020).Non-native ungulates graze upon the Guam tree snail's preferred host plants and profoundly impact the understory by clearing shrubs and trees, resulting in a drier

and hotter microhabitat unsuitable for the species (Smith et al. 2008) and by removing seed dispersers, the invasive brown treesnake also threatens the persistence of Guam tree snail habitat.

Introduced ungulates feed on, trample, and crush individual Guam tree snails and they trample or feed on seedlings, shoots, or young native plants before they can become established or tolerate herbivory and trampling. Ungulates were first introduced to the Mariana Islands by humans at least 500 years ago (De Freycinet and Barratt 2003). Pigs and deer are the biggest ungulate threats to Guam tree snail as they not only consume and trample individual snails, but they also change the structure of the forest habitat by making conditions unsuitable for regrowth by defoliating plants and destroying areas used for wallows (Wiles et al. 1999, 193-215). Since Guam tree snails prefer cool, shaded forest with high humidity and reduced air movement that prevents excessive water loss, (Smith et al. 2008; Lindstrom and Benedict 2014), areas impacted by ungulates are likely less hospitable for this species.

Invasive rodents and shrews have caused declines, and in some cases elimination, of island habitats (Cuddihy and Stone 1990). Rats feed on seeds, flowers, stems, leaves, roots, and other plant parts (Atkinson and Atkinson 2000) and can significantly affect regeneration of Guam tree snail's habitat. Introduced rats are responsible for the loss of vast lowland palm forests throughout Hawaii and on Rapa Nui because rats predated the flowers, seeds, and seedling palms, preventing them from regenerating (Hawaii DLNR 2020 and Hunt 2006). Rodents and the Asian house shrews (*Suncus murinus*) may also be predators of the Guam tree snail.

As a result of the introduction of the brown treesnake, the only remaining native avian frugivore on Guam is the Micronesian starling (*Aplonis opaca*) (Pollock et al. 2020). Almost three quarters of Guam's native trees were once dependent on birds to eat their fruits and disperse their seeds (Rogers et al. 2009; Rogers et al. 2017). Loss of seed dispersers on Guam has resulted in reduced recruitment, altered spatial distribution of native tree species, reduced species richness, and reduced forest regeneration on Guam in comparison to the other islands (Rogers et al. 2017). On Saipan, the median dispersal distance modeled by Rehm et al. (2019) for five bird species and 15 tree species was 184 feet (56 meters). In the absence of dispersal, seeds fall under the parent tree resulting in reduced connectivity between disjunct plants and reduced survival of seedlings due to conspecific competition (Nathan and Muller-Landau 2000). Elimination of seed dispersers has cascading effects on other trophic levels and can affect ecosystem stability (Perry and Morton 1999). The snake's elimination of seed dispersers is an indirect threat that negatively affects the habitats of the Guam tree snail.

Loss or degradation of habitat due to development: Guam tree snail's habitat has been substantially diminished in quality and quantity due to ongoing ungulate damage, the encroachment of invasive plants, and removal of habitat for agricultural, military, and urban development (80 FR 59424, October 1, 2015). Changes to the native forest understory particularly limit the persistence and size of extant Guam tree snail populations.

Habitat Loss due to Wildfire and Invasive Plants: Wildfire and invasive plants threaten the native species and ecosystems of Guam, and are both intentionally set (e.g., arson) or caused by altered fire regimes from alien species (80 FR 59424, October 1, 2015). Even in the absence of wildfire, invasive plants, such as vines and the legume *Leucaena leucocephala* (tangan-tangan),

crowd out native canopy trees, similarly creating a drier, less suitable understory (Hopper and Smith 1992).

Limited numbers: The low degree of genetic heterogeneity throughout the island (Lindstrom and Benedict 2014) increases the vulnerability of the Guam tree snail to extinction and may make the species more vulnerable to the effects of isolation, habitat fragmentation, and stochastic events, including disease and typhoons. The Guam tree snail is vulnerable due to having a limited number of remaining individuals. Species with small population sizes are at greater risk of extinction than species with large populations for the following reasons: a) reduced reproduction or inbreeding depression (Darwin 1859; Lacy 1997; Frankham 2005; and Crnokrak and Roff 1999); b) reduced levels of genetic variability, allele loss, due to bottlenecks, which can lead to reduced resiliency, especially in changing environments (Stebbins 1950); and c) extirpation of all remaining individuals of the species by a single catastrophic event such as a typhoon, drought, flood, or wildfire.

Overutilization: The collection of snail shells for trade threatens the persistence of the Guam tree snail (80 FR 59424, October 1, 2015).

Inadequacy of Existing Regulatory Mechanisms -Although the Guam tree snail is listed under the ESA and Guam ESA, Territorial law does not yet include protections for the species, leaving the species vulnerable to harm and harassment. In addition, local laws and interdiction efforts are inadequate to prevent intentional or accidental introduction of ungulates, the little fire ant, the manokwari flatworm and other non-native invasive species to Guam tree snail habitat.

Climate change: Climate change has the most direct impact on factors including more variable temperatures, more severe alternating periods of droughts and floods, and stronger typhoons. These changes can reduce the ability of an individual to survive, especially with additional anthropomorphic threats (USFWS 2015). The altered precipitation regimes and increased temperatures expected as a result of climate change could lead to the loss of native species that comprise the forest communities in which the Guam tree snail occurs. More frequent drought, flood, or typhoon events would affect understory microhabitat and Partulid food sources and exacerbate the effects of other threats. Further, damage or destruction of vegetation from typhoons modifies light availability and creates space for invasion by non-native pest and plant species (80 FR 59424, October 1, 2015). We anticipate the effects of climate change will further exacerbate the stress from the above listed threats, compounding the species vulnerability to habitat loss, predation, and limited numbers (USFWS 2015).

Environmental Baseline – Status of the Guam Tree Snail at Haputo ERA

Guam tree snail surveys have been completed over approximately half of the Haputo ERA (see Figure 1) and the snails are currently known to occur in patches within the site including areas where tree snails were translocated from Andersen South, Guam. Approximately 2,000 Guam tree snails have been detected in surveys of previously-known and new tree snail colonies at Haputo ERA. Surveyors detected 1,530 (ARC 2019)) Guam tree snails at the Haputo Beach tree snail colony and the number of snails detected at other locations of Haputo ERA are: Pugua

Point (31 snails), Double Reef (383 snails), South Haputo (2 snails) (Holland *et al,* 2014, 15-26), and Haputo fence line (30 snails, 0.4 snails/acre (Fiedler *et al*, 2019)).

Because the tree snail surveys did not include assessments of tree snail detection probability, there is considerable uncertainty regarding the number of tree snails in the action area. Because they would be within easy reach to surveyors, presumably detection probability is quite high for snails in the understory and on the ground while, however, due to limited visibility and backlighting during daytime snail surveys, Guam tree snail detection probability in overstory tree canopies is likely to be very low. No tree snails have been found on the ground at Haputo ERA. Detection probabilities for tree snail surveys is also likely to vary based on the level of search effort per acre searched. Tree snail detection probability can be as high as 39% when searchers spent a lot of effort searching very small areas, and as low as 1% when, such as in 2016, a tree snail is detected and snail presence is confirmed without implementation of a standardized search protocol (Rohrer 2016; Oahu Army tree snail survey information; Olmsted 2017, pers. comm. regarding Andersen South, Guam as cited in Department of the Navy 2017; Gary pers. comm. 2022; and Sischo, pers. comm. 2022). Detection of the approximately 2,000 Guam tree snails at Haputo ERA, with a 1% detection probability would mean there are actually 200,000 Guam tree snails within the surveyed areas of Haputo; a 4% detection probability would mean there are actually 50,000 tree snails. Application of a 39% detection probability would mean there are approximately 5,000 Guam tree snails living in the areas of Haputo ERA where the approximately 2,000 Guam tree snails were detected. Conservative assessment of the number of tree snails that were actually on the ground within the snail-surveyed areas of 0.08% of snails, indicates that there may have been between 4 and 160 Guam tree snails on the ground in the surveyed areas where surveyors detected zero snails on the ground. Because the detection probability of the Haputo ERA tree snails surveys was not assessed, there is considerable uncertainty regarding the number of Guam tree snails at Haputo ERA.

The Haputo ERA is vegetated by native limestone forest fringed by rocky and sand beach shoreline along the leeward side of northern Guam. Approximately 12 acres of the Haputo ERA are vegetated by bare coastal karst and short grassland areas, unsuitable for the Guam tree snail.

As detailed in the December 2021, Biological Evaluation, forest understory is heavily browsed by Philippine deer and pigs and large areas are devoid of all vegetation because of the approximately 346 deer and 48 pigs occupying the site. A very steep limestone outcrop cliff, largely inaccessible to humans and ungulates, runs along the length of the Haputo ERA (Figure 2).

The majority of tree snails at Haputo occur in a frequently studied patch of vegetation in the forest behind Haputo Beach, mainly in *Alocasia macrorrhiza* (taro) plants and in juvenile *Cocos nucifera* (coconut) leaves. The *Alocasia macrorrhiza* is a non-native mesic large-leaved plant that grows in a patch in the understory at Haputo Beach; 56% of the Guam tree snails counted at Haputo Beach by Holland et al. (2014) were found on *Alocasia macrorrhiza*. In surveys for tree snail predators within the tree snail colonies at Haputo, a relatively high density of predatory flatworms was found at the Pugua Point tree snail colony (13 worms observed per person-hour of survey), the team did not encounter any rat- or mouse-chewed native tree snail shells, and no live *Euglandina rosea* were found, but weathered shells of this predator were found. Predatory

rodents, flatworms, and wolf snails may occur on the ground at Haputo ERA. Ground predator exposure risks are likely to be sensitive to rainfall and moisture conditions.



Figure 2. Ungulate browse line at Haputo ERA (left, photo credit: Matthew Putnam) and limestone cliff (right, photo credit: Else Demeulenaere) (Photos from Fiedler *et al.* 2019).

EFFECTS OF THE ACTION

Nature of the Consequences

Because the approximately 400 ungulates at Haputo ERA are an ongoing threat to the Guam tree snails and their limestone forest habitat at Haputo ERA, the project's ungulate eradication action is among the most crucial conservation need for the Guam tree snail. Because there is considerable uncertainty regarding the number of Guam tree snails that may occur within those areas of the Haputo ERA where the standard tree snail survey and avoidance protocols will not be implemented, the risk that a field worker will trample a Guam tree snail cannot be discounted.

Risk of Trampling a Guam Tree Snail: Hunting personnel may trample and kill up to five Guam tree snails during those ungulate hunting activities that will occur within those portions of the Haputo ERA that have not been previously been surveyed for the Guam tree snail. The shooting and movement activities by eradication personnel and dogs that occurs where no tree snail survey and avoidance protocols are implemented at Haputo ERA would entail a maximum of 325 miles of human walking (with an associated 3.28 ac (1.32ha)) of footfall impact) and 210 miles of dog movements (with an associated 0.35 ac (0.14 ha) of dog footfall impact). In the absence of tree snail surveys and implementation of tree snail avoidance measures for field work in all areas of Haputo ERA, our risk assessment assumed tree snails are present in the unsurveyed areas. Because tree snails have not been detected on the ground at Haputo, the risk of tree snail trampling at this location may be lessened. However, because Guam tree snails have, at Tarague, been found on the ground (0.08% of them), and because tree snail detection probabilities may have been low in the previous surveys, our conservative estimate is that up to five Guam tree snail may be trampled as a result of the project activities.

Due to the likely prevalence of Guam tree snails within the unsurveyed work areas of Haputo ERA and given the lack of survey and avoidance implementation in these areas, there is a risk the proposed ungulate hunting work may result in the trampling and crushing death of a Guam tree snail. Footfall trampling the Guam tree snail on the karst limestone substrate of Haputo ERA would be likely to crush the tree snail's shell, resulting in fatal injury of the Guam tree snail.

Because the ungulate browsing pressure is extremely high at this site, cross-country pedestrian walking would usually be through areas devoid of understory leaves and branches. However, Guam tree snails may be dislodged from understory vegetation when the hunter's shoulders and equipment brush against understory vegetation occupied by a tree snail outside the areas where tree snail survey and avoidance precautions are in place. Additionally, the hunters would be pushing and tracking ungulates, so they would preferentially be walking in the trails and openings in the understory created by the site's significant ungulate population. There is also a risk the hunters may trample, as detailed above, the dislodged tree snail, though this risk is significantly diminished because hunters will push across the partitioned sites in side-by-side rather than single-file patterns. Because Guam tree snails have a hard protective shell and being dislodged from vegetation by wind and rain is a normal part of their behavior, any dislodged tree snails are not expected to be injured by the fall. During the time the project may cause a tree snail to be on the ground they could be exposed to predation by the flatworms that are known to occur at Haputo ERA (Holland et al 2014 p.26). Because of their brief time spent on the ground, project-dislodged tree snails are not expected to be affected by a ground predator as a result of the proposed action because any dislodged tree snail is expected to quickly return itself to the vegetation as they are known to do when they are dislodged by heavy rain and wind (Holland pers. comm. 2022).

Beneficial Consequences: The eradication of ungulates from the Haputo ERA will increase the likelihood of persistence of the Guam tree snail and by conserving the native limestone forest at that site, the project will benefit all native species in the area (USFWS. 2017). Ungulates not only consume understory and immature snail host plant species (both native and nonnative), but cause profound changes to the understory of forest habitats, which in turn affects tree snail populations (Smith et al. 2008; Smith 2013). In addition, ungulates may trample snails, and feral pigs may actively prey on snails. Removal of the ungulates from Haputo ERA and other snail habitat is among the highest priority conservation actions needed to conserve the Guam tree snail in the wild.

Cumulative Effects

Cumulative effects include the effects of future State, tribal, local or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

The Haputo ERA is expected to continue to be a focal point for the conservation of the Guam tree snail and native limestone forest. Tree snail surveys are expected to continue to occur at the site.

Conclusion

After reviewing the current status of the Guam tree snail, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is the Service's biological opinion that the action, as proposed, is not likely to jeopardize the continued existence of the Guam tree snail. The Service reached this conclusion based on the following information

described in the Effects of the Action section, above.

Although up to five Guam tree snails may be harmed by human disturbance and the trampled Guam tree snail is likely to be injured or killed, in the absence of project implementation, ungulates would continue to trample Guam tree snails and browse and graze the understory vegetation, preventing regeneration and persistence of the Guam tree snail's limestone forest habitat. The project's eradication of ungulates from the Haputo ERA would be beneficial to the long-term conservation of the Guam tree snail by restoring an ungulate-free area for the animal to occur. Project implementation is not likely to appreciably reduce the likelihood of both the survival and recovery of the Guam tree snail in the wild because the failure to implement the project would reduce the likelihood of persistence of the Guam tree snail at the Haputo ERA. Therefore, the action will be a net benefit to the species because it would restore ungulate-free habitat where a population of the Guam tree snail can be conserved.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act and Federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by FWS to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by FWS as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with the terms and conditions of this incidental take statement.

The measures described below are non-discretionary and must be undertaken by the United States Marine Corps so that they become binding conditions of any grant or permit issued to the [applicant], as appropriate, for the exemption in section 7(o)(2) to apply. The United States Marine Corps has a continuing duty to regulate the activity covered by this incidental take statement. If the United States Marine Corps (1) fails to assume and implement the terms and conditions or (2) fails to require the (applicant) to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the United States Marine Corps must report the progress of the action and its impact on the species to the Service as specified in the incidental take statement [50 CFR §402.14(i)(3)].

Amount or Extent of Take Anticipated

Based on our analysis presented in this Biological Opinion, the Service anticipates the following take may occur as a result of the proposed action:

1. The Service anticipates up to five Guam tree snails may be taken in the form of harm due to hunters walking 325 miles and 210 miles of dog movements within areas of the Haputo ERA project site where tree snail survey and avoidance measures are not implemented.

Effect of the Take

In the accompanying biological opinion, the Service determined that this level of anticipated take is not likely to jeopardize the continued existence of the Guam tree snail in the wild. Because control of ungulates is necessary for the conservation of the Guam tree snail, the proposed action is expected to result in the long-term benefits for the species.

Reasonable and Prudent Measures

The Service believes the following reasonable and prudent measure(s) are necessary and appropriate to minimize impacts of incidental take of the Guam tree snail:

1) Field crews will, where practicable, salvage any injured, dying, or freshly-dead individuals of the Guam tree snail they are made aware of.
2) The United States Marine Corps shall monitor and report on the level of incidental take of the Guam tree snail, including the number of miles walked in areas where tree snail survey and avoidance measures are not taken.

Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the Act, the United States Marine Corps must comply with the following terms and conditions, which implement the reasonable and prudent measures described above and outline required reporting/monitoring requirements. These terms and conditions are non-discretionary.

Monitoring and Reporting

Report to the Pacific Islands Fish and Wildlife Office Field Supervisor in Honolulu Hawaii, the number and locations of any new colonies of the Guam tree snail detected during field work at Haputo ERA. If practicable include GPS points.

Report to the Pacific Islands Fish and Wildlife Office Field Supervisor in Honolulu Hawaii, all known instances of injury or death of a Guam tree snail. If practicable include GPS points and photos.

Salvage of species
The United States Marine Corps shall inform the Field Supervisor of the Service's Pacific Islands Fish and Wildlife Office in Honolulu, Hawaii, in writing of take of any federally listed species within three (3) working days. In case of injury or mortality of listed species for which take has occurred, please contact Guam Department of Agriculture, Division of Aquatics and Wildlife Resources at (671) 735-0294.

Designated Repositories: The depository designated to receive specimens of any threatened or endangered species killed is the Department of Agriculture, Division of Aquatics and Wildlife Resources, 163 Dairy Road Mangilao, Guam 96913 (telephone: (671) 735-0294). If the DAWR is not able to receive dead specimens, please contact the Bernice Pauahi Bishop Museum, 1525 Bernice Street, Honolulu, Hawaii, 96817 (telephone: 808/547-3511). If the Bernice Pauahi Bishop Museum does not wish to accession the specimens, the United States Marine Corps should contact the Service's Division Office of Law Enforcement in Honolulu, Hawaii (telephone: 808/861-8525; fax: 808/861-8515) for instructions on disposition.

Inform the Field Supervisor of the Service's Pacific Islands Fish and Wildlife office in writing within three (3) working days of any injured threatened or endangered species found and the actions taken as well as any disposition of dead listed species. Care must be taken in handling any dead or injured specimens of proposed or listed species to preserve biological material in the best possible state. In conjunction with the preservation of any dead specimens, the finder has the responsibility to ensure that evidence intrinsic to determining the cause of death of the specimen is not unnecessarily disturbed. The finding of dead or injured specimens does not imply enforcement proceedings pursuant to the ESA. This reporting requirement enables the Service to determine if take is reached or exceeded and to ensure that the terms and conditions are appropriate and effective.

The Service believes that no more than five Guam tree snails will be incidentally taken as a result of the proposed action. The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize the impact of incidental take that might otherwise result from the proposed action. If, during the course of the action, this level of incidental take is exceeded, such incidental take represents new information requiring reinitiation of this consultation and review of the reasonable and prudent measures provided. The Federal agency must immediately provide an explanation of the causes of such taking and review with the Service the need for possible modification of the reasonable and prudent measures.

Conservation Recommendations

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

Conservation Recommendations

The Service recommends the standard tree snail survey and avoidance measures be completed over the entire ungulate removal project area to minimize trampling risks to the Guam tree snail.

Implement the biosecurity measures in Appendix B to avoid the spread of the little fire ant and other species to and within Haputo ERA.

In order for the Service to be kept informed of actions minimizing or avoiding adverse effects or benefitting listed species or their habitats, the Service requests notification of the implementation of any conservation recommendations.

Reinitiation Notice

This concludes formal consultation on the action(s) outlined in this biological opinion. As provided in 50 CFR § 402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained or is authorized by law and: (1) if the amount or extent of taking specified in the incidental take statement is exceeded; (2) if new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered; (3) if the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in the biological opinion; or (4) if a new species is listed or critical habitat designated that may be affected by the identified action.

Thank you for your ongoing efforts to conserve threatened and endangered species. If you have any questions concerning this Biological Opinion, please contact Island Team Manager - Mariana Islands, Jacqueline Flores, at the letterhead address or by telephone at (671) 989-6744.

Sincerely,

Michelle D. Bogardus
Deputy Field Supervisor

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APPENDIX A

NLAA Concurrence for Mariana Fruit Bat, Mariana Eight-Spot Butterfly, Two Tree Snail, and Seven Listed Plant Species

This appendix details the U.S. Fish and Wildlife Service's (Service) concurrence with your determination the proposed U.S. Marine Corps (Marine Corps) eradication of ungulates from Haputo Ecological Reserve Area (ERA), Marine Corps Base Camp Blaz (MCBCB), Guam, is not likely to adversely affect the threatened Mariana fruit bat (*Pteropus mariannus mariannus*, fanihi), *Bulbophyllum guamense* (wild onion, siboyas halumtanu, siboyan halom tano), *Cycas micronesica* (fadang), *Dendrobium guamense*, *Tabernaemontana rotensis*, *Tuberolabium guamense* and the endangered Mariana eight-spot butterfly (*Hypolimnas octocula marianensis*, ababbang, Libweibwogh), humped tree snail (*Partula gibba*, akaleha'), fragile tree snail (*Samoana fragilis*, akaleha' dogas), *Eugenia bryanii*, and *Heritiera longipetiolata* (ufa halumtanu, ufa halom tano), pursuant to section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 et seq.). Our analysis is based on information provided in your December 20, 2021, letter and telephone conversations, field investigations, and other information in our records. A complete record of this consultation is on file at the Pacific Islands Fish and Wildlife Office.

Project Description:

The proposed action would remove non-native invasive ungulates from the Haputo ERA, Guam. A detailed description of the proposed action is contained in your December 20, 2021, *Biological Evaluation of Ungulate Eradication at Haputo Ecological Reserve Area, Marine Corps Base Camp Blaz*, which we received January 4, 2022. Additional minimization and avoidance measures which were incorporated into your project at the recommendation of our office, are detailed within the Project Description body of this Biological Opinion or summarized below.

Avoidance and Minimization Measures:

Mariana Fruit Bat: Because the action area includes suitable habitat for the Mariana fruit bat, the project design incorporates the Service's standard recommended measures to reduce the likelihood the project may affect this sensitive species. The entire ERA and the surrounding forest within 150 meters of the ERA is visible from the cliff line; however, the structure of the tree canopy will usually prevent eradication teams from observing 492 feet (ft) 150 meters (m) when work is being conducted within the ERA. Prior to beginning each day's project activities, the eradication team will monitor the action area (ERA and surrounding area) for Mariana fruit bats from above the cliff line. Monitoring will be conducted again from within the individual pocket(s) or space(s) the eradication team is conducting work in that day. Monitoring will include looking for Mariana fruit bats flying to or from a roost, and visual surveys for roosting

bats. Should a diurnal roost be suspected in or adjacent to (within 492 ft (150 m) of the ERA, additional efforts to determine the location of the roost could include pre-dawn use of infrared sensors. No eradication activity will occur within 150 meters of a diurnal bat roost.

Almost all ungulate eradication activities within the ERA will be conducted during daylight hours, when Mariana fruit bats are more likely to be at a diurnal roost and less likely to be within or traversing the project site to forage. Limited night operations (spotlighting for ungulates during removal activities) will occur only on the upper cliff line in open areas outside forest habitat. Night operations will be occur no more than approximately 8 hours per month. Should any transiting or foraging Mariana fruit bats be observed during any type of project work, day or night, the project work will be postponed until the Mariana fruit bat has left the area of its own volition.

Tree snails: Minimization and avoidance measures detailed in the Biological Opinion Project Description, above, for the Guam tree snail, will also be taken to avoid trampling of the humped tree snail and the fragile tree snail.

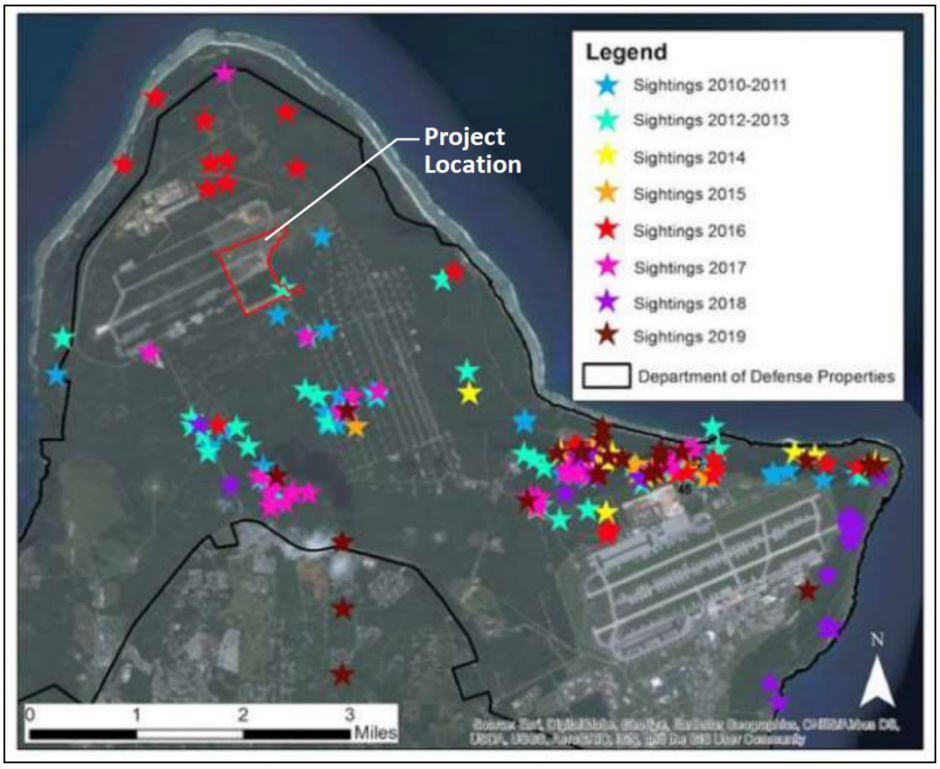
Mariana eight-spot butterfly and the listed plants: All project field staff will undergo both classroom and field identification training for all listed plants and butterfly host plants. To minimize the potential for the project to adversely affect a listed plant or butterfly host plant, no project-related soil disturbance (including soil disturbance by an ungulate in a snare) or vegetation cutting or other disturbance will occur within 10 ft (3 m) of a listed plant or 20 ft (6 m) from a butterfly host plant and personnel will not walk within 1 m (3 ft) of any such plant. Biomonitors will pre-survey all project areas other than the 325 miles of off-trail walking hunters will do outside surveyed areas, to identify the locations of listed plants and butterfly host plants so the locations of project items including nets, snares, and traps, can be modified to maintain buffer distances. Known Mariana eight-spot butterfly host plant locations are on large boulders or other areas that will be avoided during project work. Areas known to or found to be occupied by listed plants or butterfly host plants will be marked with visibility flagging or sectioned off with netting to ensure project actions maintain the avoidance buffers. Ungulate drives, entailing 325 miles of hunters walking in unsurveyed areas, would be conducted slowly and methodically during daylight hours, to ensure personnel are able to avoid walking near any previously unsurveyed listed plants and butterfly host plants.

Consequences of the Proposed Action:

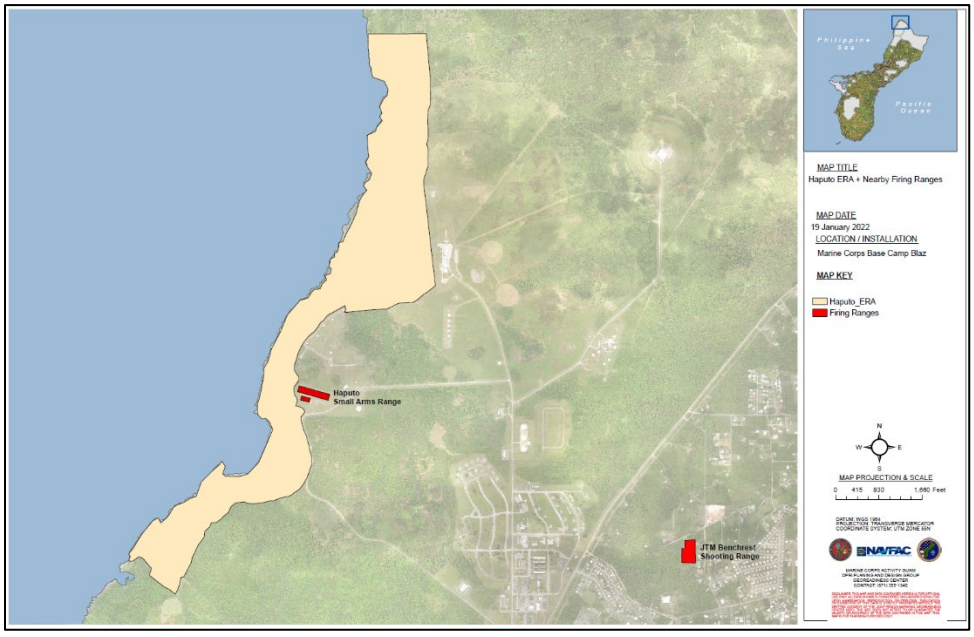
Mariana fruit bat:

The Mariana fruit bat has not been sighted within or transiting the project area, but bats are known from coastal sites north and south of the project site, and inland from the project area (Appendix A, Figure 1). The occurrence of the Mariana fruit bat at Haputo ERA may be influenced by the proximity of a small arms live-fire shooting range on the plateau above the site

(Appendix A, Figure 2).



Appendix A, Figure 1. Mariana fruit bat sightings from 2010 to 2019 at Andersen Air Force Base with proposed THAAD ADP project footprint indicated in red (U.S. Navy 2019).



Appendix A, Figure 2. Proximity of a live-fire shooting range to the Haputo ERA (NAVFAC 2022).

Mariana fruit bats are a large-bodied colonial tree-roosting species. Mariana fruit bats are at their roost during the day and they forage at night on fruits, nectar, pollen, and some leaves from at least 45 different plant species.

Colonies established by one or more bats can consist of fewer than 20 individuals or they can grow to over 1,000 individuals (Guilbert and Mullin 2020). A day roost occupied by one or more female bats is considered a maternal colony. Generally maternal colonies are occupied by a harem of bats – a single male with multiple females. Breeding occurs year-round. Bachelor colonies and solitary male bat roosts are also common. The mother bat carries its bat pups until they become too heavy. When these young bats that are not well developed enough to fly on their own, they are left at the maternal roost when the parents forage at night. Non-volant Mariana fruit bats are vulnerable at their day roost and foraging habitat to predation by the brown treesnake, disturbance by the little fire ant (Vanderwoude, pers. comm. 2022; Richardson pers. comm. 2022; and Hawaii Invasive Species Council 2022), and human disturbance and adult bats are vulnerable to harassment from these threats. When the Mariana fruit bat on its day roost is startled or alarmed by disturbance including human scent and noise it takes flight from its roost. Prolonged or severe disturbance results in abandonment of the roost. It can take months for bats to return to an abandoned root, if they return at all. Because some members of the public still consider the Mariana fruit bat to be a delicacy and a valued gift to persons of importance, these bats are vulnerable to poaching when they are outside of areas that are actively protected by law enforcement.

The eradication of ungulates from native limestone forest habitat will increase the persistence of the Mariana fruit bat's habitat on Guam. Ungulates cause profound changes to the understory of forest habitats. The high densities of feral ungulates in northern Guam dramatically alters forests and destroys native forest habitat. The proposed removal of ungulates from the Haputo ERA will improve the future condition of the area's limestone forest habitat for native species including the Mariana fruit bat.

To avoid human scent and other human disturbance to the sensitive bat, should one or more be found at the project site, the project design incorporates a 150-m (492-ft) buffer around the Mariana fruit bat. Because project activity will cease if a Mariana fruit bat is detected within 150 m (492 ft) of the project activity, impacts to the bat are expected to be extremely unlikely to occur. Because adverse effects are extremely unlikely to occur, they are **discountable** and therefore not likely to adversely affect the Mariana fruit bat.

Humped tree snail and fragile tree snail:

The humped tree snail is known from three locations at Haputo ERA: 108 snails were detected at Haputo and Pugua Point in the 2013 snail surveys (Lindstrom *et al* 2014), 88 humped tree snails were found in 2021, at a tree snail translocation site, and an additional 136 naturally-occurring humped tree snails were detected at the Haputo Beach tree snail colony and the southern area of

the Haputo ERA (ARC 2019, p. 22). A total of 43 fragile tree snails have been detected at Haputo ERA (3 were detected in the 2013 (Lindstrom *et al* 2014), one was found at Pugua Point (Holland 2014, p. 15), and a new, previously-unknown tree snail colony, containing 30 fragile tree snails, was found during pre-construction surveys for the Haputo ungulate fence (Fiedler *et al* 2019). Approximately half of the Haputo ERA has been surveyed for tree snails (NAVFAC 2022, see Biological Opinion Figure 1); no individual of either species has been found living on the ground. The humped tree snail and fragile tree snail may occur in one or more small tree snail colonies within the unsurveyed areas of Haputo where project hunters would walk 325 miles conducting ungulate eradication work.

The eradication of ungulates from the Haputo ERA will increase the likelihood of persistence of the tree snails and by conserving the native limestone forest at that site, the project will benefit all native species in the area (USFWS. 2017). Ungulates not only consume understory and immature snail host plant species (both native and nonnative), but cause profound changes to the understory of forest habitats, which in turn affects tree snail populations (Smith et al. 2008; Smith 2013). In addition, ungulates may trample snails, and feral pigs may actively prey on snails. Removal of the ungulates from Haputo ERA and other snail habitat is among the highest priority conservation actions needed to conserve listed tree snails in the wild.

Because there are expected to be very few humped tree snails and fragile tree snails within the areas of Haputo ERA where pre-work surveys and avoidance measures will not be conducted, and because zero, to a very small number, of these snails would be expected to be on the ground. The risk of the approximately 4 acres of footfall occurring on a tree snail is extremely low. The likelihood of a humped tree snail or fragile tree snail being trampled is extremely unlikely because there are not expected to be any tree snails on the ground within the small area of footfalls of the hunters. Because adverse effects are extremely unlikely to occur, they are **discountable** and therefore the project is not likely to adversely affect the humped tree snail and the fragile tree snail.

Mariana eight-spot butterfly and seven listed plants (Bulbophyllum guamense, *Cycas micronesica*, *Dendrobium guamense*, *Tabernaemontana rotensis*, *Tuberolabium guamense*, *Eugenia bryanii*, and *Heritiera longipetiolata*):

The listed plants and the Mariana eight-spot butterfly's host plants are vulnerable to physical injury and soil compaction, which could reduce their survival, reproductive success, or reproductive effort. Project risks to these species are reduced because all project field staff will undergo both classroom and field identification training for all listed plants and butterfly host plants and no project-related soil disturbance (including soil disturbance by an ungulate in a snare) or vegetation cutting or other disturbance will occur within 3 m (10 ft) of a listed plant or butterfly host plant and staff will not walk within 1 m (3 ft) of any such plant.

The eradication of ungulates from the Haputo ERA will increase the likelihood of persistence of the Mariana eight-spot butterfly and the seven listed plants and their native limestone forest habitat. Ungulates not only consume understory and immature listed plants and butterfly host plants, they cause profound changes to the understory of forest habitats, which in turn affects tree snail populations (Smith et al. 2008; Smith 2013). Removal of the ungulates from Haputo ERA is among the highest priority conservation actions needed to conserve these listed species in the wild.

Because of the project's implementation of measures to keep buffer distances for all activities to prevent project interactions with listed plants and butterfly host plants, the likelihood of a listed plant or butterfly host plant being affected by this project is extremely unlikely. Because adverse effects are extremely unlikely to occur, they are **discountable** and therefore the project is not likely to adversely affect the Mariana eight-spot butterfly, *Bulbophyllum guamense*, *Cycas micronesica*, *Dendrobium guamense*, *Tabernaemontana rotensis*, *Tuberolabium guamense*, *Eugenia bryanii*, and *Heritiera longipetiolata*.

Conclusion

Based on the proposed action, our analysis indicates consequences of the proposed action, to the Mariana fruit bat, humped tree snail, fragile tree snail, Mariana eight-spot butterfly, and *Bulbophyllum guamense*, *Cycas micronesica*, *Dendrobium guamense*, *Tabernaemontana rotensis*, *Tuberolabium guamense*, *Eugenia bryanii*, and *Heritiera longipetiolata* are discountable as described above. **The Service therefore concurs with your determination that the removal of ungulates from Haputo ERA may affect, but is not likely to adversely affect these species.** Unless the project description changes, or new information reveals that the proposed project may affect listed species in a manner or to an extent not considered, or a new species is listed or critical habitat designated that may be affected by the proposed action, no further action pursuant to section 7 of the ESA is necessary.

APPENDIX A, REFERENCES

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Richardson, M. 2022. Pers. comm. Little fire ant threat to vertebrates and invertebrates discussions with Hawaii Ant Lab regarding need for little fire ant eradication from all Pacific Islands. U.S. Fish and Wildlife Service entomologist. January 13, 2022.

Vanderwoude, C. Personal Communication. Microsoft teams meeting with the Service's entomologist Mike Richardson and biologist Dawn Bruns discussing effects of the little fire ant to listed species in the Pacific Islands. January 13, 2022.

APPENDIX B: BIOSECURITY PROTOCOLS

Biosecurity Protocols

- Ensure all work vehicles, machinery, and equipment are cleaned, inspected by its user, and found free of mud, dirt, debris and organisms prior to entry into and exit from the action area.
    - Vehicles, machinery, and equipment must be thoroughly pressure washed in a designated cleaning area (designated by the responsible land manager) and visibly free of mud, dirt, plant debris, insects, frogs (including frog eggs) and other vertebrate species such as rats, mice and non-vegetative debris. A hot water wash is preferred. Areas of particular concern include bumpers, grills, hood compartments, areas under the battery, wheel wells, undercarriage, cabs, and truck beds (truck beds with accumulated material (intentionally placed or fallen from trees) are prime sites for accidental transport of invasive species).
    - The interior and exterior of vehicles, machinery, and equipment must be free of garbage and food. The interiors of vehicles and the cabs of machinery must be vacuumed clean. Floor mats will be sanitized with a solution of at least 70-percent isopropyl alcohol or a freshly mixed 10-percent bleach solution.
    - Any machinery, vehicles, equipment, or other supplies found to be infested with ants (or other invasive species) must not enter action area. Treatment is the responsibility of the equipment or vehicle owner and operator.
- **Little Fire Ants**: Ensure all work personnel clothing and skin, and all vehicles, machinery, and equipment are inspected for invasive ants prior to moving to the project site and prior to moving from areas occupied by the little fire ant into areas where the ant does not occur.
    - Ensure a visual inspection for little fire ants (*Wasmannia auropunctata*) is conducted prior to entry into action area or movement within the project site, from previously or currently ant-occupied areas, into areas where the ant does not occur.
    - Hygiene is paramount but even the cleanest vehicle may transport little fire ant. Place insect bait into refillable tamper resistant bait stations. Note larger vehicles, such as trucks, may require multiple stations. Monitor bait stations frequently (every week at a minimum) and replace bait as needed. If the station does not have a sticker to identify the contents, apply a sticker listing contents of the station. Refer to the Hawaii Ant Lab's little fire ant fact sheet, which can be downloaded here: https://littlefireants.com/wp-content/uploads/02a-LFA-Fact-Sheet_v2.5_May2020.pdf.
    - Do not use any machinery, vehicles, equipment, or other supplies found to be infested with ants (or other invasive species) or used in an area infested by ants, for any type of project work until it is sanitized and re-tested following a resting period of at least 24 hours. Infested vehicles must be sanitized following recommendations by the Hawaii Ant Lab (http://www.littlefireants.com) or other ant control expert and in accordance with all State and Federal laws. Treatment is the responsibility of the equipment or vehicle owner and operator.
- Keep all base yards and staging areas inside and outside natural areas and native habitat free of invasive species.

- Ensure base yards and staging areas are inspected at least weekly for invasive species and any invasive found is to be removed immediately. Pay particular attention to where vehicles are parked overnight, keeping areas within 30-feet of vehicles free of debris. Parking on pavement and not under trees, while not always practical, is best.
- Project vehicles or equipment stored outside the action area, such as a private residence, are to be kept in a pest-free area as defined by the onsite land or project manager.
- Ensure all cutting tools, including machetes, chainsaws, and loppers are sanitized to remove visible dirt and other contaminants prior to entry into action area and prior to the movement of the tool from an area occupied or formerly known to be occupied by the little fire ant, into an area where the ant is not known to occur. Sanitized using a solution of >70% isopropyl alcohol or a freshly mixed 10% bleach solution. One minute after sanitizing, you may apply an oil based lubricant to chainsaw chains or other metallic parts to prevent corrosion.
- Vehicles, machinery, and equipment must be cleaned as described above.

- Safety note for individuals working in the action area:
  - Little fire ants nest in trees. If you are under a tree and that tree is bumped or somehow stressed, the threat response of the ants is to fall from the leaves and sting the person under the tree. If you are subject to an ant attack, do not panic. The ants are extremely small, but their stings are painful, so make sure you remove all ants from your body and clothing. The stings produce inch long welts that are itchy and painful, and can last for weeks.
  - Treat stings as you would other insect stings. In some persons, stings can produce life threatening reactions. Stocking antihistamine in the first aid kit is a reasonable precaution.

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F1S BO for the Construction of 48 Munition Storage Igloos at Andersen Air Force Base, Guam (June 2020)

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Biological Opinion for MSA Igloos



Photo Credit: United States Navy

June 30, 2020
(01EPIF00-2019-F-0012)

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Pacific Islands Fish and Wildlife Office
300 Ala Moana Boulevard, Room 3-122
Honolulu, Hawaii 96850

In Reply Refer To:
01EPIF00-2019-F-0012

June 30, 2020

Jeffrey Laitila
36 CES/CEV Flight Chief
Andersen AFB Guam
Unit 14007
APO AP 96543-4007

Dear Mr. Laitila:

This document transmits the U.S. Fish and Wildlife Service's (USFWS or Service) biological opinion (BiOp) based on our review of the U.S. Department of the Navy (DON) proposed construction and operation of 48 earth-covered magazines (ECMs), also referred to as munition storage igloos, within the Munition Storage Area (MSA) I located on Andersen Air Force Base (AAFB), Guam, and its effects on the threatened Mariana Fruit bat (*Pteropus mariannus mariannus*), *Cycas micronesica*, and *Tabernaemontana rotensis* (Table 1) in accordance with section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 et seq.). Your Biological Assessment (BA), containing sufficient information for the Service to complete this formal consultation was received on April 21, 2020.

This BiOp is based on information provided in the April 21, 2020 BA, previous correspondence between the Service, Air Force and DON, and information in Service files. A complete consultation record is on file at the Pacific Islands Fish and Wildlife Office (PIFWO).

Table 1: Species considered in this biological opinion.

Common Name	Latin Name	Listing Status	Critical Habitat	Effect Determination
Mariana Fruit Bat	*Pteropus mariannus mariannus*	T	NA	Likely to adversely affect
NA	*Cycas micronesica*	T	NA	Likely to adversely affect
NA	*Tabernaemontana rotensis*	T	NA	Likely to adversely affect

Consultation History

10/10/2018. USFWS received BA and request for formal consultation via email.

10/25/2018. DON and USFWS meet to discuss BA. USFWS to send comments on BA.

11/8/2018. USFWS sent a letter acknowledging the information necessary to initiate formal consultation was included in the October 10 letter and BA. Letter identified information requested to add/clarify the detail in the BA. Consultation number 01EPIF00-2019-F-0012 assigned to the project.

11/29/2018. DON submitted revised BA to USFWS with the requested information from the 11/8/2018 USFWS letter via email.

12/12/2018. USFWS-DON teleconference to discuss outstanding issues and BA revision.

12/13/2018. DON provides Mariana fruit bat (fanihi) survey methodology for Habitat Management Unit (HMU) via email.

12/14/2018. USFWS reviews and approves fanihi survey methodology via email.

12/19/2018. USFWS sends clarification regarding 10(a)(1)(A) permit requirement for potential handling of snails via email.

1/31/2019. USFWS-DON teleconference to discuss outstanding issues.

2/7/2019. USFWS provides DON with a draft snail survey protocol via email.

2/8/2019. DON seeks direction from AAFB leadership on whether to pause consultation until snail surveys are completed (email).

2/21/2019. USFWS sends email pausing consultation retroactive to 2/8/2019 (see above).

3/6/2019. DON acknowledges receipt of 2/21/2019 email and indicates AAFB is pursuing modification of University of Guam (UOG) contract for snail surveys (telephone conversation). Pending funding process, surveys expected to be completed by the end of April.

4/25/2019. USFWS requests clarification on status of consultation and use of Tarague Triangle fence via email.

6/26/2019. USFWS requests update on status of consultation.

7/15/2019. USFWS requests update on status of consultation.

7/15/2019. DON reports that snail and cycad survey contract have been awarded and are about to begin.

9/16/2019. DON email states cycad and snail surveys near completion and revised BA is expected by the end of the month.

9/20/2019. DON email requests call or meeting with USFWS.

10/2019. DON submits revised BA with snail survey report submitted to USFWS (version 3).

11/20/2019. USFWS provides comments on BA (version 3).

1/27/2020. DON submits revised BA (version 4).

2/25/2020. USFWS provides comments on BA (version 4).

3/23/2020. USFWS provides recommendations for cycad pup collection, nursery growth, and outplanting.

4/09/2020. DON and USFWS teleconference to discuss updates to draft BA.

4/21/2020. DON submits final BA for USFWS review.

4/28/2020. USFWS letter acknowledging initiation of formal consultation with DON.

BIOLOGICAL OPINION

Description of Proposed Action

The 36th Wing (WG) Commander proposes to construct new munitions storage facilities and infrastructure upgrades in MSA I. The action incudes building 48 ECMs within a 51-acre construction footprint. The ECMs will be arranged side by side along 5th to 8th Streets between C Avenue and E Avenue. The DON has chosen this arrangement because it reduces operational impacts to existing ECMs and does not require the need to demolish operating munitions storage units.

Other alternatives have been analyzed and eliminated from detailed evaluation in the Draft Environmental Assessment (EA) due to the current 36th WG munitions storage capacity deficit (DON 2018). Natural resources including protected species are just one environmental media analyzed in the DON's Draft EA. Demolishing ECMs that are operational without immediate replacement would cause a storage shortfall. In order to upgrade or replace any one of the existing storage magazines, the munitions in that existing magazine (and possibly surrounding magazines) would have to be temporarily relocated for safety purposes. No other location on AAFB can safely accommodate a temporary relocation of munitions from the existing ECMs. The only safe option would be to temporarily store munitions at an installation other than AAFB during renovation or construction periods. The 36th WG would not be able to meet their current mission requirements if their existing capabilities were further reduced by temporarily storing munitions at other installations.

Layout of the Munition Storage Facilities

The magazine storage area consists of ECMs arranged in rows linked together by a network of roads. A grassy buffer area approximately 20 feet surrounds each magazine. The area beyond the buffer is highly fragmented forest that separates rows of munitions magazines. The land area

shows signs of past land grading. Historically, the area was impacted by agroforestry, small-scale agriculture, and military use during World War II (Cardno 2017).

The proposed Hayman-style ECMs would be used to store up to 500,000 pounds of munitions. The 48 ECMs would be arranged in various clusters with 8 ECMs along 8th Street, 2 along 7th Street, 25 along 6th Street, and 13 along 5th Street. Each magazine would be 81 feet long by 25 feet wide for an area of 2,400 square feet. The walls and roof are designed to be covered in a minimum of 24 inches of fill with a topping of shotcrete to prevent plant growth and erosion. Access to the storage area would be provided through a pair of blast-resistant structural steel access doors. Each ECM would have a concrete apron connecting it to the roadway. Spacing between each ECM would be approximately 50 feet, and a buffer area of 50 feet will be spaced around each cluster. This buffer area will be cleared of vegetation, graded for water drainage, and managed for grass cover. The total area to be cleared to create a grassy buffer zone will be 21 acres. Total area of impact for all the construction will be 51 acres.

Existing access roads from 5th to 8th Streets are in poor condition and will be improved with pavement. New roads will be 24 feet wide with 2 foot shoulders and constructed of asphaltic concrete. Concrete aprons 24 feet long and 26 feet wide will connect the ECMs to the road. A staging area to hold equipment and materials for the construction phase is also planned. It will clear 1.6 acres of previously disturbed shrub and grassy area near the northern corner of 5th Street and D Avenue.

A utility connection line will provide communication and electrical service to all of the storage units. The line will connect each ECM and other clusters of magazines by underground utility corridor duct banks or trench. The duct banks would be 2 to 4 feet (60 to 122 m) deep and 6 feet (1.8 m) wide with a cleared area of 6 feet (1.8 m) for back hoe. Total width of the corridor will be a 12 feet (3.6 m) wide path. Some of these lines are sited through forest along Avenue D and will require clearing. A pad-mounted transformer and new building with standby generator will be constructed at the intersection of 5th Street and D Avenue.

Site Preparation and Construction Activities

During site preparation, surface vegetation will be cleared and grubbed (i.e., roots and stumps extracted), and the ground will be excavated for the storage unit flooring. Ground disturbance during construction will include site grading to establish positive drainage control and creation of a perimeter mound to control runoff. Best management practices for soil erosion and sedimentation control will be implemented in accordance with project-specific drainage and erosion control plans. ECMs is planned to be constructed in three phases starting with 20 ECMs roughly along D Avenue, 16 ECM along 5th and 6th Street, and 12 ECMs along 6th Street. Project construction is planned to begin in March 2021.

Night construction will not occur as part of this project and all noise generating construction will end approximately 30 minutes before sunset.

Best Management Practices

DON will implement the following efforts as best management practices (BMP) to avoid and minimize impacts to ESA-listed species that occur within the project footprint.

1. To prevent environmental stressors on the listed plants, plant assessments and collection of plant material will be conducted by an authorized biologist before any construction related vegetation clearing or site preparation. Once all the (plant) material is collected, the DON will approve the site for vegetation clearing or site preparation.
2. ESA-listed plants within 10 feet of the construction perimeter will be clearly flagged to prevent any unnecessary disturbance from construction.
3. During site preparation and prior to any clearing and grubbing of surface vegetation, the construction perimeter will be clearly marked to prevent encroachment into adjacent areas with ESA-listed plants.
4. Silt fences or straw wattles will be used to prevent soil erosion into adjacent areas with ESA-listed plants. Dust screens will be installed at the project boundary if ESA-listed plants are within 10 feet from the project boundary. The dust screens will be used to shield protect, screen, and create a buffer for the ESA-listed plants.
5. DON will implement a contractor education program to ensure contractor personnel are informed of the biological resources in the project area, including invasive species, special-status species, avoidance measures, and reporting requirements in the project area. DON staff will provide the contractors a natural resources orientation with special focus on *C. micronesica*, *T. rotensis*, and Mariana fruit bat to ensure construction personnel are aware of these species and avoid inadvertent impacts due to lack of awareness of resource presence, sensitivities, and protective measures (see Appendix A in the BA for pamphlets and natural resource training material related to coconut rhinoceros beetle (*Cocos nucifera*) (CRB) and little fire ant (*Wasmannia auropunctata*) (LFA).
6. In areas where noise, light or human activity from construction of the proposed action would result in excessive noise, light or human activity above the ambient level, construction contractor personnel will be required to survey within line of sight (up to 150 m) of construction activities for bats prior to the start of a day's construction activities. If a fruit bat is present within the 150 meter buffer, construction work generating noise, light or human activity above the ambient levels will be postponed until the bat(s) has left the area and the DON will be notified to assess the situation. The construction contractor will document bat surveys in the daily logs.
7. DON staff will examine the condition of listed plant species within 10 feet of the construction perimeter during construction activities and document any adverse effects to the plants within that buffer. DON will contact the Service if new information reveals effects of the action that may adversely affect the listed plants in a manner or to an extent not previously considered. DON will inspect the contractors work to ensure that these BMPs are implemented for the entire duration of the project. DON staff will conduct random, unannounced inspections monthly and document the results in a log.
8. The DON will provide project specific work plans to the Service for inclusion in the consultation file.

Conservation Measures-General

The project's Conservation Measures are designed to avoid or minimize project effects to listed species and their habitats or to contribute to the recovery of a listed species. Conservation Measures are considered part of the proposed action and are vital to determining the scope of the proposed action. Implementation of Conservation Measures is required under the terms of the proposed action.

1. An authorized biologist will conduct and oversee all plant Conservation Measures. The authorized biologist must have relevant experience at a comparable level of responsibility in projects of similar size, scope and complexity and must have the following minimum qualifications:
    a. A bachelor's degree with an emphasis in botany, horticulture, ecology, or a related science;
    b. At least 100 documented hours of experience conducting propagation, translocation, transplantation, pest control, and monitoring of the aforementioned species or a closely related species; and
    c. Applicant must provide contact information of three references familiar with their work related to b (above).
2. Prior to salvage DON's authorized biologist will conduct surveys for ESA-listed plants to determine the health status of plants that cannot be avoided in the construction footprint. These additional surveys, referred to as pre-construction surveys, will verify the occurrence of federally listed species in the construction footprint and evaluate them for salvage and transplantation. An assessment will be conducted to determine how many individuals can be salvaged through either collection of seeds (*C. micronesica* and *T. rotensis*) or basal shoots (*C. micronesica*). DON's authorized biologist will pursue seed germination and plant division to meet transplanting success targets.
3. Plant propagation will occur at nurseries that follow the Hawaii Rare Plant Restoration Group "Phytosanitation Standards and Guidelines."
4. All salvaged plants will be transplanted in vegetation plots. AAFB Environmental Flight will choose up to five vegetation plots for the transplantation of salvaged individuals. These vegetation plots will be mixed native limestone forest with an ungulate-proof fence and ungulate-free. DON's authorized biologist will choose transplanting locations within habitat suitable to support cycads. The sites must receive environmental approval from the 36th Wing Commander prior to award of a contract to conduct the salvage and transplant activities. DON will submit the description of the locations to the Service once the sites are approved.
5. The DON will maintain the ungulate fences around these plots and conduct weed removal (mechanically, manually, or by herbicide) to enhance the existing native forest. Invasive species within a 20-foot radius around salvaged plants will be removed and maintained to ensure no more that 15 percent of vegetation is invasive species within the plots.

6. The DON will submit an annual report to the Service one year after the BiOp is rendered and each year thereafter until the project and associated conservation measures are complete. The conservation measures will be complete once the number of plants meeting the success criteria, defined in the DON's BA, has been achieved. The report will summarize the type of activities (e.g., health status of plants, propagation, transplantation, etc.) conducted on each species and the status of transplantation efforts. It will include the number of cycads basal shoots and seeds collected from each healthy adult, mature cycad and the number of *T. rotensis* seeds collected, propagation methods (number seeds germinated), survival rate, and the number of plants meeting the success criteria. DON will also include information on bat monitoring within line of sight (up to 150 m) of construction activities.
7. If it is determined that a contractor has violated any of the DON's proposed conservation measures, the DON will provide an on-site biological monitor during all further construction actions to insure no further incidences occur.

Conservation Measures for Specific Species

Cycas micronesica

The DON has proposed the following methods for salvage, propagation, and outplanting (transplanting from the nursery to a conservation site) of *C. micronesica*:

1. Efforts will be made to salvage as many cycad basal shoots as possible that are deemed healthy and suitable for salvage. An authorized biologist with the qualifications described above would make the determination of "health." Cycad basal shoot health is based on a variety of factors including extent of cycad aulacaspis scale (*Aulacaspis yasumatsui*) infestation/damage and current health condition of the parent plant.
2. Basal shoots that are approximately 1.7 inches in diameter (golf ball size) and larger will be considered for salvage (EA Engineering 2019).
3. Prior to salvage of the basal shoots, pesticides will be applied to treat cycad scale and cycad blue butterfly (*Chilades pandava)* larvae.
4. Cycads will be visually inspected for LFA before salvage and transplant. If LFA are observed, LFA Management Procedures will be followed (See Appendix A in BA).
5. Basal shoots will be removed from the main trunk to maintain as much of the root mass as possible. All pups will be placed in an appropriate pot for the pup's size and promote drainage.
6. Basal shoots will be tagged prior to removal from the parent plant. The tags will consist of a unique alphanumeric aluminum tag, which will be secured to the individual pots.
7. A pressure washer may be used to remove any remaining debris, loose plant material, and pests (i.e. cycad scale).
8. During transportation, basal shoots will be covered for protection from sun and wind exposure.
9. Once transported to a nursery, commercial root-promoting hormone may be applied to the stem followed by the remaining treatments: fungicide and insecticide applied in accordance with label directions and applicable regulations and law.

10. Each basal shoot will be potted in plastic pots with well-drained potting media such as pumice, perlite or sand and/or soilless and placed in the nursery. Salvaged basal shoots will be processed and transplanted in the nursery within one week of salvage.
11. Cycads will be evaluated monthly or more frequently depending on the conditions of the plants to determine growth and status. Any disease outbreak or significant loss of individuals under nursery conditions should be reported to the Service to allow DON and the Service to work together to ensure the success of nursery propagation of cycads.
12. Salvaged cycad basal shoots/seeds will be propagated in a nursery until an authorized biologist determines they are suitable for transplanting.
13. After transplantation, maintenance will include watering, weeding, fertilizer, pest control, support structures and/or plant protection until the plants show stem growth of at least 1.0 cm as measured below the base of the existing leaves (fronds) since planting in the wild.
14. Salvaged cycads (basal shoots or seeds) will be monitored and maintained until a minimum of 95 genetically different individuals have been established in the wild, showing stem growth of at least 1.0 cm as measured below the base of the existing leaves (fronds) since planting in the wild, and plants will be weaned of maintenance for a period of six months since planting for natural up take of nutrients and water.
15. The 95 individuals is based on: (1) the health of the plants within the project footprint, (2) the ability to safely salvage the basal shoots or seeds, (3) whether or not the basal shoot would survive transplantation, or (4) whether the plant produces seed. An authorized biologist will make the determination of "health."

Tabernaemontana rotensis

1. The DON has proposed to salvage and propagate enough *T. rotensis* seeds to ensure a minimum of six genetically distinct individuals meet or exceed success criteria described in #2 below. This minimum number is based on the assumption that there will be at least six mature, adult *T. rotensis* trees producing seeds at the time of collection. If seeds cannot be collected from within the project footprint prior to being removed (i.e., if the trees do not produce seeds), plant cuttings will be collected from the project footprint or seeds will be collected from individuals within the action area. A seed collection site consisting of 53 *T. rotensis* trees has been identified outside the project footprint but within the action area.
2. Once collected, seeds of *T. rotensis* will be cultivated in a plant nursery for propagating and subsequent transplanting. An authorized biologist will determine when plants are ready for transplanting and plant them into the vegetation plots. Monitoring will be done monthly or more frequently depending on the conditions of the plants to record growth and health status. Maintenance will be conducted depending on environmental conditions and plant needs, these include watering, weeding, pest removal, and plant protection. The DON's success criteria for *T. rotensis* transplanting is the plants must be between 2 and 3 feet tall, leaves remain turgid on the plant, individuals produce apical stem growth, and plants will be weaned of maintenance for a period of six months.

Action Area

The action area is defined at (50 CFR 402.02) as "all areas to be affected directly or indirectly by the federal action and not merely the immediate area involved in the action." The DON has determined that the action area for this project is AAFB, which is located on the northern tip of Guam on a limestone plateau occupying approximately 14,000 acres. The Service has reviewed this proposed action area and determined that since it includes areas where no effects to listed species are expected to occur the action area is, instead, the project footprint with an additional buffer of 150 meters. This accounts for possible bat disturbance, edge effects, and all five proposed outplanting sites (Achae Point, Tarague Basin, Tarague Triangle, Palms Golf Course, and 3A Outplanting). The entire action area is a total of 274 acres, including the project footprint, 150 meter buffer, and outplanting sites each totaling 51, 216, and 7 acres, respectively. The proposed ECMs would be constructed within MSA I, which is located northwest of AAFB's airfield and southeast of Northwest Field. The project footprint is within MSA I and includes a 51-acre construction footprint of 48 ECMs and related construction activities (Figure 1). No designated critical habitat occurs within the action area.

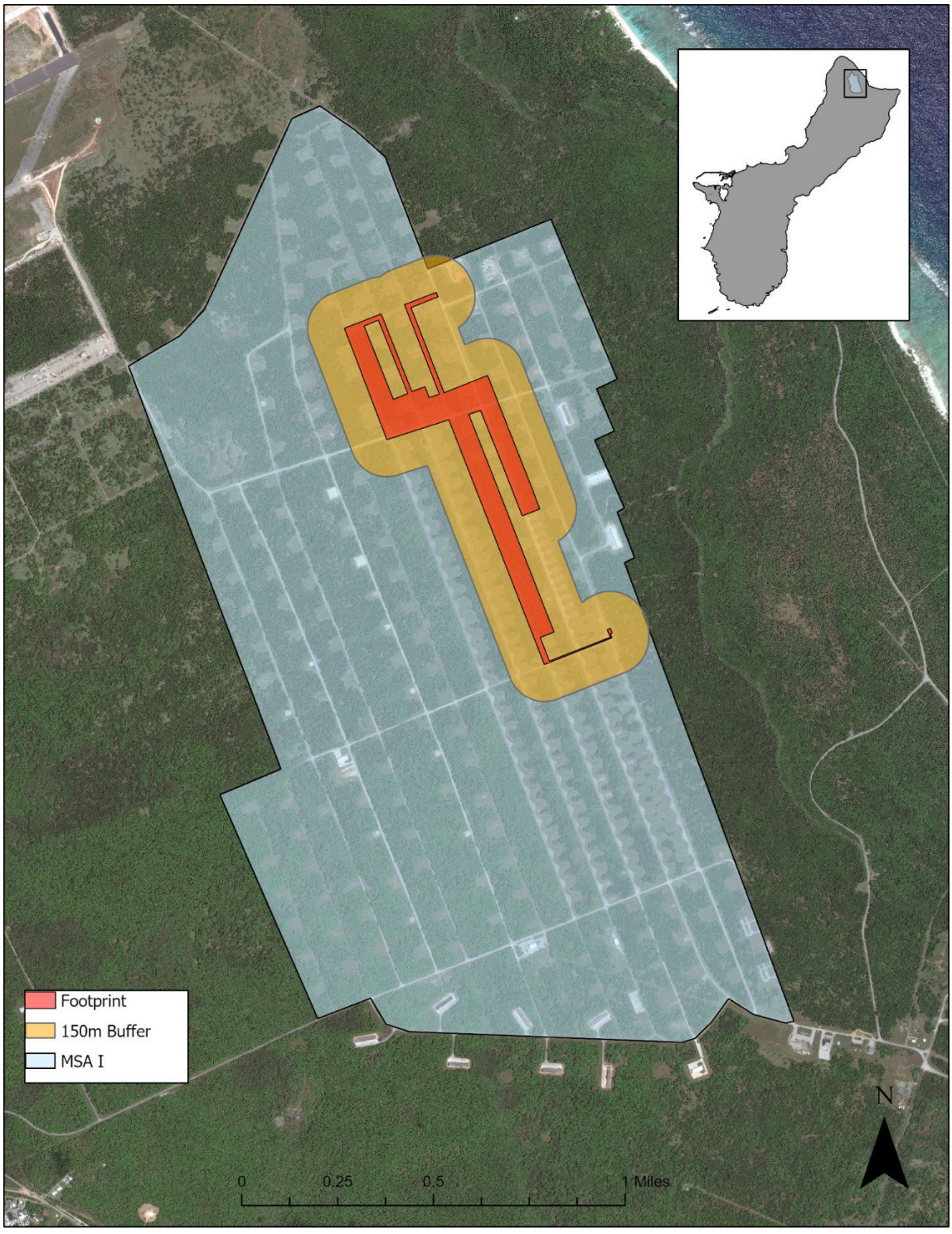

Figure 1: Layout of the Igloo site including MSA I, project footprint, and 150 meter action area buffer. Figure does not include proposed outplanting sites.

Analytical Framework for the Jeopardy/Adverse Modification Analysis

Jeopardy Analysis Framework

In accordance with regulation (see 84 FR 44976), the jeopardy determination in this BiOp relies on the following four components:

1. The *Status of the Species*, which evaluates the species' current range-wide condition relative to its reproduction, numbers, and distribution; the factors responsible for that condition; its survival and recovery needs; and explains if the species' current range-wide population is likely to persist while retaining the potential for recovery or is not viable;
2. The *Environmental Baseline*, which evaluates the current condition of the species in the action area relative to its reproduction, numbers, and distribution absent the consequences of the proposed action; the factors responsible for that condition; and the relationship of the action area to the survival and recovery of the species;
3. The *Effects of the Action*, which evaluates all future consequences to the species that are reasonably certain to be caused by the proposed action, including the consequences of other activities that are caused by the proposed action, and how those impacts are likely to influence the survival and recovery role of the action area for the species; and
4. *Cumulative Effects*, which evaluates the consequences of future, non-Federal activities reasonably certain to occur in the action area on the species, and how those impacts are likely to influence the survival and recovery role of the action area for the species.

In accordance with policy and regulation, the jeopardy determination is made by evaluating the consequences of the proposed Federal action in the context of the species' current range-wide status, taking into account any cumulative effects, to determine if implementation of the proposed action is likely to cause an appreciable reduction in the likelihood of both the survival and recovery of the species in the wild. The key to making this finding is clearly establishing the role of the action area in the conservation of the species as a whole, and how the effects of the proposed action, taken together with cumulative effects, are likely to alter that role and the continued existence (i.e., survival) of the species.

Status of the Species

Status of Mariana Fruit Bat

Species Description

The Mariana fruit bat was listed as endangered in 1984, but was reclassified to threatened on January 6, 2005, when it was determined that all fruit bats on Guam and throughout the Commonwealth of the Northern Mariana Islands (CNMI) comprise a single subspecies (70 FR 1190). The Mariana fruit bat is the only fruit bat species under U.S. jurisdiction. In 2004, critical

habitat for the fruit bat was designated at the Guam National Wildlife Refuge (GNWR) in the Ritidian Unit (69 FR 62944).

The Mariana fruit bat is a medium-sized fruit bat in the family Pteropodidae, and weighs between 0.73 lb to 1.27 lb (331 g to 577 g). Male Mariana fruit bats are slightly larger than females. The underside (abdomen) is black to brown with gray hair interspersed that creates a grizzled appearance. The shoulders (mantle) and sides of the neck are bright golden brown, but may be paler in some individuals. The head varies from brown to dark brown. The well-formed, rounded ears and large eyes give the face a canine appearance (USFWS 2010).

The paleotropical genus *Pteropus* is represented by approximately 63 species distributed across the Indian Ocean, Southern Asia, Australia, and in Oceania as far east as the Cook Islands (Almeida et al. 2014 p. 83). Most species in the genus *Pteropus* occur on islands or in coastal areas (Almeida et al. 2014 p. 84). Four species in the genus *Pteropus* are extinct and 38 species (60 percent of the genus) are considered critically endangered, endangered, threatened, near threatened, or vulnerable under the definitions of the IUCN (IUCN 2017). One of the four extinct species, *P. tokudae*, occurred only on Guam and has not been detected since 1968 (Bonaccorso et al. 2008; USFWS 2010).

Flannery (1995) and Simmons (2005) consider the Mariana fruit bat as one of two subspecies of fruit bats restricted to the Mariana Archipelago, with the Mariana fruit bat inhabiting the islands from Guam to Saipan and *P. mariannus paganensis* occurring on Pagan and Alamagan islands. However, subsequent genetic analysis conducted by Brown et al. (2011) indicate no genetic differentiation among islands within the Mariana Archipelago and that the bats on these islands, currently classified as two subspecies, should be managed as a single subspecies, *P. mariannus mariannus* (p. 940). In addition to the Mariana fruit bat, there are several other subspecies of *P. mariannus* endemic to other archipelagos, including the Caroline Islands and the Palau Archipelago (Brown et al. 2011 p. 934).

Life History

Mariana fruit bats, similar to other bats in the Pteropodidae family, do not use laryngeal echolocation, instead relying primarily on vision and smell to avoid obstacles and locate food sources (Almeida et al. 2014). Mariana fruit bats vocalize readily within colonies and when roosting. The diet of the Mariana fruit bat is comprised of fruits, nectar, pollen, and some leaves from at least 45 different plant species (Mildenstein & Johnson 2017). Rapid digestion and metabolism of food makes these animals reliant on forest habitat with diverse food resources available throughout the year (USFWS 2010). Mariana fruit bats use several forest types for foraging, roosting, and breeding, including native primary and secondary limestone forest, volcanic (or ravine) forest, old coconut plantations, and groves of *Casuarina equisetifolia* (Rice & Taisacan 1988; Worthington et al. 2001 p. 137; Wiles & Johnson 2004 p. 589, 591). Most Mariana fruit bats roost during the day in maternity colonies at sites to which they show a high level of fidelity (unless disturbed). A small proportion of Mariana fruit bats, usually males, roost alone or in small groups called bachelor colonies. Within colonies, Mariana fruit bats typically group themselves into harems (one male and 2-15 females) or bachelor groups (predominantly males) (Wiles 1987a).

Population Dynamics

Population demographic information for the Mariana fruit bat is limited. Based on three years of field observations on Guam similar to other Pteropodidae species, female Mariana fruit bats rear up to one pup annually (USFWS 2010) and likely have a gestation period of approximately 4.6 to 6.3 months (Pierson & Rainey 1992 pp. 1–17). Many *Pteropus* species typically do not give birth until 18 months of age (Pierson & Rainey 1992 pp. 1–17; McIlwee & Martin 2002 p. 76). Lifespan of substantially larger species, *P. alecto*, in Australia is four to five years, with a maximum of eight years (Vardon & Tidemann 2000).

Based on this demographic information, several authors have suggested that *Pteropus* bats have a low maximum population growth rate and thus a slow rate of recovery when a population is diminished (Pierson & Rainey 1992 p. 76; McIlwee & Martin 2002). Table 1 provides current population estimates per island and other demographic data (Mildenstein & Johnson 2017 p. 20).

Table 2: Mariana fruit bat population estimates and density by island

Island	Forest Habitat (ha)	No. of Bats	Density
Andersen, N. Guam	25,711	45	0.00
Rota	6,663	4,149	0.62
Aguiguan	302	50	0.17
Tinian	6,481	< 25	0.00
Saipan	5,355	< 50	0.01
Farallon de Medinilla	< 1	< 5	--
Anatahan	N/A	150	--
Sarigan	169	157	0.93
Guguan	170	226	1.33
Alamagan	485	86	0.18
Pagan	1,971	1,017	0.52
Agrihan	2,336	858	0.37
Asuncion	316	573	1.81
Maug	48	11[1]	

[1]Insufficient data available

Status and Distribution

The Mariana fruit bat is endemic to the Mariana Archipelago. The Mariana Archipelago extends across 459 nautical miles (nm) and is comprised of the U.S. Territory of Guam and 14 islands constituting the CNMI. The Mariana fruit bat is found on all 15 islands within the Marianas, except for Uracas, the northernmost island (Wiles et al. 1989 p. 69). The Mariana fruit bat is currently thought to be extirpated from Tinian (USFWS 2014). A single Mariana fruit bat was photographed on Farallon de Medinilla on two occasions, in 1996 and in 2008 (DON 2013 pp. 4–123).

Mariana fruit bats in general are strong fliers and highly mobile and small groups have been observed flying over the ocean between islands (Wiles & Glass 1990 p. 2; Wiles & Johnson

2004 p. 593). Distances between are: Guam to Rota, 32.3 NM; Rota to Aguijan, 42.1 NM; Aguijan to Tinian, 4.9 NM; Tinian to Saipan, 2.7 NM; Saipan to Farallon de Medinilla, 45.9 NM; and Saipan to Anatahan, 64.3 NM. In the remaining northern Marianas, interisland distances range from 15.7 NM to 54.0 NM. All islands have a maximum elevation ranging from 551 feet to 3,166 feet with the exception of Farallon de Medinilla, which has a maximum elevation of 266 ft. All islands are visible in clear weather from the tops of adjacent islands (Wiles & Glass 1990 p. 1).

Distribution of occupied Mariana fruit bat roost sites have fluctuated sharply in the southern islands. Fluctuations are attributed to variations in survey methods, coverage, and movements of Mariana fruit bats between islands (USFWS 2010). Initial observations of Mariana fruit bats in the southern islands (Aguiguan, Tinian, and Saipan) in 1983 and 1984 revealed populations of less than 25 to 50 Mariana fruit bats on each island. Mariana fruit bat numbers increased to about 75 to 100 individuals on Saipan in 1986 and to about 300 individuals on Aguiguan by 1988 (Wiles & Glass 1990 p. 2). Mariana fruit bats on Rota are believed to move periodically among the southern islands, and thus Rota is considered to be important to the long-term stability of the species in the southern part of the Marianas (Wiles & Glass 1990 p. 2; Wiles et al. 1995).

Historic numbers of Mariana fruit bats on Guam have been between 400 and 800 since 1984, but have since been decreasing. By the early 1980s nearly all Mariana fruit bats on Guam lived in Northern Guam in a single colony, which occasionally divided into several smaller aggregations (Wiles & Glass 1990 p. 2; Mildenstein & Johnson 2017 p. 25).

Survey data in the northern islands (Anatahan, Sarigan, Guguan, Alamagan, Pagan, and Agrihan; excluding Asuncion and Maug, which were not surveyed during this time period), indicate a 40 percent decline in Mariana fruit bat numbers between 1983 and 2000 (USFWS 2010). In the Service's 2014 5-year review, Mariana fruit bats were found to be stable or declining throughout most of their range; the only exception being on Rota where populations were increasing since 2008 due to increased enforcement of wildlife regulations (USFWS 2014).

Threats

Illegal hunting, loss of native forest, predation by the brown tree snake (*Boiga irregularis*) (BTS) on Guam, and the increased risk of extirpation or extinction of small, fragmented populations are the most significant threats to the survival of the Mariana fruit bat (USFWS 2014). These current known and potential threats are discussed below.

Threats:

- Loss or Degradation of Habitat:
    - Human development is a factor in habitat loss on all inhabited southern islands and on northern islands with military activity.
    - Feral ungulates and Philippine sambar deer (*Rusa marianna*) degrade habitat on many of the islands in the Marianas Archipelago. The successful eradication of feral ungulates from Sarigan and Anatahan suggests that similar projects may succeed on other islands. However, once grazing and browsing pressure is

removed, the potential invasion of native forest by non-native plants may be a more difficult and long-term recovery issue.

- Human Disturbance:
    - Illegal hunting is a threat to Mariana fruit bats throughout its range. Although law enforcement activity has increased since 2009 (CNMI -DLNR 2008; CNMI-DLNR 2009a, 2009b, 2010), illegal hunting of Mariana fruit bats on Rota continues and will likely resume to historical levels unless consistent, effective law enforcement efforts in tandem with education and outreach programs continue. Mariana fruit bats appear to be declining on Tinian, Saipan and Guam, and illegal hunting is thought to have greatly contributed to the decimation or decline of those populations (Wiles & Payne 1986; Wiles & Glass 1990; Sheeline 1991; Stinson et al. 1992; Esselstyn et al. 2006). As with Rota, recovery of the Mariana fruit bat on human-inhabited islands will not likely be possible without strong education programs combined with effective control of illegal hunting.
- Non-native Snake Predation:
    - BTS prey on non-volant young left at the roost during the night, thus preventing the recruitment of young bats into the breeding population. Effective control of BTS is among the actions that must be achieved before the Mariana fruit bat population on Guam can recover. The interdiction, control, and ultimate eradication of BTS on Guam are the focus of major, ongoing projects, and the Mariana fruit bat is likely to benefit from these efforts in the long term across the archipelago. This prognosis would change drastically if the BTS were to become established widely throughout the archipelago.
- Stochastic Events:
    - Typhoons and volcanic eruptions result in mortality, reduced population viability, and habitat loss. Natural disasters can be especially damaging to the viability of smaller Mariana fruit bat populations (e.g., on Guam, Saipan, Aguiguan, and Maug). The significant loss of habitat on Anatahan after the volcanic eruption in 2003 resulted in the loss of a substantial Mariana fruit bat population that has not yet recovered.

<u>Mariana Fruit Bat Recovery Criteria</u>

A draft revised recovery plan for the Mariana fruit bat (USFWS 2010) addressed actions needed for the survival and recovery needs of the Mariana fruit bat. New information indicates that, to meet recovery objectives, stable or increasing fruit bat subpopulations should, at a minimum, be distributed on the islands that currently have extant populations (USFWS 2010). Actions that reduce or eliminate the potential for self-sustaining populations of resident Mariana fruit bats on Guam may hamper or preclude recovery of the species. The reduction or elimination of this potential may take many forms: degradation or loss of habitat and resources required by the fruit bat for foraging, roosting, and reproduction; increased exposure of fruit bats to illegal hunting and other sources of human disturbance; and introduction of non-native predators that prey upon fruit bats. In order for the Mariana fruit bat's population to recover on Guam, sufficient amounts of functional habitat will need to be protected and restored on Guam (USFWS 2010).

Guam contains a large proportion of the remaining native limestone forest in the southern inhabited Mariana Islands, and most of that habitat is located within Department of Defense (DoD) lands. Habitat loss and degradation, illegal hunting, predation by non-native predators, and human disturbance currently impact fruit bats. If threat levels increase within Mariana fruit bat habitat, it may further inhibit the potential for the species to recover.

Survival and Recovery Needs

Before the Mariana fruit bat is considered for delisting, the Service proposes that stable or increasing populations should exist on three of the five southern islands (Saipan, Tinian, Aguiguan, Rota, and Guam), and six of the northern islands where Mariana fruit bats have persisted historically (Anatahan, Sarigan, Guguan, Alamagan, Pagan, Agrihan, Asuncion, and Maug (USFWS 2010). Of the six northern islands that require stable or increasing numbers, two of these must include Pagan, Anatahan, or Agrihan. Since publication of the draft revised recovery plan (USFWS 2010), new information on the Mariana fruit bat has resulted in changes to how we look at recovery for the species. We now consider recovery in terms of stable or increasing subpopulations of sufficient size distributed across Guam and the Mariana Islands. To meet recovery objectives, stable or increasing Mariana fruit bat subpopulations should at a minimum be distributed on the islands that currently have extant populations (USFWS 2010). The final version of the Mariana fruit bat recovery plan is currently in review, and recovery criteria stated here may change upon completion of the final plan.

Of the six northern islands, the only evidence for a possibly increasing population is on Asuncion (USGS 2010 p. 33). Of the five southern islands, only Rota has achieved an increasing population. Although a conservation area containing some important habitat for Mariana fruit bats was established on Rota (USFWS 2011 p. 1), there is not currently enough protected Mariana fruit bat habitat on Rota, Guam, Tinian, or Saipan to support substantial population recovery on any of those islands. Even if sufficient habitat is set aside in conservation to support recovery of populations, controlling illegal hunting may continue to be a challenge that limits recovery of the species (USFWS 2014).

Status of the *Cycas micronesica*

Species Description

Cycas micronesica (fadang in Chamorro) was federally listed as threatened under the ESA on October 1, 2015. No critical habitat has been designated for this species. A recovery plan for *C. micronesica* has not been completed.

Cycas micronesica is part of the Cycadaceae family, which contains only one genus, *Cycas*, a very ancient genus of trees dating back to the Jurassic period. Ninety-eight *Cycas* species are described, and 75 species (77 percent of the genus) are considered critically endangered, endangered, threatened, near threatened, or vulnerable under the definitions of the (IUCN 2017). All *Cycas* species are restricted to the equatorial regions.

Cycas micronesica is a palm-like plant, usually unbranched tree with a thick trunk. Adult stem lengths reach 8m, rarely to 12m, and 14-25 cm in diameter with pinnate leaves 150-180 cm long (Hill 1994).

Life History

Cycas micronesica is the only native gymnosperm in the Mariana Islands. Cycads are dioecious, and both sexes bear reproductive structures that are relatively massive amongst gymnosperms (e.g. conifers). *Cycas micronesica* occurs in limestone forests in Guam and Rota, with fewer occurrences in volcanic soils typical of southern Guam (Stone 1970 p. 65; Hill 1994). Few studies exist that describe cycad natural history and ecology in the Mariana Islands, and much of the current literature is focused on its decline and effects from introduced pests. However, *C. micronesica* (identified as *C. circinalis* at the time) is a food source for the Mariana fruit bat, which feed on its fruits (Wiles & Fujita 1992 p. 27), as well as for the Chamorro people, who process the fruits to rid the naturally-occurring toxins (Whiting 1963).

Cycas micronesica emits chemical cues to attract specialist insects for pollination (Schneider et al. 2002); however, there is also evidence of wind as a pollen vector in open areas or forested areas with some wind on Guam (Terry et al. 2009 p. 96; Hamada et al. 2015).

Population Dynamics

At the time of listing, there were fewer than 516,000 individuals on Guam (Marler 2013). This number does not distinguish between successfully reproducing adults and juveniles (Marler 2013), which, because of the effects of the cycad aulacaspis scale, implies that the number of extant individuals that can successfully reproduce is much lower.

Within Guam's AAFB, over 257,000 individuals were documented in July 2013; however, the population structure was dominated by adults with little recruitment and declining reproductive success (Marler 2014). In a separate survey, an unquantified number of *C. micronesica* individuals were found at 11 sites across Guam, some of which were on AAFB (Harrington et al. 2012). Between March 2015 and January 2017, natural resources personnel from the Marine Corps Activity Guam conducted surveys, which identified 19,852 mature individuals (DON 2017).

Status and Distribution

Cycas micronesica is known historically from Guam, Rota, Palau (politically the independent Republic of Palau) and Yap (geographically part of the Caroline Islands; politically part of the Federated States of Micronesia (Hill 2004; Hill et al. 2004) and has been outplanted on Tinian (NAVFACMAR 2016). In a 2002 forest inventory on Guam, prior to the introduction of *A. yasumatsui*, *C. micronesica* was the most abundant tree detected with over 1.5 million individuals counted on island (Donnegan et al. 2004 p. 16). In 2013 population estimates for Guam was down to 516,000 and 111,500 on Rota. Outside of the Marianas 300,000 were estimated on Yap, and 2,500 on Palau. Currently, there are no updated population numbers for Yap and Palau, but estimates for Guam and Rota are 344,000 and 52,000, respectively. These

estimates signify a decline of 33.3 percent on Guam and 53.4 percent on Rota, since 2013. As of February 2016, the total outplanted experimental population on Tinian was 903, half of which were small and required continued maintenance (NAVFACMAR 2016). The latest projections estimate a complete extirpation of *C. micronesica* from the island of Guam by 2032 if current rates of mortality continue unabated (Marler & Krishnapillai 2020).

Threats

The following threats to the species contributed to its listing or were identified subsequent to listing and continue to be an issue in the ability of the species to recover.

- Loss or degradation of habitat due to:
    - Development, urbanization, agriculture, as well as wild or incidental fire;
    - Non-native plants, trees, shrubs, and vines that compete with *C. micronesica* for space; and,
    - Non-native ungulates that degrade remaining forest habitats through herbivory and physical damage.
- Low population number from:
    - A lack of recruitment into the population on Guam that is currently dominated by adults increases the vulnerability of the species and challenges its ability to increase or maintain a population structure.
- Non-native pest species including:
    - *A. yasumatsui* which is an introduced cycad specialist armored scale insect that is the most significant threat and primary driver of mortality of all life stages (Marler & Muniappan 2006 p. 3, Marler & Krishnapillai 2020; Marler 2014). As of January 2013, *C. micronesica* mortality reached 92 percent on Guam, and cycads on Rota are experiencing a similar fate from the cycad aulacaspis scale (Marler 2013). *A. yasumatsui* has also invaded Palau; however the effects of the invasion on *C. micronesica* have not yet been determined. A specialist scale predator beetle, *Rhyzobius lophanthae*, was introduced purposefully to treat the *A. yasumatsui* outbreak with some positive results (Marler & Lawrence 2012 pp. 234–238). A number of other insects, including the cycad blue butterfly and a native longhorn beetle that bore cycad stems (*Dihammus marianarum*), also contribute to declining health and mortality in Guam cycad populations (Marler & Muniappan 2006 p. 3; Marler & Lawrence 2012 pp. 238–240).
- Reduction of resiliency if:
    - Unhealthy trees are not able to withstand or recover from damage caused by high winds and rains of typhoons (Hirsh & Marler 2002) if their natural resilience has decreased due to chronic *A. yasumatsui* damage.

Survival and Recovery Needs

In order to recover *C. micronesica*, individuals of this species need to be protected throughout its range. To promote population stability, *C. micronesica* populations should consist of a minimum 200 individuals and have age classes consisting of seedlings, juveniles, and adult plants (HPPRCC 2011). Expanded trials with biocontrol, especially targeting *A. yasumatsui*, should be

considered to help stabilize the population (Marler & Lawrence 2012 p. 240). In addition, future invasions from other pests must be prevented (Marler & Lawrence 2012 p. 240). Feral pigs and introduced deer are also threats through herbivory and physical damage, further compounding effects from insects (Marler & Lawrence 2012 p. 238); therefore, ungulate control and fencing restoration sites are also crucial steps in managing cycad populations.

Status of the *Tabernaemontana rotensis*

Species Description

Tabernaemontana rotensis (no common name) is currently listed as threatened (USFWS 2015). No critical habitat has been designated for this species. A recovery plan for *T. rotensis* has not been completed.

Tabernaemontana rotensis is in the dogbane family, Apocynaceae, which includes trees, shrubs, herbs, stem succulents, and vines. The family contains 366 genera, and the *Tabernaemontana* genus consists of 103 species (The Plant List 2013). *Tabernaemontana rotensis* is a small to medium-sized (8-10 m tall) tree with leaves that are thin, light green, opposite, and 15-30 cm long (Stone 1970). Flowers are white, elongate, slender, and branch from the tree. *Tabernaemontana rotensis* produce conspicuous orange fruit that are twinned or single and beaked (UOG 2007 p. 6; GPEPP 2015 p. 22).

Life History

Tabernaemontana rotensis occurs in forests with crevices of rough limestone (Raulerson & Rinehart 1991 p. 94) and are able to colonize sites that occur in full sun or in deep shade (UOG 2007 p. 16). The species has primarily been found in areas of little to no slope (<15 percent) (UOG 2007; JRM 2016). *Tabernaemontana rotensis* has been found in forest habitats most often co-occurring with *C. micronesica*; however, *T. rotensis* were not found in areas that were dominated by non-native tree species (UOG 2007).

Tabernaemontana rotensis populations typically flower in August through October, followed by the production of immature or orange fruit (UOG 2007 p. 23). During this time, 40 to 80 percent of trees were found to have at least some flowering occur every month (UOG 2007). The fruit of *T. rotensis* reaches full size of 1.6 inches, approximately 30 to 35 days after flowering. Fruit is mature after approximately 90 days, when it has turned from green to bright orange and splits open and exposes seeds (UOG 2007).

Seed dispersal of *T. rotensis* is dependent on birds and therefore a lack of frugivore bird species on Guam has resulted in limited spatial distribution of *T. rotensis*. Today, *T. rotensis* is generally found clumped within confined areas, as seedling establishment is restricted to within the vicinity of the parent tree (UOG 2007). This phenomenon does not support seedling recruitment, as seedlings develop in extreme competition with one other, and many of them become stunted and die (UOG 2007).

In typhoon conditions, *T. rotensis* develops a synchronized pulse of flowering about one month after the typhoon. This pulse of flowering leads to a mast seeding event about four months after a typhoon (UOG 2007 p. 29). This species may behave like a pioneer species since germination and seedling emergence have been shown to be maximized in full sun conditions (i.e., after typhoon damage) (UOG 2007).

Population Dynamics

In a study specific to AAFB, the species occurred in clumped patches within 256 sites across the base (UOG 2007). The population structure of over 21,000 individuals included emerging seedlings, young juveniles, and reproductive mature individuals with an extensive canopy size. The species was observed in northern Guam in the following areas: Ritidian Point, Pati Point, the Habitat Management Unit (HMU), and central and southeast edge of AAFB (UOG 2007; JRM 2016). At least five individuals of *T. rotensis* also occur within the GNWR. At the time of listing, *T. rotensis* was known from six occurrences on Guam and nine individuals on Rota (80 FR 59423). Individuals on Rota varied in size between 0.5 m and 6 m (1.6 ft. to 19.7 ft.) spread across the western, southern, and eastern parts of the island (CNMI-DLNR 2015).

Since the time of listing, additional surveys have identified and tagged 196 total individuals (88 of which were mature) at two locations outside of DoD property (GPEPP 2015). A total of 23,325 individuals have been identified at six locations on DoD property, over 85 percent of which are on AAFB (DON 2017).

Status and Distribution

Tabernaemontana rotensis is endemic to Guam and Rota and was suggested to be restricted to limestone forest habitat (Stone 1970). It was originally noted as very rare needing seed cultivation or cuttings to assure the existence of the species (Stone 1970).

Threats

The following threats to the species contributed to its listing or were identified subsequent to listing and continue to be an issue in the ability of the species to recover.

- Loss or degradation of habitat due to:
    - Wildfire, urbanization, and agricultural development;
    - Non-native plants and non-native ungulates that further degrade remaining forest habitats;
    - Spatial distribution when many individuals are growing in close proximity throughout AAFB. This aggregated pattern increases the vulnerability of the population, especially at sites with less than 15 percent slope that are suitable for human development.
- Low population numbers and lack of recruitment and dispersal are due to:
    - Restrictions to the spatial extent and distribution of bird populations on Guam.
    - Clustered populations exhibit less genetic diversity, becoming less resilient to evolutionary changes (UOG 2007).

- Clustered populations are more vulnerable to stochastic events causing a disproportionate species effect (extreme events or disease), thus the become more prone to extinction pressures (UOG 2007).
- Forest degradation due to typhoons which may require multiple years to regenerate.
- The lack of a viable seed bank for natural regeneration.

Survival and Recovery Needs

In order to recover *T. rotensis*, the remaining individuals of this species need to be protected on Guam and Rota. *Tabernaemontana rotensis* populations should have age structures consisting of seedlings, juveniles, and adult plants. Ungulate and invasive species control should be implemented throughout its range. On Guam, restoring areas with this species' natural dispersers (e.g., native frugivore birds) would expand the distribution of the *T. rotensis* population into new habitat niches, niches that would have likely been naturally occupied by the *T. rotensis* population prior to the loss of seed dispersal on Guam. Outplanting or relocation of wild seedlings within protect areas would help increase their abundance and distribution on Guam and Rota.

Environmental Baseline

Regulations implementing the ESA (50 CFR 402.02) define the environmental baseline as the past and present impacts of all federal, state, or private actions and other human activities in the action area. Also included in the environmental baseline are the anticipated and/or ongoing impacts of all proposed federal projects in the action area that have undergone Section 7 consultation, and the impacts of state and private actions which are contemporaneous with the consultation in progress.

Status of the Species within the Action Area

Mariana Fruit Bat

The habitat within the action area consists of both primary and secondary limestone forest and *Vitex* dominated forest as described by the Guam Plant Extinction Prevention Program (GPEPP) (2017). Limestone forest habitat contain trees suitable for bat roosting and feeding, namely *Elaeocarpus, Tristiropsis,* and *Artocarpus*. All are present within the action area (GPEPP 2017). *Vitex* dominated forest is less desirable, but may provide roosting habitat. Fruit bats are highly mobile and while they have been documented flying over the action area, there are no records of bats actively roosting or foraging in the action area. It is reasonable to assume that fruit bats have occasionally utilized the area to roost or feed.

Cycas micronesica

As of 2019, 473 *C. micronesica* were estimated to occur within the project footprint (DON 2020, GPEPP 2019). This number does not include cycad individuals growing immediately adjacent to,

but outside of, the project footprint. Within the five proposed outplanting sites (Achae Point, Tarague Basin, Tarague Triangle, Palms Golf Course, and 3A), there are at least 412 total cycads (GPEPP 2019). The proposed action is expected to remove the existing plants within the project footprint through land clearing. Surveys of the MSA by GPEPP (2017) showed the highest density of cycads within the MSA occurs within the project footprint (32.1 to 37.7 *C. micronesica* per acre) proposed for clearing. When considering *C. micronesica* counted in 2017, the action area includes an estimated minimum 481 additional *C. micronesica*, 86 of which are within the 10 foot buffer of the project footprint. Project BMP's recommend all listed plants within this buffer be protected during construction, but they will be further exposed to threats, such as typhoon damage, predation, and parasitism, once the project is complete (Laurance 2008, Marler 2020). The action will not physically remove any plants outside of this footprint, but they will be further fragmented, subjecting the remaining population to a likely decline in condition (Laurence 2008, Laurance & Curran 2008, Marler 2020). *C. micronesica* are generally considered adapted for consistent typhoons (Hintz & Marler 2002), but presence of introduced ungulates (e.g. deer and pigs) and novel predators such as cycad scale greatly reduce the survivability after storm impacts (Marler 2012). Of the *C. micronesica* within the project footprint, 2019 surveys estimated approximately 92 of the plants were classified as being in good condition, 285 in fair condition, and 96 in poor condition (DON 2020). No condition index was provided for plants outside of the footprint, surveyed in 2017 (GPEPP).

Tabernaemontana rotensis

In a 2019 survey of the project footprint, 22 *T. rotensis* were counted, most of which were seedlings (GPEPP 2019). Only the Tarague Basin and Golf Course proposed outplanting sites contain *T. rotensis*, each with about 50 trees, no information on age structure was provided (Diebel, pers. com. 2020). Specific numbers on adult and seedling plants were not provided in the survey, but a 2017 survey of a similar plot within the MSA showed roughly half (53 percent) of the *T. rotensis* in the plot were seedlings (GPEPP 2017). The proposed action will result in the removal of all 22 individuals from the project footprint and an overall population decline of 0.094 percent (DON 2020).

Factors affecting species environment within the action area

Habitat loss and degradation, predation by non-native predators, and human disturbance are the primary factors affecting Mariana fruit bats within the action area. Brown tree snakes can be found within every habitat type on the island of Guam and are present within the action area. If a bat roosted within the action area, it would be susceptible to predation by BTS. AAFB functions as one of the most active military airfields in the Western Pacific with an average of 21 daily take-off and landing events (Diebel, pers. com. 2020). Noise generated by these activities reduces the likelihood that Mariana fruit bats utilize the existing habitat for roosting and feeding, although the vegetation types preferred by the bats is present.

Several possible outplanting sites (Achae Point, Tarague Basin, and Palms Golf Course) currently function as study plots for a long-term cycad study performed by GPEPP on AAFB (GPEPP 2019). GPEPP biologists survey cycads within these plots regularly, as well as apply pesticides to control pest species. If *C. micronesica* are outplanted in study plots they must be

separated from the cycads in the GPEPP study and must not be included in cycad research data collected. If bats are roosting or feeding when biologists enter the study plots it may result in disturbance to the bats, but this disturbance is not expected to alter the bat's behavior enough to rise to the level of injury. Biologists are required to vacate the site if bats are seen in the study plots and they are prohibited from returning until the bats leave on their own volition.

The cycad scale and other cycad predators are present in every *C. micronesica* population on Guam, including the action area. The *C. micronesica* already present within the proposed outplanting sites are receiving treatments of pesticide to help alleviate scale infestations and increase recruitment of seedlings in the population. Those cycads proposed for clearing within the project footprint are receiving no treatment for scale. The site experiences little to no recruitment of seedlings and surveys show one-fifth of the population to be in poor condition.

Effects of the Action

Factors to be considered

Proximity of the Action

The proposed 48 new ECMs fall within the MSA on AAFB, located on the northernmost portion of Guam. AAFB is home to half of the remaining limestone forest on Guam. Native [limestone] forest is considered the preferred habitat type of the Mariana fruit bat, based on the availability of roosting and foraging habitat, *C. micronesica*, and *T. rotensis,* (USFWS 2014, Cibrian-Jaramillo 2010, UOG 2007). For analysis, the Service is using primary and secondary limestone forest types as a proxy for preferred habitat, although it should be noted that this is likely an overestimation of actual functional habitat for these species (Almeida-Gomes 2016). The action area comprises 151.7 acres of primary and secondary limestone forest, representing 1.2 percent of this habitat type on Guam and 2.3 percent on AAFB. Of the 151.7 acres contained in the action area, 31.1 acres falls within the project footprint and will be removed entirely. This represents 0.24 percent of the limestone forest on Guam and 0.47 percent of the limestone forest on AAFB.

Distribution

Fruit bats are occasionally observed as far south as the Naval Magazine, in central Guam, but most sightings occur in the north (USFWS 2014). The proposed munition igloos will be situated approximately 4.7 miles from Pati Point, the last known maternal fruit bat colony on Guam. Colony surveys at Pati Point have been in consistent decline since 2005 and have yielded low bat numbers, between 0 and 10, since 2009. Between 2015 and 2016 a colony of 112 fruit bats were observed in the HMU on AAFB, but since August of 2016, fruit bat aggregations have not been observed at this site.

Cycas micronesica occurs across Guam with the highest density on AAFB (USFWS 2014). Populations of *C. micronesica* occur across Guam, although the distribution and health of these populations is patchy (USFWS 2020, Cibrian-Jaramillo 2010).

The majority of *T. rotensis* on Guam exists within the borders of AAFB and approximately nine individuals are located on GNWR.

Timing

Once started, construction is expected to last for an estimated 42 months (March 2021-September 2024) and will start at 0600 hours and stop no later than 1800 hours, or 30 minutes prior to sunset, whichever comes first. After construction is complete, very little active disturbance is expected. Although the construction itself will result in the loss of *C. micronesica* and *T. rotensis* individuals, this will be restricted to the action of ground clearing during site preparation.

Nature of the Consequences

The action will remove 22 genetically distinct individuals of *T. rotensis* and 473 *C. micronesica* from the environment. If the individual plants are not replaced, the action will result in a population decline of 0.14 percent of the known population of *C. micronesica* and 0.1 percent for *T. rotensis* on the island of Guam (DON 2020). No take of Mariana fruit bats is expected, although activity and noise associated with the action would likely disturb bats in the action area.

Since the action results in clearing of the project footprint, that habitat will be lost to bats in the future.

Duration

1) Short-term (pulse) consequences: Construction activities will result in disturbance to bats present in the action area during construction. Bats may be disturbed by noise and subsequently discouraged from utilizing the area's resources. Once construction has completed these disturbances will no longer be present.
2) *C. micronesica* pups and both *C. micronesica* and *T. rotensis* seeds will be collected prior to habitat clearing. Once that is complete all *C. micronesica* and *T. rotensis* within the project footprint will be destroyed.
3) Long-term (press) consequence: Existing habitat within the project footprint for all listed species will be converted to cleared or developed area.
4) Permanent (threshold) Consequence: The clearing of *C. micronesica* and *T. rotensis* followed by construction of new permanent structures, leaves no opportunity for future recruitment of these species resulting in no replacement within the footprint. Since habitat will be completely lost, the action area is not likely to function as a roosting or feeding area for Mariana fruit bat, indefinitely.

Disturbance Frequency

The action will take place in five phases: the removal of *C. micronesica* pups and seeds and *T. rotensis* seeds, clearing and construction of the ECMs, propagation of the harvested pups and seeds, outplanting of the propagated material, and maintenance of outplanted material. Harvesting of the *C. micronesica* pups has potential to negatively impact the mother plant, but

since all individual *C. micronesica* will be destroyed during construction, this is not a concern. Clearing and construction will occur between March 2021 and April 2024. During this period, all plants will be removed and bats may be disturbed, if in the area. Plant propagation will continue until the pups and seeds are hardy enough to be outplanted in the wild (~1 year or more). Outplanting of the propagated material will be brief and will likely disturb topsoil in areas where plants are placed, but this will be a short-lived disturbance. Maintenance of the planted individuals will involve supplemental watering and applications of pesticide to control pests of *C. micronesica*. Maintenance activities are expected to continue until plants achieve the DON's proposed success criteria for each species after being outplanted, which is expected to take less than two years.

Analyses for consequences of the action

Beneficial consequences – The DON is proposing to collect *C. micronesica* seeds and pups, as well as *T. rotensis* seeds from the project footprint before habitat clearing occurs. The pups and seeds will be propagated under nursery conditions until an authorized biologist determines they are suitable for outplanting. The individuals will then be outplanted in at least one, and up to five, fenced, ungulate-free conservation sites. The DON will provide supplemental water and fertilizer to the outplanted individuals and apply pesticide to control pest invasions. The plants will be cared for and monitored until they achieve at least 1.0 centimeter of stem growth in the wild, as measured from the base of existing leaves (fronds). Removal of invasive species from the proposed outplanting sites will potentially result in an increase in use of the area(s) by the Mariana fruit bat. If the outplanted *C. micronesica* and *T. rotensis* reach sexual maturity, they will contribute to the genetic diversity and overall population numbers of each of these species.

Adverse consequences – The proposed action will likely result in the disturbance of all Mariana fruit bats that use the habitat within and immediately adjacent to the project footprint during construction. Fruit bats could also be disturbed during use of habitat adjacent to the project area once construction is complete. However, such disturbance during and after construction would be expected to be short term and intermittent and not likely to cause a significant disruption of their breeding, feeding, and sheltering behavior. Therefore, the disturbance of Mariana Fruit bats within the action area is not likely to rise to the level of injury to the bat and therefore would not meet the definition of harass.

Clearing of the project footprint will result in the destruction of all *C. micronesica* and *T. rotensis* within the project footprint. This will result in a reduction in the overall number of sexually mature individuals of each species by 377 of the good or fair *C. micronesica* and 22 *T. rotensis*. Genetic representation will also be reduced due to the removal of these individuals. A total of approximately 481 *C. micronesica* fall within the 150 meter buffer of the project footprint including 86 within the first 10 feet. The land clearing opens these individuals to future disturbance by typhoons as well as higher susceptibility to parasitism and predation.

Cycad pups and seeds collected and propagated/grown in the nursery environment, then outplanted into protected habitat may provide a replacement of up to 95 *C. micronesica* and 6 *T. rotensis.* However, there are already populations of *C. micronesica* within the five outplanting sites and two *T. rotensis* sites (Tarague Basin and Golf Course). In addition, the success criteria

of minimal growth of the outplanted individuals at the outplanting sites, rather than the replacement of sexually mature individuals, leaves significant uncertainty in whether the outplanted individuals will grow to a point that they contribute to the long-term recovery population or genetic diversity of the overall listed plant populations.

Species' response to the proposed action

Construction related disturbance and normal use of the project area post-construction is not expected to result in injury or death of any Mariana fruit bats.

As stated above, the proposed action would result in the direct loss of 473 *C. micronesica* and 22 *T. rotensis* from these species overall populations, and a possible 481 *C. micronesica* damaged or lost due to indirect (edge) effects. Some amount of genetic diversity would also be lost. The destruction of up to 473 cycads and 22 *T. rotensis*, plus the possible indirect effects to an additional 86 cycads, would not affect the growth and survival of individuals of these species outside of the project's action area. However, the population trend for *C. micronesica* is in steep decline in recent years due to the *A. yasumatsui* scale and other pest species. The combination of existing threats, plus projects such as the action, are pushing *C. micronesica* toward a point in which the species will no longer be recoverable. While the current impacts only represent a minimum 0.062 percent of the range-wide population of *C. micronesica*, continuing to impact this species without fully offsetting those impacts is not sustainable.

Cumulative Effects

Cumulative effects include the effects of future State, tribal, local or private actions that are reasonably certain to occur in the action area considered in this BiOp. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

The Service is not aware of any future state, tribal, local, or private actions that are reasonably certain to occur within the action area at this time; therefore, no cumulative effects are anticipated.

Conclusion

After reviewing the current status of the threatened Mariana fruit bat (*Pteropus mariannus*), threatened *Cycas micronesica*, and threatened *Tabernaemontana rotensis*, the environmental baseline for the action area, the effects of the proposed construction and operation of 48 ECMs within MSA I, located on AAFB, Guam, and the cumulative effects, it is the Service's Biological Opinion that the action, as proposed, is not likely to jeopardize the continued existence of the Mariana fruit bat, *C. micronesica*, or *T. rotensis.* There is no designated critical habitat within the action area; therefore, there will be no affect to critical habitat.

The Service reached this conclusion based on the following information described in the Effects of the Action section, above.

- Mariana fruit bats have not been observed roosting or feeding in the project footprint, where the clearing of land will occur, so it is assumed this is not a loss of functional habitat for the bats. No take of Mariana fruit bats is expected to occur because disturbance of the bat during and after construction is not expected to rise to the level of injury. The level of disturbance within the possible outplanting vegetation plots or transplantation of individuals is limited to biologists working in the forest plots.
- In areas where noise, light or human activity from construction of the proposed action would result in excessive noise, light or human activity above the ambient level, construction contractor personnel will be required to survey within line of sight (up to 150 m) of construction activities for bats prior to the start of a day's construction activities. Construction work generating noise, light or human activity above the ambient levels will be postponed until the bat(s) has left the area. The construction contractor will document bat surveys in the daily logs.
- Based on most recent estimates, the action is expected to remove 0.068 percent of the existing *C. micronesica* across its native range and 0.14 percent of the cycads on Guam. Considering just the cycads in good condition on Guam, 0.067 percent will be removed. Although this fraction seems minimal, *C. micronesica* has been in a state of decline since introduction of the *A. yasumatsui* scale in 2003. The current Guam population experienced an initial decline of 92 percent in the years following scale introduction. Between 2013 and 2020, cycad populations have declined by a further 33.3 percent. The continued loss of *C. micronesica* individuals from the population without adequate offset is likely to have significant consequences to the species as a whole and could result in the extirpation of the species on Guam within the next 15 years.
- An additional 481 *C. micronesica* fall within the 150-meter action area buffer and at least 86 of those are within the 10 foot BMP buffer of the cleared footprint. All of these plants will be subjected to increased fragmentation as a result of the action and a portion are expected to succumb to future stressors, such as typhoons, predation, and parasitism, because of increased exposure to the forest edge. When all of these plants are taken into account, the estimated loss to the population on Guam doubles from 0.14 to 0.28 percent. If just the 86 in the 10 foot buffer are added, 0.16 percent of the *C. micronesica* on Guam will be lost.
- The DON has proposed to salvage a minimum of 95 genetically unique individuals and ensure their survival in ungulate-proof fenced plots within AAFB. The 95 individuals is based on: (1) the health of the plants within the project footprint, (2) the ability to safely salvage the basal shoots or seeds, (3) whether or not the basal shoot would survive transplantation, or (4) whether the plant produces seed. The lead biologist will make the determination of "health." If these outplantings are successful, the reduction of *C. micronesica* will fall to 0.040 percent across their native range and 0.082 percent on Guam. The DON is not following nursery growth and outplanting recommendations provided by the Service on March 23, 2020, so outplanted individuals are not considered as an offset to the plants being removed.
- Outplantings will occur in up to five proposed vegetation plots on AAFB. These plots already contain a minimum 412 *C. micronesica*, which are maintained by the GPEPP as

*C. micronesic*a study sites. The addition of 95 new individuals is not expected to harm the plants already present across these plots, but the increase in individuals does not benefit the cycad populations at the outplant sites beyond increasing the genetic diversity. If outplanting is successful and the outplants reach sexual maturity, the result will be beneficial by providing increased local genetic diversity and support for the survival and recovery of the species.

- The proposed action will result in the removal of 22 *T. rotensis* from the project footprint, representing a range wide reduction of approximately 0.094 percent. The DON has proposed to replace a minimum of six genetically distinct *T. rotensis*, grown from seeds or cuttings and planted in up to five vegetation plots on AAFB. Accounting for the replacement of these six individuals the population wide reduction is reduced to 0.070 percent.
- Two of the five proposed outplanting plots, Tarague Basin and Golf Course, already contain a combined 100 *T. rotensis* (50 each), but if these sites are used, outplanting activities are not expected to harm existing trees. If outplanting is successful and the plants reach sexual maturity, the result will be beneficial by providing increased local genetic diversity.

INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and Federal regulation pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by the Service as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with the terms and conditions of this incidental take statement.

The measures described below are non-discretionary, and must be undertaken by the DON for the exemption in section 7(o)(2) to apply. The DON has a continuing duty to regulate the activity covered by this incidental take statement. If the DON: (1) fails to assume and implement the terms and conditions; or (2) fails to require contractors to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the contract document, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the DON must report the progress of the action and its impact on the species to the Service as specified in the incidental take statement. [50 CFR §402.14(i)(3)] Sections 7(b)(4) and 7(o)(2) of the ESA generally do not apply to listed plant species. However, limited protection of listed plants from take is provided to the extent that the ESA prohibits the removal and reduction to

possession of Federally listed endangered plants or the malicious damage of such plants on areas under Federal jurisdiction, or the destruction of endangered plants on non-Federal areas in violation of State law or regulation or in the course of any violation of a State criminal trespass law.

Amount or Extent of Take Anticipated

The Service does not anticipate the proposed action will incidentally take any Mariana fruit bats.

Effect of the take

In the accompanying BiOp, the Service determined that this level of anticipated take is not likely to result in jeopardy to the Mariana fruit bat.

Reasonable and Prudent Measures

The Service has determined that no Reasonable and Prudent Measures are necessary to minimize the potential for Mariana fruit bat incidental take.

Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the ESA, the DON must comply with the following reporting and monitoring requirements.

The DON must monitor the implementation of the project to a sufficient degree to ensure that disturbance of Mariana fruit bats does not rise to the level of harass or harm, resulting in injury or death through the alteration of normal feeding roosting, and breeding behaviors. The DON will implement systematic searches for Mariana fruit bat colonies in all areas of suitable habitat within the action area. If a maternity colony is found, the DON will notify the Service per the Reinitiation Notice.

Upon locating a dead or injured specimen, immediately notify the Service's Law Enforcement Office at 671-647-6064 and PIFWO's Marianas Field Office at 671-989-6743. Care must be taken in handling any dead or injured specimens of proposed or listed species to preserve biological material in the best possible state. In conjunction with the preservation of any dead specimens, the finder has the responsibility to ensure that evidence intrinsic to determining the cause of death of the specimen is not unnecessarily disturbed. The finding of dead or injured specimens does not imply enforcement proceedings pursuant to the ESA. This reporting requirement enables the Service to determine if take is reached or exceeded and to ensure that the terms and conditions are appropriate and effective.

The Service believes that no incidental take of the Mariana fruit bat will result from the proposed action. If, during the course of the action, non-intentional harassment of Mariana fruit bats utilizing habitat in the action area results in injury or death of one or more individual fruit bats, such incidental take represents new information requiring reinitiation of consultation and review of the reasonable and prudent measures provided. The DON must immediately provide an

explanation of the causes of the taking and review with the Service the need for possible modification of the reasonable and prudent measures.

Conservation Recommendations

Section 7(a)(1) of the ESA directs Federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation Recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

The Service recommends the DON continue to implement their comprehensive BTS interdiction program to ensure that military activities, including the transport of civilian and military personnel and equipment to and from Guam, do not contribute to the spread of the BTS to other islands or regions. The BTS interdiction requirements are specified in DoD instructions (i.e., *36 Wing Instruction 32-7004, BTS Control Plan and JTREGMARIANASINST 5090.10A, BTS Control and Interdiction*).

Reinitiation Notice

This concludes formal consultation on the action(s) outlined in this BiOp. As provided in 50 CFR § 402.16, reinitiation of formal consultation is required where discretionary DON involvement or control over the action has been retained or is authorized by law and: (1) if taking of a Mariana fruit bat occurs; (2) if new information reveals effects of the action that may affect listed species in a manner or to an extent not previously considered; (3) if the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in the BiOp; or (4) if a new species is listed or critical habitat designated that may be affected by the identified action.

Sincerely,

KATHERINE MULLETT

Digitally signed by KATHERINE MULLETT
Date: 2020.07.01 07:15:40 -10'00'

Katherine Mullett
Field Supervisor

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Biological Opinion for Relay Ground Station-Asia (RGS-A), Marine Corps Base Camp Blaz, Guam



Cycas micronesica in propagation on Guam. Photo Credit: Mike Park

December 11, 2022
(01EPIF00-2022-0083226)

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Pacific Islands Fish and Wildlife Office
300 Ala Moana Boulevard, Room 3-122
Honolulu, Hawaii 96850

In Reply Refer To: 01EPIF00-2022-0083226

December 11, 2022

Mr. Albert T. Borja
Installation Environmental Program Director
United States Marine Corps
Marine Corps Base Camp Blaz
PSC 488 Box 105
FPO AP 96537-0149

Subject: Biological Opinion for Relay Ground Station-Asia (RGS-A), Marine Corps Base Camp Blaz, Guam

Dear Mr Borja:

This document transmits the U.S. Fish and Wildlife Service's (Service) biological opinion based on our review of the proposed construction and operation of the Relay Ground Station-Asia (RGS-A), Marine Corps Base Camp Blaz, Guam, and its effects on the threatened *Cycas micronesica* (fadang), and *Tabernaemontana rotensis* in accordance with section 7 of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 et seq.). The proposed RGS-A will be part of a worldwide system of "Overhead Persistent Infrared" satellite ground stations. RGS-A will provide communication links for United States Space Force (USSF) between space-based assets and a ground station in Guam. The US Marine Corps requested formal consultation on August 9, 2022.

This biological opinion is based on information provided in the biological assessment dated August 2022, Microsoft Teams conversations and emails of September 12, 19, 26, October 3, 11, and 24, and November 2 and 17, 2022, between the Service's Mariana Islands Team Manager, Jacqueline Flores, and biologists Dawn Bruns, Tyler Willsey, Lauren Taylor, and Toni Mizerek, and you and your biologist Lauren Gutierrez, field investigations, and other sources of information. A complete administrative record of this consultation is on file at our office. The biological assessment included a request for Service concurrence with a "not likely to adversely affect" determination for the Mariana fruit bat (*Pteropus mariannus mariannus*, fanihi). The US Marine Corps determined the proposed action is not likely to adversely affect the

federally Mariana fruit bat because project construction will not occur when a Mariana fruit bat is within 150-m (492-ft) of the project site. Because project activity will cease if a Mariana fruit bat is detected within 150 m (492 ft) of the project activity, impacts to a bat are expected to be extremely unlikely to occur. Because adverse effects are extremely unlikely to occur, they are **discountable** and therefore not likely to adversely affect the Mariana fruit bat. Additional details are summarized in Appendix A of this biological opinion.

On July 5, 2022, the U.S. District Court of the Northern District Court of California vacated the 2019 regulations implementing section 7 of the Endangered Species Act (ESA). On September 21, 2022, the Ninth Circuit Court of Appeals granted a request to stay the U.S. District Court of Northern California's July 5, 2022, order that vacated the 2019 ESA regulations. As a result, the 2019 regulations are again in effect, and the Service has relied upon the 2019 regulations in rendering this biological opinion. However, because the outcome of the legal challenges to 2019 ESA Regulations is still unknown, we considered whether our substantive analyses and conclusions in this consultation would have been different if the pre-2019 regulations were applied. Our analysis included the prior definition of "effects of the action," among other prior terms and provisions. We considered all the “direct and indirect effects” and the “interrelated and interdependent activities” when determining the “effects of the action.” As a result, we determined the substantive analysis and conclusions would have been the same, irrespective of which regulations applied.

CONSULTATION HISTORY

August 9, 2022: The US Marine Corps requested initiation of consultation.

September 7, 2022: The Service confirmed initiation of consultation.

September 12, 2022 through November 17, 2022: The US Marine Corps and the Service held weekly Microsoft Teams conversations and exchanged emails to further refine the RGS-A conservation measures. The Service’s Mariana Islands Team Manager, Jacqueline Flores, and biologists Dawn Bruns, Tyler Willsey, Lauren Taylor, and Toni Mizerek, participated in this coordination with you and your biologist Lauren Gutierrez and Sheeka Tareyama.

October 17, 2022: The Service transmitted a DRAFT of this Biological Opinion to the US Marine Corps.

October 30, 2022: The US Marine Corps provided comments on the October 17, 2022, Draft of this Biological Opinion.

BIOLOGICAL OPINION

Description of Proposed Action

The proposed RGS-A complex will involve construction and operation of radar and antenna facilities within a 26.2 acres (ac) 10.6 hectare (ha) area adjacent to an existing telecommunications site within Camp Blaz, Guam. Off-site conservation of *Cycas micronesica*, and *Tabernaemontana rotensis* will occur at existing greenhouse facilities and within the approximately 10-ac (4 ha) block in the northwest corner of the ungulate-free limestone forest of the Caiguat Forest Enhancement Area, north of the RGS-A construction site (Figure 1). Because the project configuration is being reassessed to work to further reduce impacts to listed species, the final project footprint may be smaller than the 26.2 ac (11 ha) project footprint detailed here. Construction is scheduled for 2023 and the facility is scheduled to be fully-operational in 2025.

The proposed action entails the construction and operation of six approximately 76-foot (ft) (23.2-meter (m)) diameter inflatable radome facilities with attached antenna control facilities, lower equipment rooms, and Ground Terminal Equipment shelter facilities with a 50-ft (15.2-m) area cleared around each radome. Sixteen additional equipment structures will house power, communications, air conditioning, and fire protection equipment. Three generators within these structures will be fed by three, 12,000-gallon (45,425-liter) fuel storage tanks. Two Future Communications System (or similar) antennas, a parking area, and paved pathways will be constructed within the site. A fence will enclose these facilities and a 225-square ft (21-square m) entrance control building will be outside the fence. A 427-ft (130-m) length of road, 66-ft (9-m) wide section of existing road will be rerouted away from the facility.

During long-term operations, security personnel will be posted at the entrance control facility full-time. The site will be visited for maintenance and inspection as needed. Grass and brush cutting will be conducted inside and outside the perimeter fence. Downward-facing security lighting will be on from dusk to dawn. The backup generator will operate at irregular intervals during power failures. The facility will otherwise be operated remotely.

Two-way communications with satellites and space vehicles will result in low-level electromagnetic radiation being emitted from the site. The antennas can transmit on L, S, and Q bands to space vehicles. The L-Band refers to a part of the microwave band of the electromagnetic spectrum covering frequencies from 1 to 2 gigahertz; the S-Band covers frequencies from 2 to 4 gigahertz; and the Q-Band covers frequencies from 36 to 46 gigahertz. The beams used for transmitting earth-to-satellite signals are highly directional, similar to the beam from a flashlight with the most concentrated area of the beam related to the diameter of the antenna dish. These antennas will transmit at various angles of inclination, depending on where the space vehicles are located with a minimum height of 15 ft (6 m) above ground level.



Figure 1. Location of the potential RGS-A project footprint and the off-site conservation area in the northwest corner of the Caiguat Forest Enhancement Area (labeled North Finegayan Forest Enhancement Site).

The following conservation measures are specific to the action and promote the continued existence of *Tabernaemontana rotensis* and *Cycas micronesica*, their pollinators, seed dispersers and habitat. Conservation Measures are considered part of the Proposed Action. Conservation measures included in the proposed action are intended to avoid, minimize, or offset the effects of an action and are considered like other portions of the action and do not require any additional demonstration of binding plans (50 CFR § 402.14 (g)(8))

1) DON will employ qualified biologists(s) to support and conduct Conservation Measures identified in this BA. Qualified biologist is defined as:
    a. A person who has successfully completed a full four-year course of study at an

accredited college or university leading to a bachelor's or higher degree, which includes a major field (24 semester hours) of study in biological sciences, wildlife biology, botany, natural resource management, environmental sciences, or related disciplines appropriate to this position, and

b. A combination of at least 100 documented hours of experience conducting propagation or transplantation of the aforementioned species or closely related species, and
c. Documented one year of experience with monitoring/maintenance of tropical plant species to include pest and nutritional management.

2) In order to validate the above information, potential qualified biologist(s) will provide to the DON contact information of three references familiar with their work related to b and c (above).
3) The DON has completed pre-construction surveys to identify all listed plant species prior to the commencement of construction activities. Over a period of six days in April 2021 (7, 9, 14, 21, 23, and 28 April) and three days in August 2021 (13,19, and 30 August), biological surveys were conducted to detect the presence of ESA-listed species and host plants within the construction footprint. If the project construction does not occur within 3 years of the 2021, biological surveys, these surveys will be re-done prior to construction implementation.
    a. As detailed in species-specific conservation measures below, if pre-construction surveys identify a listed plant species present in the construction area and the individuals cannot be avoided, healthy plant material will be salvaged or available seeds will be collected, propagated and outplanted into suitable protected areas (fenced, ungulate free). The selected area for outplanting is the Caiguat Forest Enhancement Area (see Figure 1).
4) If the *Tabernaemontana rotensis* plant is within the final project footprint, the following conservation measures will be taken to offset the effect of the removal of that individual from the population. If the individual plant and the intact forest to the north of the plant can be avoided during project implementation, left intact, and no clearing occurs within 10 feet (ft) (3 meters (m)) of the plant's location, the following conservation activities would not be undertaken.
    a. Seeds or stem cuttings will be collected from the *T. rotensis* plant growing within the area proposed for development. This material will be propagated in a greenhouse, and the propagules will be outplanted to preserve the genetics of the individual within the project footprint. The outplanting site will be treated for pests and invasive species for one year following outplanting and the plants will be monitored for an additional six months beyond the maintenance period.

5) *Cycas micronesica* conservation: The DON commits to ensure the *C. micronesica* population, 20 years from now, will not be reduced as a result of the proposed action. The DON will collect seed or cuttings from plants in the project footprint or adjacent areas to propagate, outplant, and conserve the plants in an off-site conservation site at the northwest corner of the nearby Caiguat Forest Enhancement Area.

   In the absence of the proposed action, the *C. micronesica* population in the project area would be expected to decline at a rate of between 5.8 and 13.2 percent. In our design of this *C. micronesica* conservation measure, we conservatively anticipate the lower 5.8% decline. The DON will collect seed and, where appropriate, salvage pups and stem cuttings, from the healthy/appropriate plants within the project footprint, propagate, and outplant these individuals to the approximately 10-ac (4 ha) area in the northwest corner of the Caiguat Forest Enhancement Area (see Figure 1). Salvage of plant material for cycads would be dependent on salvage work method feasibility (e.g., safety and site-specific conditions) and sufficient plant health to support transplantation survival. Seed collection, rather than salvage of plant material, is expected to be the primary conservation method used.

   The number of plants that are outplanted and the level of on-the-ground long-term effort taken to protect these plants from invasive invertebrates and other pests, will depend on the number of plants impacted in the project footprint and the mortality experienced by the outplanted plants. There is some uncertainty regarding the final project footprint and the number of *C. micronesica* that will be permanently removed as a result of the action. At maximum, 74 *C. micronesica* are within the project area and an additional two *C. micronesica* are within 10 ft (3 m) of that footprint. At the project development phase, the number (**"X" number in Table 1, below)** of genetically-distinct affected *C. micronesica* will be determined by the Department of the Navy and reported to the Service. This **"X" number** will be used to populate an updated table with numbers of plants, based on the percentages in Table 1. In addition, the level of invertebrate and invasive plant control that may be needed to achieve these targets is uncertain.

   The DON commits to ensure the number of genetically-distinct plants in Year 20, is the same as the number of plants we currently expect there would have been in the absence of the project. To achieve this, trajectories of plant survival were used to develop interim benchmarks at project years 5, 10, and 15. During the years leading up to the benchmark 5, 10, 15, and 20 years, the survival of the outplanted plants will be assessed and the need for any additional long-term field maintenance will be assessed. If survival rates are lower than anticipated and, even with field maintenance actions, the percent of plants is

on a trajectory to fall short of the expected trend-lines used to design this conservation measure, additional seed collection, propagation, and outplanting will be conducted to ensure the years 5, 10, 15, and 20 benchmark numbers are achieved. Seeds collected for this propagation activity would come from wild plants growing adjacent to the RGS-A project footprint; any such seed collection outside the project footprint would entail collection of no more than ten percent of any individual plant's seeds.

Identification tags will accompany outplanted *Cycas micronesica* as well as GPS sub-meter coordinates for the *C. micronesica* locations during the 20 years. *Cycas micronesica* outplanted for this project will not be interspersed with other construction site *C. micronesica* outplantings. Outplanted *C. micronesica* will be considered living/surviving when they show full crown development, no visible sign of nutrient deficiencies, and no visible sign of stem rot/decay.

Table 1. RGS-A *Cycas micronesica* Conservation Commitment with Project Year 5, 10, 15, and 20, Benchmark Percentage of Genetically Distinct Plants Remaining in the Wild in Relation to the Baseline Percentage Expected to Remain in the Absence of the Proposed Action.

YEAR / Approximate Project Year		**Baseline - Percent of *Cycas micronesica* in the proposed development area expected to persist in the absence of the proposed action (with 5.8% ongoing population decline)**	RGS-A Conservation Commitment: **Percent of the X-number of Cycas micronesica occurring in 2021** (to be determined during project construction, at maximum 76 plants, fewer if project footprint is smaller) that had to be removed (or within 10-feet of the project vegetation clearing footprint) that survive (having been propagated/outplanted/conserved) or occur from additional augmentation at the off-site conservation area	
			Maximum %	**Minimum %**
2021				
2022				
2023	1			
2024	2			
2025	3			
2026	4			
2027	5	70%	70%	46%
2028	6			
2029	7			
2030	8			
2031	9			
2032	10	52%	52%	39%
2033	11			
2034	12			
2035	13			
2036	14			
2037	15	38%	38%	34%
2038	16			
2039	17			
2040	18			
2041	19			
2042	20	29%	29%	29%

6) The DON will implement a contractor education program to ensure that construction contractor personnel are informed of the biological resources in the project area, including invasive species, special-status species, avoidance measures, and reporting requirements. The measure is intended to prevent inadvertent effects to terrestrial biological resources due to lack of awareness of resource presence, habitat requirements, and protective measures. The DON will conduct regular (e.g., monthly) construction site inspections for conservation measure implementation.
7) DON will ensure that all construction activities will occur within the limits of construction to prevent additional habitat loss. Limits of construction must be shown on contract plans and specifications and physically demarcated in the field prior to any vegetation clearing. This measure is intended to prevent additional habitat loss. The measure will be implemented during pre-construction and construction.
8) Per OPNAV M-5090.1 §12-3.9, the DON will specify housekeeping and vehicle cleanliness measures in contractor environmental plans to reduce the likelihood of spread of invasive species within the construction area. To the extent practicable and to be performed in conjunction with stormwater pollution prevention practices, cargo and vehicles will be inspected upon entry to the construction site and high-pressure wash-down will be performed to reduce organic material and mud from leaving or entering the

jobsite. Dirty vehicles, equipment or cargo shall be cleaned of dirt, debris, organisms, weeds and other material before they enter the jobsite and discarded material will be tested, packaged or treated before disposal. Green waste will be reused on-base to the greatest extent practicable and will be managed to reduce Coconut Rhinoceros Beetle and Little Fire Ant spread or breeding.

9) To avoid potential impacts to limestone forest plant pollinators and seed dispersers, outdoor lighting will be minimized, and construction work will not occur within 150 m (492 ft) of a Mariana fruit bat roost. When a Mariana fruit bat is seen flying or foraging within 150 m (492 ft) of construction activity, work will pause until the bat has left the area. The DON will implement a contractor education program to ensure that construction contractor personnel are shown how to identify, respond, and report a Mariana fruit bat sighting.

   Additional pre-construction biomonitor surveys for Mariana fruit bats and bat roost sites will be conducted up to one week prior to the onset of vegetation clearing. Any pause in work beyond seven days in vegetation clearing will trigger additional surveys. These surveys will follow JRM protocols (USFWS 2009).

   All construction and maintenance work is expected to occur during daytime hours. Although the Navy does not expect night work to occur the following conservation measures will be implemented should unforeseen night construction or exterior maintenance work be required:

   - A dusk biomonitor survey following JRM protocol (USFWS 2009); and
   - When installing permanent lights, and if appropriate for antiterrorism force protection or airspace safety criteria, the DON will use downward-facing, shielded or full cut-off lens lights (with the lowest lumens necessary). Properly shielded or full-cutoff lens illumination can only be seen below the horizontal plane at the fixture height. To avoid vertical glare and illumination of forest habitats, should temporary lighting be needed for nighttime work, only downward-facing, full cutoff-off lens lights or fully-shielded lights will be used.

Action Area

The action area is defined (50 CFR 402.02) as “all areas to be affected directly or indirectly by the federal action and not merely the immediate area involved in the action.” The Service has determined that the action area for this project is the project footprint, and the offsite conservation area in the northwest corner of the Caiguat Forest Enhancement Area (both shown in Figure 1).

Analytical Framework for the Jeopardy Analysis

In accordance with regulation (see 84 FR 44976), the jeopardy determination in this Biological Opinion relies on the following four components:

1) The *Status of the Species*, which evaluates the species' current range-wide condition relative to its reproduction, numbers, and distribution; the factors responsible for that condition; its survival and recovery needs; and explains if the species' current range-wide population is likely to persist while retaining the potential for recovery or is not viable;
2) The *Environmental Baseline*, which evaluates the current condition of the species in the action area relative to its reproduction, numbers, and distribution absent the consequences of the proposed action; the factors responsible for that condition; and the relationship of the action area to the survival and recovery of the species;
3) The *Effects of the Action*, which evaluates all future consequences to the species that are reasonably certain to be caused by the proposed action, including the consequences of other activities that are caused by the proposed action, and how those impacts are likely to influence the survival and recovery role of the action area for the species; and
4) *Cumulative Effects*, which evaluates the consequences of future, non-Federal activities reasonably certain to occur in the action area on the species, and how those impacts are likely to influence the survival and recovery role of the action area for the species.

In accordance with policy and regulation, the jeopardy determination is made by evaluating the consequences of the proposed Federal action in the context of the species' current range-wide status, taking into account any cumulative effects, to determine if implementation of the proposed action is likely to cause an appreciable reduction in the likelihood of both the survival and recovery of the species in the wild. The key to making this finding is clearly establishing the role of the action area in the conservation of the species as a whole, and how the effects of the proposed action, taken together with cumulative effects, are likely to alter that role and the continued existence (i.e., survival) of the species.

Status of the Species

Cycas micronesica

Species Description
Cycas micronesica was listed as threatened on October 1, 2015 (80 FR 59424). No critical habitat has been designated for the species.

Cycas micronesica is a palm-like tree, usually unbranched with a thick trunk. Adult stems range from 26 to 39 ft (8 to 12 m) in length and 5 to 10 inches (13 to 25 centimeters) in diameter. The leaves, 3 to 6.5 ft (1 to 2 m) long, are glossy, pinnate, and restricted to the top of the trunk (Stone 1970, p. 65; Raulerson and Rinehart 1991, p. 4; Hill 1994, p. 556).

The species *Cycas micronesica* (formerly *Cycas circinalis*) is part of the Cycadaceae family, which contains only one genus, *Cycas*, a very ancient genus of trees dating back to the Jurassic period. *Cycas micronesica* is known from Guam, Rota, and Tinian (the Tinian population being outplanted) in the Mariana Islands, Yap in the Federated States of Micronesia, and the Republic of Palau.

Life History

Cycas micronesica is the only native gymnosperm in the Mariana Islands. *Cycas micronesica* occurs in limestone forests in Guam and Rota, with fewer occurrences in volcanic soils typical of southern Guam (Stone 1970, p. 65; Hill 1994, p. 556). *Cycas micronesica* is also observed in coastal strands (Harrington et al. 2012, p. 14). The fruit of *Cycas micronesica* has been identified as a food source for the Mariana fruit bat (*Pteropus mariannus mariannus*) (Wiles and Fujita 1992, p. 27), as well as for the CHamoru, who, after first processing to rid the naturally occurring toxins, use them to make flour (Whiting 1963, pp. 276–277).

Cycads are dioecious, and both sexes bear reproductive structures that are relatively massive amongst gymnosperms. The average age at sexual maturity of naturally occurring *Cycas micronesica* plants has not been documented, however, reproductive parts appeared after three years on trees propagated in a nursery (GPEPP 2021, p. 40). Male trees bear an elongated, upright cone in the center of the leaves, with the woolly scales of the cone producing pollen. When the pollen is mature the cone is very strongly scented. The female trees also produce a central cone-like structure that opens outward to reveal individual soft, woolly, tan leaves that are deeply lobed and toothed and bear ovules in notches along the margins. If the ovules are fertilized by pollen, glossy, large, hard-shelled brown seeds develop on the leaves (Raulerson and Rinehart 1991, p. 4). Many plants reach the pollination phase between April and early August (Hamada et al. 2015, p. 527). *Cycas micronesica* emits chemical cues to attract specialist insects for pollination, primarily of the genus Anatrachyntis (Lepidoptera: Cosmopterigidae) (Schneider et al. 2002, p. 282; Terry et al. 2009, p. 95), but there is also evidence of wind as a pollen vector in Guam in open or forested areas (Terry et al. 2009, p. 96; Hamada et al. 2015, entire).

Cycas micronesica can also reproduce vegetatively (USFWS 2020a, p. 5) and can be propagated by seeds, basal suckers, vegetative offsets (i.e., cycad pups), and cuttings. Cibrian-Jaramillo et al. (2010, pp. 2373–2374) suggested *Cycas micronesica* seeds may disperse by floating on rivers and streams. Cycads pups, which may or may not have natural root growth while on the parent tree, may be salvaged and propagated (DON 2019, p. 12). Concave spots on young plants between 12 and 18 months old can be cut out and planted, similar to the eyes on potatoes (Raulerson and Rinehart 1991, p. 4).

The species is considered long-lived and plants may live up to 40 years (Marler et al. 2010).

Population Dynamics

Populations of *Cycas micronesica* were known historically from Guam, Rota, Yap, and Palau (Hill 2004, p. 556; Hill et al. 2004, p. 280) and the species has been outplanted on Tinian (NAVFAC Marianas 2016, p. 18). In a 2002 forest inventory on Guam, prior to the unintentional introduction of the devastating Cycad aulacaspis scale (*Aulacaspis yasumatsui*), *Cycas micronesica* was the most abundant tree detected, with over 1.5 million individuals counted on island (Donnegan et al. 2004, p. 16). In 2009, sampling at 24 locations across Guam identified 18 genetic populations by analyzing genetic connectivity throughout the island (Cibrian-Jaramillo et al. 2010, pp. 2373–2375). Populations were found in both volcanic and calcareous coralline soils. The Ritidian population was the most geographically isolated in the north, with almost no immigrants from nearby populations, while the most genetically diverse were found in the south, in Talofofo and Nasa. In another survey, an unquantified number of *Cycas micronesica* individuals were found at 11 sites across Guam, some of which were on Andersen Air Force Base (Harrington et al. 2012, entire).

In 2013, over 257,000 individuals were documented on Andersen Air Force Base, but in a population structure dominated by adults with little recruitment and declining reproductive success (Marler 2014, entire). Between March 2015 and January 2017, natural resources personnel from Marine Corps Activity Guam (now Marine Corps Base Camp Blaz) conducted surveys in Guam which identified 19,852 mature *Cycas micronesica* (DON 2017, p. 82).

At the time of listing in 2015, there were fewer than 516,000 individuals on Guam (80 FR 59424, October 1, 2015, p. 59434). This number did not distinguish between successfully reproducing adults and juveniles, and due to the effects of cycad aulacaspis, it is likely that the number of extant individuals that could successfully reproduce was much lower. The population estimate for Rota was 111,500 individuals; outside of the Marianas, approximately 300,000 were estimated on Yap, and 2,500 on Palau (80 FR 59424, October 1, 2015, p. 59434).

The spatial distribution of the species has become more isolated in time and less continuous as habitat loss and fragmentation have acted as barriers to seed and pollen dispersal. In 2015, there were an estimated 15 to 20 populations across Guam, Rota, Yap, and Palau with no more than four populations on any one island or island group (80 FR 59424, October 1, 2015, p. 59435). By spatially comparing populations based on the most recent genetic study (Cibrian-Jaramillo et al. 2010, entire) and targeted surveys, we now assume there are approximately 21 distinct populations of *Cycas micronesica* spread throughout forested areas of Guam. Recent surveys outside of Guam have not been extensive, and the number of known populations for Rota, Palau, and Yap have not been revised since the time of listing. *Cycas circinalis* has been identified on Pagan (Pratt 2011, p. 54) and because of unstable nomenclature is likely to be *Cycas micronesica*. However, this has not been verified.

Status and Distribution

In 2002, the Forest Inventory and Analysis Program estimated the Guam island-wide cycad population using 46 permanent field plots serving as a baseline. In 2012, cycad populations were

re-monitored to detect change since 2002. In the 10 years between field studies, the population estimate decreased from 1,571,556 to 624,000 individuals (range including sampling error: 382,000-866,000) (Donnegan et al. 2004 p. 16; Lazaro et al. 2013, p. 7). This represents an average annual rate of decline of 8.1% (5.8%-13.2%) (Figure 2).

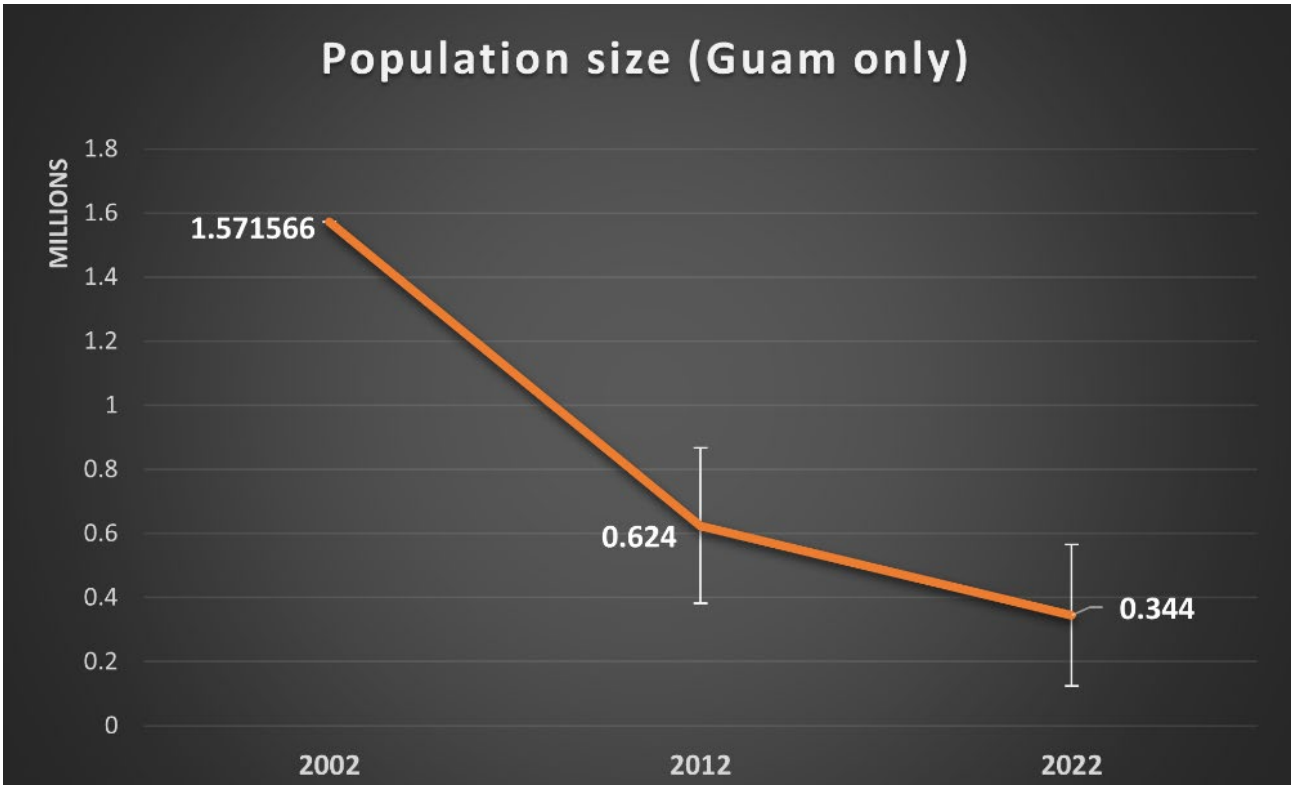

Figure 2. *Cycas micronesica* population decline on Guam (estimated from Donnegan et al. 2004; Lazaro et al. 2013).

The 2020 population estimates signify a total decline of 33.3 percent on Guam and 53.4 percent on Rota since 2013, primarily the result of cycad aulacaspis and loss of habitat through development. We estimate a total of 32 populations of *Cycas micronesica*—approximately 396,133 individuals in the wild in the Mariana Islands and fewer than 290,950 individuals in Yap and Palau—for a total of no more than 687,083 individuals across the range of the species (USFWS 2020a, p. 13). The population estimates for Palau and Yap made at the time of listing remain the most recent (80 FR 59424, October 1, 2015, p. 59434). The latest projections include the possible complete extirpation of *C. micronesica* from Guam by 2032 if the current rate of mortality continues unabated (Marler and Krishnapillai 2020, p. 7). Applying the 8.1% average annual rate of decline, the 2022, number of C. micronesica on Guam is approximately 290,529.

In February 2016, the total outplanted experimental population of *Cycas micronesica* on Tinian was 903, half of which was small and required continued maintenance (NAVFAC Marianas 2016, p. 11). Cycad aulacaspis scale and another introduced pest, cycad blue butterfly (*Chilades*

pandava), were detected in August 2019, and cycad aulacaspis had spread to half of the plots by April 2021 (NAVFAC Marianas 2021a, p. 18). Ongoing maintenance of the outplanted plants includes systematic pesticide application and vegetation management, although the highest mortality is being observed in plots with little cycad aulacaspis infestation. As of April 2021, there were approximately 850 live cycads in the Tinian plots (NAVFAC Marianas 2021, p. 18).
Table 2: The 2020 Estimates of the Range-Wide Number of Populations and Individuals of *Cycas micronesica*.

Island	Estimated Number of Populations	Estimated Number of Individuals
Guam	21	344,000 (123,000–538,000)
Rota	4	< 52,133
Palau	4	< 2,500
Yap	3	< 288,450
Total	**32**	**396,133 (Guam and Rota) + < 290,950 (Palau and Yap)**

Threats
The following threats to *Cycas micronesica* contributed to its listing or were identified after listing and continue to impact the ability of the species to recover.

Disease and pests: Cycad aulacaspis scale, a cycad specialist insect scale, is the most significant threat to the recovery of *Cycas micronesica* and the primary driver of mortality at all life stages, limiting reproduction and recruitment of individuals into the population (Marler and Muniappan 2006, p. 3; Marler 2014, p. 1; Marler and Krishnapillai 2020, entire). *C. micronesica* mortality from cycad aulacaspis reached 92 percent in Guam by 2012 (Marler and Lawrence 2012, p. 1). Other invertebrates, such as the leaf miner *Erechthias* species, the cycad blue butterfly, and the native longhorn beetle, *Dihammus marianarum*, also contribute to declining health and mortality of individuals in Mariana Islands cycad populations (Marler 2013, entire).

Loss or degradation of habitat: The conversion of land for agriculture and urban development continues to reduce and degrade the amount of habitat available for *Cycas micronesica* in the Mariana Islands; 21 percent of Guam and 6 percent of Rota is now developed land unsuitable for the species (Spies et al. 2019, p. 6). Ongoing military expansion and training is also reducing the availability or suitability of habitat for *Cycas micronesica*. The establishment of Marine Corps Base Camp Blaz will result in the loss of approximately 1,219 ac (493 ha) of limestone forest and 613 ac (248 ha) of herbaceous scrub in Guam (USFWS 2017, p. 17). A large population of *Cycas micronesica* was found on Andersen Air Force Base where a live fire training range complex is under construction as part of the Marine Corps relocation. Live fire may cause damage to individuals within and outside of the training range, and ordnance poses a wildfire risk in the area (80 FR 59424, October 1, 2015, p. 59469).

Non-native plants: Invasive plants compete with *Cycas micronesica* for space and convert native plant communities to non-native dominated communities, degrading native habitats through a

variety of processes that modify light availability, soil-water regimes, nutrient cycling, and fire regimes (80 FR 59424, October 1, 2015, p. 59456).

Invasive animals: Non-native ungulates trample vegetation, cause erosion, graze to the point of clearing understory vegetation, and prevent regeneration by eating seeds and seedlings. The species most impacting *Cycas micronesica* by herbivory are feral pigs (*Sus scrofa*) and Philippine deer (*Cervus mariannus*) (USFWS 2020a, p. 11). Plant regeneration is also impacted by rats, which eat most plant parts (80 FR 59424, October 1, 2015, p. 59455). The introduction of the brown treesnake (*Boiga irregularis*) to Guam caused the loss or severe reduction of most native bird species that dispersed seeds or pollinated native plants (80 FR 59424, October 1, 2015, p. 59456) and has had a cascading effect on the health of the island's forests. Biocontrol or other methods of targeting introduced pests, especially cycad aulacaspis, must be developed to stabilize the population, and future invasions from other pests must be prevented (Marler and Lawrence 2012, p. 240). Because physical damage and herbivory from feral pigs and deer compound the effects of insect pests (Marler and Lawrence 2012, p. 238), ungulate control and fencing restoration sites are also crucial steps in managing *Cycas micronesica* populations.

Low population numbers: A lack of recruitment into the *Cycas micronesica* populations in Guam that are currently dominated by adults increases the vulnerability of the species and challenges its ability to maintain or expand a viable population structure (Cibrian-Jaramillo et al. 2010, p. 2373; Marler and Lawrence 2012, p. 237).

Fire: Fires threaten native species and ecosystems of the Mariana Islands, particularly in Guam, and are both intentionally set, e.g., arson, or caused by altered fire regimes due to alien species (80 FR 59424, October 1, 2015, p. 59457). Wildfires burn an annual average of 1.6 to 2.4 percent of the land area in the Northern Mariana Islands and 2.8 to 4.0 percent of land area of Guam (Minton 2006, p. 23; Dendy 2019 in litt., Trauernicht and Kunz 2019, p. 1; FSRD 2022, p. 3). In 2021, a total of 177 wildfires burned approximately 3,624 ac (1,467 ha) of land in Guam (FSRD 2022, p. 3).

Stochastic events and climate change: The Mariana Islands lie in the world's most prolific typhoon basin. Unhealthy trees are less able to withstand or recover from damage caused by the high winds and rains of typhoons (Hirsh and Marler 2002, pp. 600–602) particularly if the tree's natural resilience has been impaired by chronic cycad aulacaspis scale. Further, the damage or destruction of vegetation from typhoons modifies light availability and creates space for invasion by non-native pest and plant species that compete for space, water, and nutrients, and alter basic water and nutrient cycling processes (80 FR 59424, October 1, 2015, p. 59458). While the impacts of climate change on *Cycas micronesica* are not well understood, climate change has had impacts in the tropical Pacific generally. Anticipated weather regime changes are likely to be one of the direct climate change impacts to *Cycas micronesica* and could also exacerbate the effects of other threats (80 FR 59424, October 1, 2015, p. 59458).

Tabernaemontana rotensis

Species Description
Tabernaemontana rotensis was listed as threatened on October 1, 2015 (80 FR 59424). No critical habitat has been designated for the species.

Tabernaemontana rotensis is a small to medium-sized tree ranging in height from 26 to 33 ft (8 to 10 m) with light green leaves that are thin, opposite, and 6 to 12 inches (15 to 30 centimeters) long. Flowers are white, elongate, slender, and branch from the tree (Stone 1970, p. 485). *Tabernaemontana rotensis* is in the dogbane family, Apocynaceae, and is a genetically distinct species endemic to Guam and Rota in the Mariana Islands (Harbaugh Reynaud 2012, p. 11).

Life History
A long-lived perennial tree, *Tabernaemontana rotensis* occurs in limestone forests and is most often found co-occurring with other native plants (UOG 2007, p. 11). The species can colonize sites with a range of light conditions from full sun to deep shade and has primarily been found in areas of little to no slope, i.e., with less than a 15 percent gradient (UOG 2007, p. 10; JRM and UOG 2016, p. 5).

While the average age of sexual maturity of naturally occurring *Tabernaemontana rotensis* plants has not been documented, propagated nursery plants were seen flowering after one year for trees reaching a height of 4 ft (1.2 m) (GPEPP 2019, in litt., p. 3). *Tabernaemontana rotensis* populations typically flower from August through October, during which 40 to 80 percent of trees are found to have at least some flowering occurring every month (UOG 2007, p. 23). Germination and seedling emergence have been shown to be maximized in full sun conditions, such as after typhoon damage. About one month after a typhoon the species develops a synchronized pulse of flowering which leads to a mass seeding event approximately four months post-typhoon (UOG 2007, p. 21).

Following flowering, *Tabernaemontana rotensis* trees produce conspicuous beaked orange fruits that are either single or twinned. The fruits reach full size around 1 inch (3 centimeters) long, 30 to 35 days after flowering. Fruit is mature at around 90 days, when it turns from green to orange, splits open, and exposes the seeds (UOG 2007, p. 6, 24).

There is little data on the pollinators of *Tabernaemontana rotensis*, although seed dispersal of the species is thought to be dependent on birds. The eradication of most pollinators and frugivorous bird species in Guam by invasive species has restricted the spatial distribution of *Tabernaemontana rotensis* so that the trees are generally found clumped in confined areas, with seedling establishment limited to fruit that falls in the vicinity of the parent tree. As a result, seedlings develop in extreme competition with each other, and many become stunted and die (UOG 2007, p. 14).

Population Dynamics

The species *Tabernaemontana rotensis* is known historically from Guam and Rota. At the time of listing in 2015, the number of documented individuals had increased to seven naturally occurring populations comprised of more than 21,000 seedlings, immature trees, and reproductive, mature trees on Guam, and nine trees on Rota (80 FR 59424, October 1, 2015, p. 59438). Most of the *Tabernaemontana rotensis* on Guam were found in clustered populations on Andersen Air Force Base with an average of 80, but up to 850, individuals per site (UOG 2007, p. 9). Thirty *Tabernaemontana rotensis* trees had also been outplanted on Rota (80 FR 59424, October 1, 2015, p. 59438). Surveys on Guam have continued to document mature trees and seedlings throughout military lands, as well as in the Anao Conservation Area, Ipan, and the Guam National Wildlife Refuge, Ritidian Unit (USFWS 2020b, p. 9−10). As of 2020, an estimated 15,510 naturally occurring plants remain within eight populations on Guam and as scattered individuals across Rota (USFWS 2020b, p. 1-15). In 2000, two mature trees were known on Rota and 167 seedlings, immature trees, and mature, reproductive trees were found at five sites on Guam, including at Andersen Air Force Base and the Guam National Wildlife Refuge (65 FR 35025, June 1, 2000, p. 35027). By 2004, there were at least eight *T. rotensis* trees known on private lands on Rota, and at least 250 trees on Guam (69 FR 1560, January 9, 2004, p. 1560).

While reproducing individuals are frequently observed in *Tabernaemontana rotensis*, the lack of adequate seed dispersal has meant that there is a reduced recruitment of mature individuals into the population in Guam.

Status and Distribution

Our 2020 population estimate shows an increase in the number of *Tabernaemontana rotensis* populations known since 2015, but a decline in the overall number of individuals. This population estimate of 15,341 naturally occurring individuals across eight sites in Guam and six sites in Rota (USFWS 2020b, p. 10) primarily reflects a decrease in the number of individuals reported at Andersen Air Force Base, where the majority of the species has been observed. On Guam, six populations are located in the northern half of the island and two populations are located in the southern half. Individuals on Rota are spread out across the island.

Subsequent surveys performed from late 2019 through 2021 found an additional 86 individuals at Andersen Air Force Base and Naval Base Guam Naval Munitions Site, and 54 individuals in the vicinity of the Bolanos Conservation Area and Yigo Raceway (NAVFAC Marianas 2021b, pp. 109−110, 112, 114). Some of these detections are on or near lands slated for development or other projects and have not yet been incorporated into the population estimate for the species.

Threats

The following threats to *Tabernaemontana rotensis* contributed to its listing or were identified after listing and continue to impact the ability of the species to recover.

Loss or degradation of habitat: The conversion of land for urban development and agriculture continues to reduce and degrade the amount of suitable habitat available for *Tabernaemontana rotensis* in the Mariana Islands; 21 percent of Guam and 6 percent of Rota is now developed land (Spies et al. 2019, p. 6). *Tabernaemontana rotensis* typically grows on flat terrain with little to no slope, land which is also particularly suited to development. Ongoing military expansion and training is also reducing the availability or suitability of habitat for *Tabernaemontana rotensis*. The establishment of Marine Corps Base Camp Blaz will result in the loss of approximately 1,219 ac (493 ha) of limestone forest in Guam (USFWS 2017, p. 17). A large population of *Tabernaemontana rotensis* was found on Andersen Air Force Base where a live fire training range complex is under construction for the military expansion. Live fire can cause damage to individuals within and outside of the training range, and there is potential for the ordnance to cause wildfires in the area (80 FR 59424, October 1, 2015, p. 59469).

Fire: Fires threaten native species and ecosystems of the Mariana Islands, particularly in Guam, and are both intentionally set, e.g., arson, or caused by altered fire regimes due to alien species (80 FR 59424, October 1, 2015, p. 59457). In 2021, a total of 177 wildfires burned approximately 3,624 ac (1,467 ha) of land in Guam (FSRD 2022, p. 3).

Non-native plants: Invasive plants compete with *Tabernaemontana rotensis* for space and convert native plant communities to non-native dominated communities, degrading limestone forests through a variety of processes that modify light availability, soil-water and fire regimes, and nutrient cycling (80 FR 59424, October 1, 2015, p. 59456). *Tabernaemontana rotensis* is rarely found co-occurring with non-native species (UOG 2007, p. 11).

Invasive animals: Non-native ungulates trample and damage vegetation, graze often to the point of clearing understory vegetation, cause erosion, and prevent regeneration by eating seeds and seedlings. The species most impacting *Tabernaemontana rotensis* by herbivory are feral pigs (*Sus scrofa*), Philippine deer (*Cervus mariannus*), and water buffalo (*Bubalus bubalis*) (USFWS 2020, p. 12). Plant regeneration is also impacted by rats, which eat most plant parts (80 FR 59424, October 1, 2015, p. 59455). The introduction of the brown treesnake (*Boiga irregularis*) to Guam caused the loss or severe reduction of most native bird species that dispersed seeds or pollinated native plants (80 FR 59424, October 1, 2015, p. 59456). This lack of seed dispersal has resulted in clustered populations of *Tabernaemontana rotensis*, which compete for space and sunlight, exhibit less genetic diversity, are less resilient to evolutionary changes (UOG 2007, p. 28), and are more vulnerable to stochastic events and extinction from other threats.

Stochastic events and climate change: The Mariana Islands lie in the world's most prolific typhoon basin. Damage and destruction of vegetation from typhoons modifies light availability and creates space for invasion by non-native species that compete for space and alter basic water and nutrient cycling processes (80 FR 59424, October 1, 2015, p. 59458). All populations of *Tabernaemontana rotensis* except at three locations on Guam have low resiliency due to low numbers of individuals. While the impacts of climate change on *Tabernaemontana rotensis* are not well understood, climate change has had impacts in the tropical Pacific generally.

Anticipated weather regime changes are likely to be one of the direct climate change impacts to *Tabernaemontana rotensis* and could also exacerbate the effects of other threats (80 FR 59424, October 1, 2015, p. 59458).

Environmental Baseline

Regulations implementing the ESA (50 CFR 402.02) define the environmental baseline as the past and present impacts of all federal, state, or private actions and other human activities in the action area. Also included in the environmental baseline are the anticipated and/or ongoing impacts of all proposed federal projects in the action area that have undergone Section 7 consultation, and the impacts of state and private actions which are contemporaneous with the consultation in progress.

General Environmental Baseline

The project footprint is not within an area slated for protection from ungulates or other site-specific conservation action. The site is currently protected to some extent from incursion of invasive species pursuant to two active Department of the Navy formal consultations, *Biological Opinion for the Department of Navy's Relocation of the U.S. Marine Corps from Okinawa to Guam and Associated Activities on Guam*, 2015 (01EPIF00-2015-F-0025) and *Reinitiation of the 2015 Biological Opinion on the Department of the Navy's Relocation of U.S. Marine Corps from Okinawa to Guam and Associated Activities on Guam*, 2017 (01EPIF00-2016-F-0185).

The Caiguat Forest Enhancement Area is among the native limestone forest areas that will be conserved long-term in relation to the above-listed Biological Opinions and the *Memorandum of Agreement between the Department of the Navy and the U.S. Fish and Wildlife Service Regarding Conservation of Guam Micronesian Kingfisher Recovery Habitat in Northern Guam* (2015, as amended). The area will be kept free of ungulates and experimental brown treesnake suppression will occur within the site.

Environmental Baseline: *Cycas micronesica*

Status of the species within the action area: There are 74 *Cycas micronesica* within the 26.2 ac (10.6 ha) area within which vegetation clearing and RGS-A development may occur and there are an additional two *C. micronesica* within 10 ft (3 m) of this area (Figure 3). *Cycas micronesica* density within the northwest corner of the Caiguat Forest Enhancement Area is currently low to medium (Gutierrez *pers. comm.* 2022). *Cycas micronesica* used to be the most common understory tree in the region's limestone forests (Stone 1970, p. 65; Raulerson and Rinehart 1991, p. 4; Donnegon et al. 2004, p. 19).

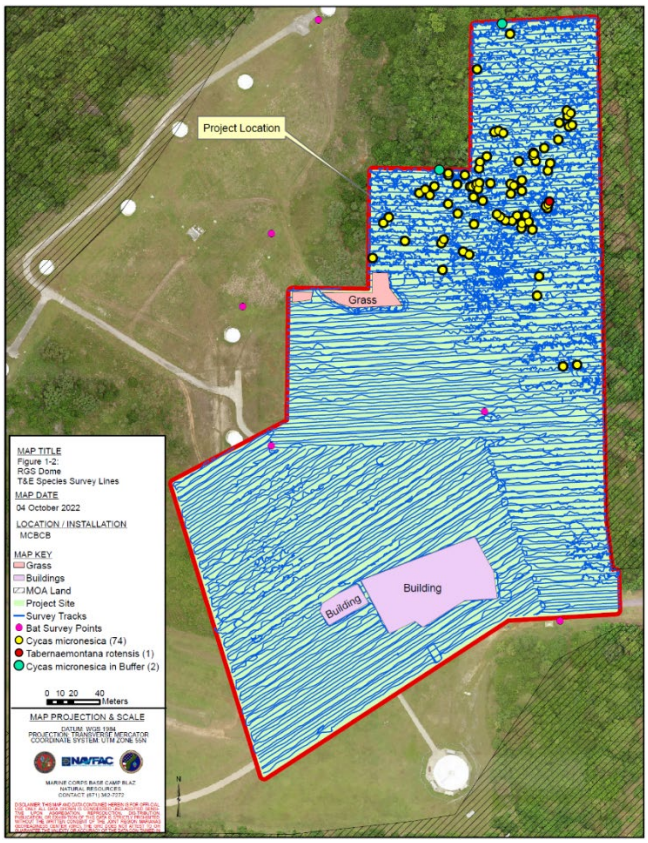

Figure 3. Location of *Cycas micronesica* plants within the area that may be cleared for RGS-A development.

Factors affecting species environment within the action area: The *Cycas micronesica* population within the action area are likely to be experiencing the same dramatic declines occurring throughout the species' range on Guam. Estimates from the Forest Inventory and Analysis Program on Guam (Donnegan et al. 2004 p. 16 and Lazaro et al. 2013 p. 7) indicate an estimated average 8.1% (5.8%-13.2%) rate of decline for *C. micronesica*, primarily due to cycad aulacaspis scale and development but the contribution of each has not been quantified. *Cycas micronesica* recruitment is extremely low due to high seedling mortality due to the scale insect and other threats, including ungulates. The current high rates of population decline due to threats other than development are likely to continue to affect the cycads at the RGS-A project footprint and Caiguat Forest Enhancement Area until an effective cycad aulacaspis scale biocontrol can be developed and implemented. In the absence of the proposed action and inability to determine a rate of decline independent of development, the 76 *C. micronesica* plants within the RGS-A project area are expected to continue to decline at an average annual rate of 8.1%. However, this rate of decline would be lower without accounting for development, thus the expected number for replacement should be higher. Five years from now, only 45 of the 76 cycads would be expected to persist at the project area, and seedling recruitment would not be expected to be successful. The senescing cycad population at the project site is expected to continue to decline to fewer than 13 plants in the next 20 years. The most optimistic, 5.8%, annual continued decline

of the *C. micronesica* population in the project footprint in the absence of the proposed action (53 of the 76 plants remaining in year 5, 39 plants in year 10, 29 plants in year 15, and only 22 plants remaining in year 20), is shown in Table 3. The plants surviving to year 20 are expected to be old; this population is expected to continue to experience very low levels seedling recruitment due to invertebrate and ungulate damage. Therefore, the plants in the project footprint living to year 20 are expected to be nearing the end of their life spans at that time.

Table 3: Baseline number (and % of the 2021 population) of *Cycas micronesica* expected to persist in the project footprint, and within 10 ft (3 m) of the project footprint, in the absence of the proposed action with anticipated continued 5.8% annual decline.

YEAR / Approximate Project Year		Baseline - Number of Cycads expected to persist in the proposed development area in the absence of the proposed action: 74 genetically distinct cycads in project footprint (2021) and an additional 2 cycads within 10 feet of the project footprint (anticipated continued annual decline of 5.8%)	Baseline - Percent of *Cycas micronesica* in the proposed development area expected to persist in the absence of the proposed action (with 5.8% ongoing population decline)
2021		76	
2022		72	
2023	1	67	
2024	2	64	
2025	3	60	
2026	4	56	
2027	5	53	70%
2028	6	50	
2029	7	47	
2030	8	44	
2031	9	42	
2032	10	39	52%
2033	11	37	
2034	12	35	
2035	13	33	
2036	14	31	
2037	15	29	38%
2038	16	28	
2039	17	26	
2040	18	24	
2041	19	23	
2042	20	**22**	**29%**

The 74 *C. micronesica* within the potential project footprint were assessed individually by the DON. The condition of the plants is summarized in Table 4. Just over half the plants were affected by cycad aulacapsis scale. Nine female plants were in seed and 14 individuals had vegetative propagules at the time of the survey.

Table 4. The condition of the 74 *Cycas micronesica* remaining within the project footprint at the time of the 2021 survey (DON 2022, p. 4-6).

Total Number of Cycads	74
Number of Males	3
Number of Females	13
Number of Females with Seeds	9
Number of Unknown Sex	58
Cycads with Vegetative Propagules (total number of propagules)	14 (33)
Cycads with Scale	40
Cycads with Butterfly Damage	18
Cycads with Longhorn Beetle Damage	9

Environmental Baseline: *Tabernaemontana rotensis*

Status of the species within the action area: There is one *Tabernaemontana rotensis* within the area that may be affected by the project (see Figure 3). This *T. rotensis* tree is a mature individual exhibiting healed stem damage, leaf drop and was flowering but fruits or seedlings were not observed (DON 2022, p. 4-7). *Tabernaemontana rotensis* occur throughout the Caiguat Forest Enhancement Area; there are an unknown number of *T. rotensis* within the northwest corner of the site where plants for this project will be outplanted (Gutierrez, pers. comm. 2022).

Factors affecting species environment within the action area: *Tabernaemontana rotensis* within the project footprint are exposed to ungulate browsing and, due to the plant's seed dispersers by brown treensnakes, the plant's seedlings would be expected to continue to experience very low survival rates due to a failure to disperse seeds away from the parent tree.

Effects of the Action

General Effects: The project will result in the permanent removal of up to 26.2 ac of vegetation, including approximately 7 ac of native limestone forest. Edge effects, including changes in microclimate, increased exposure to damaging winds during typhoons, and increases in dust are expected to occur in the forest habitats adjacent to vegetation cleared for the RGS-A. At the Caiguat Forest Enhancement Area, *Cycas micronesica* and *Tabernaemontana rotensis* plants grown from material collected at the project footprint will be planted and conserved. Conservation actions will include control of threats including weeds and invertebrates. Each stressor and benefit caused by the proposed action may have consequences to these listed plants. The consequences of the proposed action on the species are discussed below.

Beneficial and Adverse Consequences of the Proposed Action on the on *Cycas micronesica*

Species' response to a proposed action

The RGS-A's *Cycas micronesica* project is designed to ensure the maintenance of the long-term baseline number of genetically-distinct *C. micronesica* in the wild based on our current estimates of the population's continued decline. Twenty years from now the RGS-A's implementation of

C. micronesica conservation measures are likely to ensure there are the same number of genetically-distinct *C. micronesica* in the wild as there would have been in the absence of the project without intervention such as ungulate and invertebrate control. In the short-term, project implementation would result in a reduction in the number of *C. micronesica* in the wild. A comparison of the baseline *C. micronesica* population decline, compared to the commitments of the RGS-A conservation action, are shown in Table 5.

During project year 1, when the land is cleared, the *C. micronesica* plant material collected from the site will be in propagation and not yet outplanted. Additionally, there may be a small, temporary project-caused reduction in the number of *C. micronesica* in the wild during years 2 through 19. In year 20, the number of plants propagated and conserved in the conservation area will likely be the same as, or more than, the number of plants that would have persisted within the RGS-A construction site in the absence of RGS-A implementation.

Table 5. Long-term conservation commitments by RGS-A to establish a cohort of *Cycas micronesica* at the Caiguat Forest Enhancement Area in comparison to the anticipated continued decline of the *C. micronesica* within the project footprint if the RGS-A was not implemented.

YEAR / Approximate Project Year		Baseline - Number of Cycads expected to persist in the proposed development area in the absence of the proposed action: 74 genetically distinct cycads in project footprint (2021) and an additional 2 cycads within 10 feet of the project footprint (anticipated continued annual decline of 5.8%)	Baseline - Percent of *Cycas micronesica* in the proposed development area expected to persist in the absence of the proposed action (with 5.8% ongoing population decline)	Effects of the RGS-A Action - Number of propagated/outplanted Cycas micronesica living at the off-site conservation area (these numbers are based on worst-case scenario of a large project footprint affecting all 76 C. micronesica; proportionally fewer individuals will be outplanted and conserved if the project footprint affects fewer plants)			
				Minimum # (if all 76 are affected)	Minimum % of the 2021 number	Maximum #	Maximum % of the 2021 number
2021		76					
2022		72					
2023	1	67					
2024	2	64					
2025	3	60					
2026	4	56					
2027	5	53	70%	35	46%	53	70%
2028	6	50					
2029	7	47					
2030	8	44					
2031	9	42					
2032	10	39	52%	30	39%	39	52%
2033	11	37					
2034	12	35					
2035	13	33					
2036	14	31					
2037	15	29	38%	26	34%	29	38%
2038	16	28					
2039	17	26					
2040	18	24					
2041	19	23					
2042	20	**22**	**29%**	**22**	**29%**	**22**	**29%**

The RGS-A's implementation of propagation and outplanting of *C. micronesica* plants, during this current period when the species is otherwise experiencing very low levels of recruitment due to these serious threats, is expected to result in the development of a small but important cohort of younger plants. In the absence of the proposed action, and unless a control for cycad aulacaspis scale is developed and implemented to boost recruitment, most of the plants that would remain within the project footprint in 20 years would be nearing the end of their 40-year lifespans.

The short-term removal of up to 74 individuals within the project footprint in addition to the potential reduced survival of the 2 individuals near the project area would constitute a loss of 0.02 percent of Guam's estimated 290,529 remaining *Cycas micronesica*. The temporary reduction of the local population by 76 individuals would not disrupt the reproduction, distribution, or number of plants in the local *C. micronesica* population. The short-term loss of these plants would be offset, in the long-term, by the collection of seed and plant materials from the plants within and adjacent to the project footprint and the outplanting and long-term conservation of these plants at the nearby Caiguat Forest Enhancement Area. The RGS-A would continue to conduct long-term conservation of the plants at the off-site conservation area, such as weed and invertebrate control to ensure long-term persistence of the *C. micronesica* or additional seed collection, propagation, and outplanting would occur if needed to ensure 5-year benchmark number of plants are achieved to stay on track to ensure the species baseline in project year 20 is not reduced as a result of the project. The RGS-A project is likely to ensure the number of *C. micronesica* in the wild in project year 20 will be the same as it would have been in the absence of the RGS-A development. The RGS-A's implementation of propagation and outplanting of *Cycas micronesica* plants, during this current period when the species is otherwise experiencing very low levels of recruitment due to these serious threats, is expected to result in the development of a small but important cohort of younger plants. In the absence of the proposed action, and unless a control for cycad aulacaspis scale is developed and implemented to boost recruitment, the plants that would be expected to remain within the project footprint in 20 years would be nearing the end of their 40-year lifespans.

The distribution of *Cycas micronesica* plants would be unchanged as a result of the RGS-A, since the plant's population spans across the landscape on all sides of the project site. The project would not result in fragmentation of the plant population or appreciable reductions in plant pollinator dispersal, so it would not interfere with reproduction or connectivity of the plant population.

In summary, these impacts are not likely to create a change in the *Cycas micronesica* ability to survive and recover. The proposed action would not be expected, directly or indirectly, to reduce appreciably the likelihood of the survival and recovery of *C. micronesica* in the wild by reducing the reproduction, numbers, or distribution of this species.

Beneficial and Adverse Consequences of the Proposed Action on the on *Tabernaemontana rotensis*

Species' response to a proposed action

Land clearing for the RGS-A may result in permanent removal of one adult *Tabernaemontana rotensis* plant. If the *T. rotensis* plant ends up being within the project footprint, seeds or stem cuttings will be collected from the *T. rotensis* will be propagated in a greenhouse, and the propagules will be outplanted to the Caiguat Forest Enhancement Area and treated for pests and invasive species for one year following outplanting. There is an unknown likelihood these small *T. rotensis* plants outplanted and conserved for only one year will survive to maturity. Therefore, the RGS-A implementation may result in the permanent loss of up to one *T. rotensis* from the population on Guam.

If the individual plant and the intact forest to the north of the plant can be avoided during project implementation, left intact, and no clearing occurs within 10 ft of the plant's location, the propagation and outplanting will not occur. The plant would be left intact where it may be injured or killed as a result of the adjacent land clearing. Ground disturbance due to use of heavy equipment may injure the plant's roots. The injury to the roots may reduce the plant's survival by reducing its ability to collect water and nutrients from the soil or it may increase the plant's exposure to pathogens. The removal of nearby forest vegetation may increase the plant's exposure to typhoon winds, increasing the plant's vulnerability to being injured in a wind storm. Dust from project construction may temporarily settle on the plant's leaves, reducing its photosynthetic productivity. The likelihood of plant survival increases with any increase in the buffer distance, if any, the RGS-A is ultimately able to give the wild *T. rotensis* plant.

As of 2020, an estimated 15,510 naturally occurring plants remain within eight populations on Guam (USFWS 2020 l, p. 1-15). Should one individual *Tabernaemontana rotensis* plant occur as a result of the RGS-A, it would result in a permanent .0066% reduction of the *T. rotensis* population on Guam. This reduction would not significantly impact the population because the one plant affected constitutes a small part of the relatively large local plant population. The distribution of plants would be unchanged, since the plant's population spans across the landscape on all sides of the project site, and the project would not result in fragmentation of the plant population. As such, loss of the plant would not interfere with connectivity of the plant population.

In summary, the permanent loss of one *Tabernaemontana rotensis* plant is not likely to result in a change to the species ability to survive and recover. The proposed action would not be expected, directly or indirectly, to reduce appreciably the likelihood of the survival and recovery of *T. rotensis* in the wild by reducing the reproduction, numbers, or distribution of this species.

Cumulative Effects

Cumulative effects include the effects of future State, tribal, local or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

The Service is not aware of any future state, tribal, local, or private actions that are reasonably certain to occur within the action area at this time; therefore, no cumulative effects are anticipated.

Conclusion

After reviewing the current status of C*ycas micronesica* and *Tabernaemontana rotensis*, the environmental baseline for the action area, the effects of the proposed RGS-A action, and the cumulative effects, it is the Service's biological opinion that the RGS-Action, as proposed, is not likely to jeopardize the continued existence of C. *micronesica* or *T. rotensis*.

Conservation Recommendations

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

To prevent the spread of invasive species during project implementation, implement the pertinent sections of the Biosecurity Protocols detailed in Appendix B of this Biological Opinion.

In order for the Service to be kept informed of actions minimizing or avoiding adverse effects or benefitting listed species or their habitats, the Service requests notification of the implementation of any conservation recommendations.

Reinitiation-Closing Statement

This concludes formal consultation on the action(s) outlined in this biological opinion. As provided in 50 CFR § 402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained or is authorized by law and: (1) if the amount or extent of taking specified in the incidental take statement is exceeded; (2) if new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered; (3) if the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in the biological opinion; or (4) if a new species is listed or critical

habitat designated that may be affected by the identified action.

We appreciate your cooperation and assistance in helping us prepare this biological opinion. If you have any questions about this consultation, please contact Mariana Islands Geographic Team Manager Jacqueline Flores of my staff at jacqueline_flores@fws.gov.

Sincerely,

Michelle D. Bogardus
Assistant Field Supervisor
Pacific Islands Fish and Wildlife Office

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APPENDIX A

NLAA Concurrence for Mariana Fruit Bat

This appendix details the U.S. Fish and Wildlife Service's (Service) concurrence with your determination the proposed implementation of the RGS-A project at Marine Corps Base Camp Blaz (MCBCB), Guam, is not likely to adversely affect the threatened Mariana fruit bat (*Pteropus mariannus mariannus*, fanihi) pursuant to section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 et seq.). Our analysis is based on information provided in your August 2022, Biological Assessment and email and MS Teams conversations, field investigations, and other information in our records. A complete record of this consultation is on file at the Pacific Islands Fish and Wildlife Office.

Project Description:

The proposed action is detailed in the Department of the Navy's *Final Biological Assessment for Construction of Relay Ground Station-Asia at Marine Corps Base Camp Blaz, Guam*, dated August 2022. Additional minimization and avoidance measures which were incorporated into your project at the recommendation of our office, are detailed within the Project Description body of this Biological Opinion or summarized below.

Avoidance and Minimization Measures:

Mariana Fruit Bat: Because the action area includes suitable habitat for the Mariana fruit bat, the project design incorporates the Service's standard recommended measures to reduce the likelihood the project may affect this sensitive species. Construction work will not occur within 150 m (492 ft) of a Mariana fruit bat roost and when a Mariana fruit bat is seen flying or foraging within 150 m (492 ft) of construction activity, work will pause until the bat has left the area. The DON will implement a contractor education program to ensure that construction contractor personnel are shown how to identify, respond, and report a Mariana fruit bat sighting.

Additional pre-construction biomonitor surveys for Mariana fruit bats and bat roost sites will be conducted up to one week prior to the onset of vegetation clearing. Any pause in work beyond seven days in vegetation clearing will trigger additional surveys. These surveys will follow JRM protocols (USFWS 2009).

All construction and maintenance work is expected to occur during daytime hours. Although the Navy does not expect night work to occur the following conservation measures will be implemented should unforeseen night construction or exterior maintenance work be required:

- Up to one week prior to night work a dusk biomonitor survey following JRM protocol (USFWS 2009); and
- When installing permanent lights, and if appropriate for antiterrorism force protection or airspace safety criteria, the DON will use downward-facing,

shielded or full cut-off lens lights (with the lowest lumens necessary). Properly shielded or full-cutoff lens illumination can only be seen below the horizontal plane at the fixture height. To avoid vertical glare and illumination of forest habitats, should temporary lighting be needed for nighttime work, only downward-facing, full cutoff-off lens lights or fully-shielded lights will be used.

Consequences of the Proposed Action:

Mariana Fruit Bat Biology:

Mariana fruit bats are a large-bodied colonial tree-roosting species. Mariana fruit bats are at their roost during the day and they forage at night on fruits, nectar, pollen, and some leaves from at least 45 different plant species. Colonies established by one or more bats can consist of fewer than 20 individuals or they can grow to over 1,000 individuals (Guilbert and Mullin 2020, p. 1). A day roost may be occupied by one or more bats. Generally maternal colonies are occupied by a harem of bats – a single male with multiple females. Breeding occurs year-round. Bachelor colonies and solitary male bat roosts are also common. The mother bat carries its bat pups until they grow to be too heavy. When these young bats that are not well developed enough to fly on their own, they are left at the maternal roost when the parents forage at night. Non-volant Mariana fruit bats are vulnerable at their day roost and foraging habitat to predation by the brown treesnake, disturbance by the little fire ant (Vanderwoude, pers. comm. 2022; Richardson pers. comm. 2022; and Hawaii Invasive Species Council 2022), and human disturbance and adult bats are vulnerable to harassment from these threats. When the Mariana fruit bat on its day roost is startled or alarmed by disturbance including human scent and noise it takes flight from its roost. Prolonged or severe disturbance results in abandonment of the roost. It can take months for bats to return to an abandoned roost, if they return at all. Because some members of the public still consider the Mariana fruit bat to be a delicacy and a valued gift to persons of importance, these bats are vulnerable to poaching when they are outside of areas that are actively protected by law enforcement.

Although in the recent past, Mariana fruit bats have been sighted at coastal sites north and south of the project site, and inland from the project area, Mariana fruit bats are not known to currently be roosting, feeding or transiting within more than 150 m (492-ft) of the project site.

Effects of the Action:

Construction activity has the potential to startle or alarm roosting, foraging, and transiting Mariana fruit bats. Such disturbance would be expected to cause abandonment of breeding, roost abandonment, abandonment of a foraging site, and avoidance of the construction area. These changes in behavior could reduce the animal's reproductive success or survival. To avoid human disturbance to the sensitive bat, the project design incorporates a 150-m (492-ft) stop-work buffer around any roosting, foraging, or transiting Mariana fruit bat.

Because the Mariana fruit bat has not previously been detected within 150 m (492-ft) of the project site and project activity will cease if a Mariana fruit bat is detected within 150 m (492 ft) of the project activity, impacts to the bat are expected to be extremely unlikely to occur. Because adverse effects are extremely unlikely to occur, they are **discountable** and therefore not likely to adversely affect the Mariana fruit bat.

Conclusion

Based on the proposed action, our analysis indicates consequences of the proposed action, to the Mariana fruit bat is discountable as described above. **The Service therefore concurs with your determination that the RGS-A project may affect, but is not likely to adversely affect the Mariana fruit bat.** Unless the project description changes, or new information reveals that the proposed project may affect listed species in a manner or to an extent not considered, or a new species is listed or critical habitat designated that may be affected by the proposed action, no further action pursuant to section 7 of the ESA is necessary.

APPENDIX A, REFERENCES

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APPENDIX B: BIOSECURITY PROTOCOLS

1. Ensure all work vehicles, machinery, and equipment are cleaned, inspected by its user, and found free of mud, dirt, debris and organisms prior to entry into and exit from the action area.
    a. Vehicles, machinery, and equipment must be thoroughly pressure washed in a designated cleaning area (designated by the responsible land manager) and visibly free of mud, dirt, plant debris, insects, frogs (including frog eggs) and other vertebrate species such as rats, mice and non-vegetative debris. A hot water wash is preferred. Areas of particular concern include bumpers, grills, hood compartments, areas under the battery, wheel wells, undercarriage, cabs, and truck beds (truck beds with accumulated material (intentionally placed or fallen from trees) are prime sites for accidental transport of invasive species).
    b. The interior and exterior of vehicles, machinery, and equipment must be free of garbage and food. The interiors of vehicles and the cabs of machinery must be vacuumed clean. Floor mats will be sanitized with a solution of at least 70-percent isopropyl alcohol or a freshly mixed 10-percent bleach solution.
    c. Any machinery, vehicles, equipment, or other supplies found to be infested with ants (or other invasive species) must not enter action area. Treatment is the responsibility of the equipment or vehicle owner and operator.
2. **Little Fire Ants**: Ensure all work personnel clothing and skin, and all vehicles, machinery, and equipment are inspected for invasive ants prior to moving to the project site and prior to moving from areas occupied by the little fire ant into areas where the ant does not occur.
    a. Ensure a visual inspection for little fire ants (*Wasmannia auropunctata*) is conducted prior to entry into action area or movement within the project site, from previously or currently ant-occupied areas, into areas where the ant does not occur.
    b. Hygiene is paramount but even the cleanest vehicle may transport little fire ant. Place insect bait into refillable tamper resistant bait stations. Note larger vehicles, such as trucks, may require multiple stations. Monitor bait stations frequently (every week at a minimum) and replace bait as needed. If the station does not have a sticker to identify the contents, apply a sticker listing contents of the station. Refer to the Hawaii Ant Lab's little fire ant fact sheet, which can be downloaded here: https://littlefireants.com/wp-content/uploads/02a-LFA-Fact-Sheet_v2.5_May2020.pdf.
    c. Do not use any machinery, vehicles, equipment, or other supplies found to be infested with ants (or other invasive species) or used in an area infested by ants, for any type of project work until it is sanitized and re-tested following a resting period of at least 24 hours. Infested vehicles must be sanitized following recommendations by the Hawaii Ant Lab (http://www.littlefireants.com) or other ant control expert and in

accordance with all State and Federal laws. Treatment is the responsibility of the equipment or vehicle owner and operator.

3. Keep all base yards and staging areas inside and outside natural areas and native habitat free of invasive species.
    a. Ensure base yards and staging areas are inspected at least weekly for invasive species and any invasive found is to be removed immediately. Pay particular attention to where vehicles are parked overnight, keeping areas within 30-feet (ft) (9 m) of vehicles free of debris. Parking on pavement and not under trees, while not always practical, is best.
    b. Project vehicles or equipment stored outside the action area, such as a private residence, are to be kept in a pest-free area as defined by the onsite land or project manager.
    c. Ensure all cutting tools, including machetes, chainsaws, and loppers are sanitized to remove visible dirt and other contaminants prior to entry into action area and prior to the movement of the tool from an area occupied or formerly known to be occupied by the little fire ant, into an area where the ant is not known to occur. Sanitized using a solution of >70% isopropyl alcohol or a freshly mixed 10% bleach solution. One minute after sanitizing, you may apply an oil based lubricant to chainsaw chains or other metallic parts to prevent corrosion.
    d. Vehicles, machinery, and equipment must be cleaned as described above.
4. Safety note for individuals working in the action area:
    a. Little fire ants nest in trees. If you are under a tree and that tree is bumped or somehow stressed, the threat response of the ants is to fall from the leaves and sting the person under the tree. If you are subject to an ant attack, do not panic. The ants are extremely small, but their stings are painful, so make sure you remove all ants from your body and clothing. The stings produce inch long welts that are itchy and painful, and can last for weeks.
    b. Treat stings as you would other insect stings. In some persons, stings can produce life threatening reactions. Stocking antihistamine in the first aid kit is a reasonable precaution.

F1U BO for Firefighter Training Facility Marine Corps Base Camp Blaz, Guam (September 2023)

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Biological Opinion for Firefighter Training Facility Marine Corps Base Camp Blaz, Guam



Photo Credit: Anne Brooke, U.S. Fish and Wildlife Service

September 14, 2023
(2023-0081810)

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Pacific Islands Fish and Wildlife Office
300 Ala Moana Boulevard, Room 3-122
Honolulu, Hawai‘i 96850

In Reply Refer To:
2023-0081810

September 14, 2023

Mr. Albert T. Borja
Installation Environmental Program Director
Marine Corps Base Camp Blaz
PSC 488 Box 105
FPO AP 96537-0149

Dear Mr. Borja:

This document transmits the U.S. Fish and Wildlife Service's (Service) biological opinion (BO) based on our review of the U.S. Department of the Navy proposed construction and operation of a firefighter training facility located at Marine Corps Base Camp Blaz (MCBCB), Finegayan, Guam, and its effects on the Mariana fruit bat (fanihi, *Pteropus mariannus mariannus*) in accordance with section 7 of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 *et seq*.). Your request for formal consultation was received on May 3, 2023.

This biological opinion is based on information provided in the May 2, 2023, formal biological evaluation, a Microsoft Teams conference call of March 27, 2023, email correspondence, field investigations, and other sources of information. A complete administrative record of this consultation is on file at our office.

Consultation History

February 9, 2023: The U.S. Department of the Navy requested initiation of informal consultation, and the Service confirmed receipt of the request.

March 1, 2023: The Service provided comments on the informal consultation request and biological evaluation.

March 27, 2023: Microsoft Teams conference call with Naval Facilities Engineering Command (NAVFAC) Pacific Senior Natural Resources Specialist Coralie Cobb, and Mariana Islands Team Manager Jacqueline Flores and Fish and Wildlife Biologists Dawn Bruns and Lauren Taylor of the Service, to discuss unavoidable adverse effects of the action to the Mariana fruit bat.

March 29, 2023: The U.S. Marine Corps transmitted a draft formal consultation request and biological evaluation to the Service.

April 5, 2023, through April 26, 2023: U.S. Marine Corps provided additional project details and effects analysis for the Mariana fruit bat in the biological evaluation in response to Service comments.

May 3, 2023: U.S. Marine Corps requested initiation of formal consultation.

May 17, 2023: The Service transmitted a letter to the U.S. Marine Corps acknowledging initiation of formal consultation and confirming all information required to initiate consultation was provided in the consultation request or otherwise accessible for consideration and reference. ECOSphere number 2023-0081810 was assigned to the project.

August 10, 2023: The Service transmitted the Draft Biological Opinion to the Department of the Navy.

August 21, 2023, The Department of the Navy provided the Service with comments on the Draft Biological Opinion.

BIOLOGICAL OPINION

Description of Proposed Action

The proposed action includes construction and operation of a firefighter training facility (FFTF) to encompass approximately 8 acres (ac) (3.2 hectares [ha]) on the former Andersen Softball Field site on MCBCB, adjacent to Route 3 and the base security gate (Figure 1). The FFTF will involve construction of four training facilities within this previously developed area: an approximately 6-ac (2.4-ha) paved emergency vehicle operator course; a six-story enclosed firefighter training tower; 11 firefighter training mockups; and a two-story, 2,500 square foot (ft) (232 square meter [m]) enclosed observation/control facility. Firefighter training mockups—to practice skills such as fire extinguishing and search and rescue—will be constructed on a paved 2-ac (0.8-ha) area and will include props such as vehicles, a drafting pit, a horizontal tank, a dumpster, portable fire extinguishers, simulated electrical powerlines, fuel storage, and a structural collapse area. The observation/control facility will have a video camera system to monitor the entire FFTF and will control the capabilities of the on-site propane gas (fire mockup fuel), communication, mechanical, electrical, and public address speaker systems. The proposed action also includes installation of an approximately 10,000 gallon (gal) (37,854 liter [l]) aboveground propane tank and an approximately 21,000 gal (79,494 l) aboveground water tank. An 8-ft (2.4-m) security fence (non-barbed wire) will be installed along the FFTF perimeter. The access road and parking lot will be resurfaced. Exterior building lighting and floodlights will be shielded to reduce impacts to wildlife.

During construction, the existing softball field, appurtenant structures, and some adjacent tennis courts will be demolished, and the area will be graded and grubbed. Most construction will occur during the daylight hours of 6 a.m. to 3:30 p.m. but nighttime work may be required. Construction is expected to take two years beginning in 2024.



Figure 1: FFTF on Marine Corps Base Camp Blaz, Guam project footprint including construction, operations, security fencing and facility parking area.

The FFTF will be used approximately once per month for training exercises and maintenance throughout the estimated 25-year lifespan of its operations at MCBCB. Most training events will take place between 6 a.m. and 3:30 p.m. for approximately three hours and will involve up to 28

people and ten vehicles (including fire engines). Nighttime training events of the same magnitude are expected to occur approximately once per quarter (four times a year) and will conclude by approximately 9 p.m.

During daytime training exercises a public address system of approximately 90 to 100 decibels (dB) will be used to instruct participants and may also be used in nighttime training, such as during an emergency. Fire extinguishing training will use burning hay and wood pallets, smoke machines, and propane gas in the mockups to produce visible flames and smoke. Burning hay (anticipated volume 50 lbs [22.7 kilograms] per event) or wood pallets (3–5 pallets per event) will only be used inside the training tower to minimize the risk of wildfire. Fire extinguishing training outside of the building will be restricted to paved areas and will utilize propane gas in props such as the dumpster mockup, and domestic water for fire suppression.

The following conservation measures are incorporated into the proposed action:

1. The U.S. Marine Corps will ensure that all construction activities will occur within the limits of construction to prevent additional habitat loss. Limits of construction must be shown on contract plans and specifications and physically demarcated in the field prior to any vegetation clearing. This measure is intended to prevent additional habitat loss. The measure will be implemented during pre-construction and construction.
2. Pre-construction surveys for Mariana fruit bats will be conducted by a qualified biologist the day before and the day of vegetation clearing of Mariana fruit bat habitat.
    a. Qualified biologist is defined as a person who has successfully completed a full four-year course of study in an accredited college or university leading to a bachelor's or higher degree, which includes a major field (24 semester hours) of study in biological sciences, wildlife biology, botany, natural resource management, environmental sciences, or related disciplines appropriate to this position or an appropriate combination in education and experience, and a minimum of 100 documented hours conducting Mariana fruit bat surveys or monitoring, or conducting these activities for closely related species.
3. Construction contractors will be trained by a qualified biologist to identify Mariana fruit bats and conduct visual observations of the project footprint at the start of each day when noise generating equipment will be used. If Mariana fruit bats are observed prior to the start of work in the project footprint, work will be postponed until the Mariana fruit bat has left the area of its own volition. If bats enter the project footprint after the start of construction, work will continue.
4. Operators of the FFTF will be trained by a qualified biologist to identify Mariana fruit bats and conduct visual observations of the project footprint prior to use of the facility. If Mariana fruit bats are observed prior to the start of training, work will be postponed until the Mariana fruit bat has left the area of its own volition. If bats enter the project footprint after the start of training, work will continue.
5. Changes to the night sky resulting from operations-related nighttime lighting will be minimized through the use of shielded outdoor lights to protect Mariana fruit bats.
6. Per OPNAV M-5090.1 §12-3.9, the U.S. Marine Corps will specify housekeeping and vehicle cleanliness measures in contractor environmental plans to reduce the likelihood

of spread of invasive species within the construction area. To the extent practicable and to be performed in conjunction with stormwater pollution prevention practices, cargo and vehicles will be inspected upon entry to the construction site and high-pressure wash-down will be performed to reduce organic material and mud from leaving or entering the jobsite. Dirty vehicles, equipment, or cargo shall be cleaned of dirt, debris, organisms, weeds, and other material before they enter the jobsite and discarded material will be tested, packaged, or treated before disposal. Green waste will be reused on base to the greatest extent practicable and will be managed to reduce coconut rhinoceros beetle (*Oryctes rhinoceros*) and little fire ant (*Wasmannia auropunctata*) spread or breeding.

Action Area

The action area is defined at 50 CFR 402.02 as "all areas to be affected directly or indirectly by the federal action and not merely the immediate area involved in the action." The Service has determined that the action area for this project is includes all areas within 492 ft (150 m) from the outermost perimeter of the project footprint that may be exposed to human disturbance from project activities. The action area is shown in Figure 2.

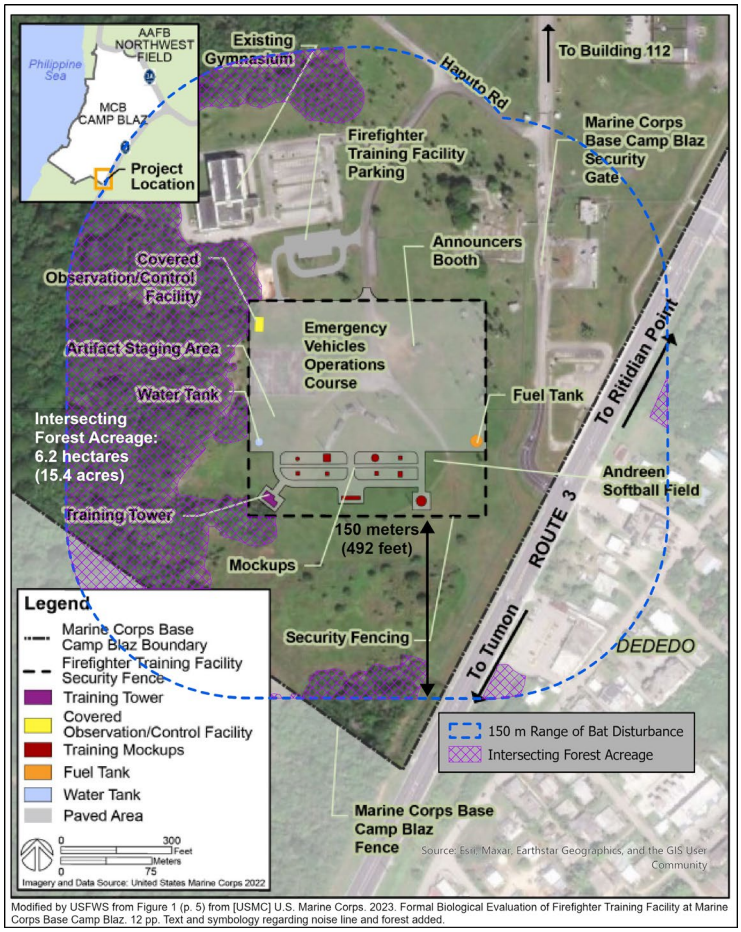

Figure 2: Project action area perimeter (blue dashed line).

Mariana fruit bat habitat within 492 bt (150 m) of the project footprint is highlighted in the purple cross-hatched areas in Figure 2.

Analytical Framework for the Jeopardy Analysis

Jeopardy Analysis Framework

In accordance with regulation (see 84 FR 44976), the jeopardy determination in this Biological Opinion relies on the following four components:

1. The *Status of the Species*, which evaluates the species' current range-wide condition relative to its reproduction, numbers, and distribution; the factors responsible for that condition; its survival and recovery needs; and explains if the species' current range-wide population is likely to persist while retaining the potential for recovery or is not viable;

2. The *Environmental Baseline*, which evaluates the current condition of the species in the action area relative to its reproduction, numbers, and distribution absent the consequences of the proposed action; the factors responsible for that condition; and the relationship of the action area to the survival and recovery of the species;

3. The *Effects of the Action*, which evaluates all future consequences to the species that are reasonably certain to be caused by the proposed action, including the consequences of other activities that are caused by the proposed action, and how those impacts are likely to influence the survival and recovery role of the action area for the species; and

4. *Cumulative Effects*, which evaluates the consequences of future, non-Federal activities reasonably certain to occur in the action area on the species, and how those impacts are likely to influence the survival and recovery role of the action area for the species.

In accordance with policy and regulation, the jeopardy determination is made by evaluating the consequences of the proposed Federal action in the context of the species' current range-wide status, taking into account any cumulative effects, to determine if implementation of the proposed action is likely to cause an appreciable reduction in the likelihood of both the survival and recovery of the species in the wild. The key to making this finding is clearly establishing the role of the action area in the conservation of the species as a whole, and how the effects of the proposed action, taken together with cumulative effects, are likely to alter that role and the continued existence (i.e., survival) of the species.

Status of the Mariana fruit bat

Species description

The Mariana fruit bat was listed as endangered in 1984, but later reclassified to threatened when it was determined that all fruit bats throughout Guam and the Commonwealth of the Northern Mariana Islands (CNMI) comprise a single endemic subspecies (70 FR 1190, January 6, 2005). In 2004, critical habitat for the fruit bat was designated at the Guam National Wildlife Refuge (GNWR) in the Ritidian Unit (69 FR 62944, October 28, 2004).

The Mariana fruit bat is a medium-sized fruit bat in the family Pteropodidae with dark brown to black leathery wings and a wingspan of 34 to 43 in (86 to 109 centimeters). Individuals weigh between 0.73 and 1.27 lbs (330 and 577 grams) and male Mariana fruit bats are slightly larger than females. The abdomen is black to brown with gray hair interspersed, creating a grizzled appearance. The mantle and sides of the neck are bright golden brown but can be paler in some individuals, and the head is a brown to dark brown. The well-formed, rounded ears and large eyes give the face a canine appearance (USFWS 2009, p. 4).

The paleotropical genus *Pteropus* is represented by approximately 63 species distributed across the Indian Ocean, Southern Asia, Australia, and Oceania, as far east as the Cook Islands (Almeida et al. 2014, p. 83). Six species of *Pteropus* are extinct while 42 species are considered critically endangered, endangered, threatened, near threatened, or vulnerable under the definitions of the International Union for Conservation of Nature and Natural Resources (IUCN 2021). Most *Pteropus* fruit bats occur on islands or in coastal areas (Almeida et al. 2014, p. 84). Although it was previously thought that two subspecies of fruit bat may have inhabited the Mariana Islands (Flannery 1995, p. 266; Simmons 2005, p. 340), subsequent genetic analyses conducted by Brown et al. (2011) and Mildenstein and Mills (2013) indicate *Pteropus mariannus mariannus* is a single subspecies. In addition to the Mariana fruit bat, there are subspecies of *Pteropus mariannus* endemic to other island chains, including the Caroline Islands and the Palau archipelago (Brown et al. 2011, p. 934).

Life history

Mariana fruit bats do not use laryngeal echolocation, instead relying on vision and smell to avoid obstacles and locate food sources (Almeida et al. 2014, p. 83). The diet of the Mariana fruit bat is comprised of fruit, nectar, pollen, and some leaves from at least 45 different plant species (Mildenstein and Johnson 2017, pp. 38–41). The bats rapidly digest and metabolize food and rely on forest habitat with diverse food resources to be available throughout the year (USFWS 2009, p. vii). The foraging behavior of the Mariana fruit bat has not specifically been assessed, but bats in similar habitat are known to visit two to five fruit trees per night, making five to seven flights of 492 to 2,625 ft (150 to 800 m) between the fruit trees, for an estimated maximum nightly travel distance of 0.6524 to 2.485 miles (mi) (1.05 to 4 kilometers [km]). During their nights away from their day roost tree, fruit bats can also fly for longer periods in search of new food sources and spend long periods roosting in trees other than fruit trees (Morrison 1980, pp. 22–24). Mariana fruit bats use several forest types for foraging, roosting, and breeding, including native primary and secondary limestone forests, volcanic or ravine forests, old coconut

plantations, and groves of *Casuarina equisetifolia* (Glass and Taisacan 1988, pp. 11–12; Worthington et al. 2001, p. 137; Wiles and Johnson 2004, pp. 589–591), and may also use grasslands with trees (Wiles and Johnson 2004, p. 590).

Most Mariana fruit bats roost during the day at sites to which they show a high level of fidelity, unless disturbed. A small proportion of Mariana fruit bats, usually males, roost alone or in small groups called bachelor colonies. Colonies established by one or more bats can grow to over 1,000 individuals. A day roost occupied by one or more female bats is considered a maternal colony. Within maternal colonies, Mariana fruit bats typically group themselves into harems of one male and 2–15 females (Wiles 1987, p. 93). Mariana fruit bats vocalize readily within colonies and when roosting.

Population dynamics

Based on three years of field observations on Guam, female Mariana fruit bats were observed to rear up to one pup annually, with a gestation period of approximately 4.6 to 6.3 months (Pierson and Rainey 1992, p. 1; USFWS 2009, p. 17). Many *Pteropus* species typically do not give birth until 18 to 24 months of age (Pierson and Rainey 1992, p. 1; McIlwee and Martin 2002, p. 79). The age of sexual maturity is not known for *Pteropus mariannus mariannus* but mating and the presence of nursing young have been observed year-round (Perez 1972, p. 145; Wiles 1987, p. 94). The mother bat carries her bat pups until they become too heavy. When the non-volant young bats are not yet well developed enough to fly on their own, they are left at the maternal roost when the parents forage at night.

The natural lifespan of the Mariana fruit bat is also unknown, but evidence suggests *Pteropus* species are long-lived, with lifespans of 10 to over 20 years recorded (McIlwee and Martin 2002, p. 80). Based on this demographic information, several authors have suggested that *Pteropus* bats have a low maximum population growth rate and thus a slow rate of recovery when populations are diminished (Pierson and Rainey 1992, p. 13; McIlwee and Martin 2002, p. 91).

Status and distribution

Our 2020 population estimate for the Mariana fruit bat of between 3,500 and 4,000 individuals suggested the species was stable overall throughout its range (USFWS 2020, p. 4). The Mariana fruit bat has been found on all the Mariana Islands except for Uracas, the northernmost island (Wiles et al. 1989, p. 69). While the species has been thought to be extirpated from Tinian (USFWS 2020, p. 4), a fruit bat was sighted on the island in 2022 (NAVFAC Marianas 2022, p. 23). Similarly, while there have been anecdotal sightings of fruit bats in Farallon de Medinilla in recent years, the last recorded sightings were in the 1970s (Wiles et al 1989, p. 71). Mariana fruit bats are strong fliers and highly mobile, and small groups have been observed flying over the ocean between islands (Wiles and Glass 1990, entire; Wiles and Johnson 2004, p. 593). Distribution of occupied roost sites has fluctuated greatly in the southern islands and may be attributed to not only variations in survey methods and coverage, but also movements of fruit bats between islands. Surveys are sporadic on most islands except Rota and Guam, which are now surveyed annually.

Other than a few isolated periods of increase, Mariana fruit bats have been declining on Guam since the early 1900s (Wiles 1987, entire; USFWS 2009, pp. 6–8). By the 1980s, most Mariana fruit bats on the island lived in a single colony in northern Guam which occasionally divided into smaller aggregations (Wiles and Glass 1990, p. 2; Mildenstein and Johnson 2017, p. 25). From 1981 to 2008, fruit bat population estimates were made by the Guam Division of Aquatic and Wildlife Resources (DAWR) via opportunistic counts at known roosting locations on Andersen Air Force Base (AAFB; Mildenstein and Johnson 2017, p. 23). By 1995, nearly all of Guam's remaining fruit bats occurred at Pati Point on AAFB (Wiles et al. 1995, p. 39). Fruit bat abundance at Pati Point has declined since annual surveys began in 2005, and, by 2010, regular clustering of bats at the site had become unreliable. In 2006, the only known maternal colony on Guam was located at Pati Point and had less than 100 individuals (Mildenstein and Johnson 2017, p. 25). By 2010, the Pati Point colony no longer existed (SWCA 2013, p. 30), and no other colonies were known on Guam.

From 2010 to 2013, SWCA Environmental Consultants performed fruit bat surveys on AAFB consisting of pre-dawn, timed (2 to 3 hour) visual surveys at 83 forested locations and direct colony counts at historical colony locations within AAFB (SWCA 2013, entire). Since 2014, a collaborative monitoring effort between the University of Guam and AAFB has produced simultaneous, multi-observer (>80), base wide counts yielding annual abundance estimates of Mariana fruit bats on AAFB. Compilations of Pati Point fruit bat survey data are shown in Figures 3 and 4.

A total of 64 bats were detected within the 6,541 ac (2,647 ha) of Andersen Air Force Base that was surveyed in 2021. Searches cover all areas where, based on visual sightings of flying bats, bat occurrence is suspected. Possibly due to increased search effort over recent years, for most years, there has been an annual increase in the number of bats detected. Preliminary findings from the 2022 AAFB surveys report another increase in the number of bats detected, and a potentially cyclic migration of bats between Rota and Guam in 2021 and 2022 (NAVFAC Marianas 2022, pp. 212–213).

In January and February of both years the number of bats detected on AAFB increased—to an estimated 200 bats in 2021 and to 1,300 bats in 2022—after which numbers decreased to lower year-round numbers in March and April. In addition, both individual bats, and a colony of approximately 40 bats, have been detected near Cross Island Road and on Cocos Island off southern Guam in recent years (USFWS 2021, p. 24).

Our current estimate of Mariana fruit bats on Guam is at least 122 bats during non-peak months (USFWS 2020, p. 4), and approximately 1,300 bats during what may be a peak and temporary annual increase during a peak time of year.

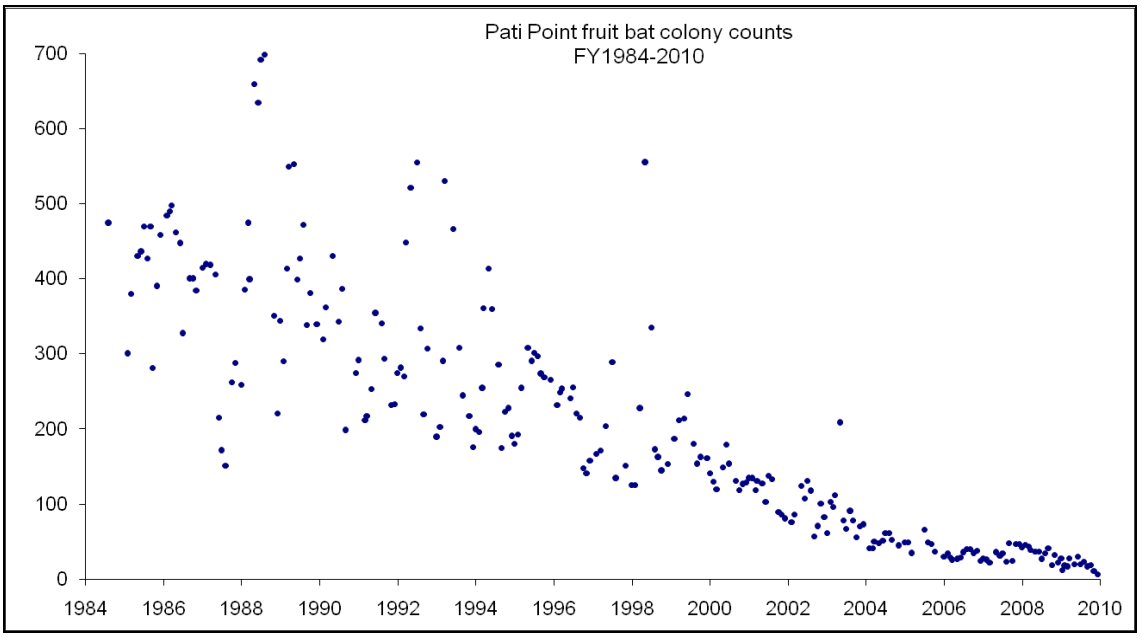

Figure 3. Mariana fruit bats counted at the Pati Point colony, AAFB, Guam: 1984 to 2010 (DAWR unpublished data).

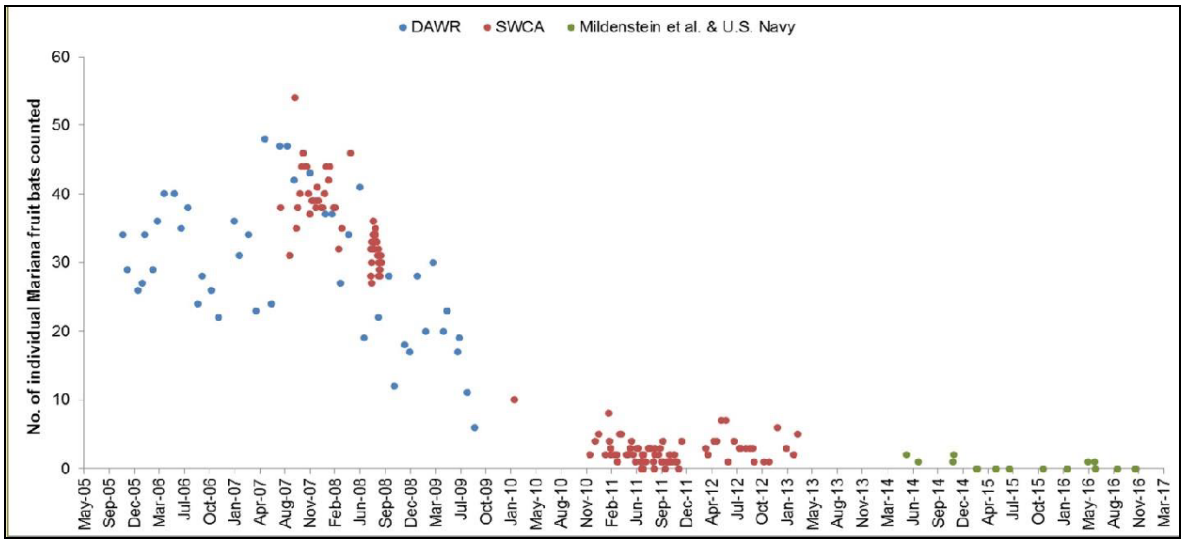

Figure 4. Mariana fruit bat colony counts at the Pati Point colony, AAFB, Guam: October 2005 to September 2009; December 2010 to December 2011; March 2012 to March 2013; and May 2014 to November 2016 (Mildenstein and Johnson 2017).

The largest Mariana fruit bat population is in Rota. From 2012 to 2019, Rota's population averaged between 2,500 and 3,000 bats, with peaks after major typhoons (DFW 2019, entire); our 2020 estimate was approximately 3,000 individuals (USFWS 2020, p. 4). The fruit bats in Rota are thought to move periodically among the southern islands, and Rota is considered important to the long-term stability of the species (Wiles and Glass 1990, p. 6; Wiles et al. 1995,

p. 41). In 2014, when Mariana fruit bats were found to be stable or declining throughout most of their range, Rota's fruit bat populations had increased due to increased enforcement of anti-poaching regulations at maternal colonies (USFWS 2014, p. 2).

Initial observations of Mariana fruit bats in Aguiguan, Tinian, and Saipan in 1983 and 1984 revealed populations of less than 25 to 50 individuals on each island. Species numbers increased to an estimated 75 to 100 individuals in Saipan in 1986 and 300 individuals in Aguiguan by 1988 (Wiles and Glass 1990, p. 2). Survey data in the northern islands of Anatahan, Sariguan, Guguan, Alamagan, Pagan, and Agrihan showed a 40 percent decline in Mariana fruit bat numbers between 1983 and 2000 (USFWS 2009, p. 11). There is evidence for a possibly increasing population on Asuncion (Valdez 2010, p. 33), last surveyed in 2010, and Alamagan. The Alamagan population increased from 86 bats in 2010 to an estimated 385 bats in 2017 in 3 colonies (Murray et al. 2018, entire). Around 249 bats were estimated on Guguan in 2016 (Liske-Clarke et al. 2016, p. 25).

Threats

The following threats to the Mariana fruit bat contributed to its listing and continue to impact the ability of the species to recover.

Loss and degradation of habitat: The degradation and loss of primary and other forest habitats from ungulate damage, the encroachment of invasive plants, military activities, conversion to agriculture, and economic development has substantially diminished available habitat for fruit bats in the Mariana archipelago (USFWS 2009, p. 33; USFWS 2014, p. 3). The degradation of intact native forests particularly limits the persistence and population size of the fruit bat because these forests provide essential foraging and roosting resources that may not otherwise be found in nonnative and agricultural habitats. In Guam's remaining native forests, ungulate browsing has been shown to reduce the presence and recruitment of breadfruit, an important food for fruit bats, as ungulates consume both fallen fruit and seedlings (Wiles 2005, entire). Economic development has caused habitat loss and fragmentation on all inhabited southern islands, and all islands with military activity, which has reduced the opportunities for bats to shift the location of their roost sites and foraging activities in response to human disturbance (USFWS 2009, p. 31). The quality of bat habitat is further degraded by the presence of invasive predators and human disturbance. Mariana fruit bats are expected to be vulnerable at their roosts and in foraging habitat to predation by the brown treesnake (*Boiga irregularis*), disturbance from little fire ants (*Wasmannia auropunctata*), and human disturbance. When a roosting or foraging Mariana fruit bat is startled or alarmed by a disturbance, including detecting human movements, human scent, brown treesnakes, little fire ants, and noise, it is likely to have a stress response and take flight to move away from the disturbance. Prolonged or severe disturbance can cause roost abandonment.

Nonnative snake predation: Brown treesnakes prey on non-volant young left at the roost during the night and reduce the recruitment of young bats into the breeding population. Effective control of the invasive brown treesnake must be achieved for the Mariana fruit bat population on Guam to recover (Wiles 1987, p. 94). Efforts to interdict, control, and ultimately eradicate the snake are ongoing.

Poaching: Illegal hunting has long threatened the persistence of the Mariana fruit bat throughout its range, particularly in Rota. Because of access controls on military installations, Mariana fruit bats on and in the vicinity of MCBCB and neighboring AAFB are afforded some relief from poaching. The presence of increased law enforcement activity has been shown to positively impact population numbers but has not eliminated poaching (USFWS 2014, p. 3). Hunting has greatly contributed to the decimation or decline of fruit bat populations in Rota, Saipan, and Guam (Wiles and Payne 1986, entire; Wiles and Glass 1990, pp. 2–4; Sheeline 1991, pp. 6–7; Stinson et al. 1992, entire; Esselstyn et al. 2006, entire). Monitoring of illegal hunting and law enforcement on the northern islands are limited.

Stochastic events: Typhoons and volcanic eruptions result in mortality, reduced population viability, and habitat loss. Natural disasters can be especially damaging to the viability of smaller Mariana fruit bat populations such as those on Guam, Saipan, Aguiguan, and Maug. The significant loss of habitat on Anatahan after a volcanic eruption in 2003 caused the loss of a substantial Mariana fruit bat population that is not known to have recovered.

Environmental Baseline

Regulations implementing the ESA (50 CFR 402.02) define the environmental baseline as the past and present impacts of all federal, state, or private actions and other human activities in the action area. Also included in the environmental baseline are the anticipated and/or ongoing impacts of all proposed federal projects in the action area that have undergone Section 7 consultation, and the impacts of state and private actions which are contemporaneous with the consultation in progress.

Status of the species within the action area

The majority of the Mariana fruit bat population on Guam has been detected in northern Guam in and about Andersen Air Force Base due to annual surveys being conducted in these areas. Only recently has DAWR and other military installations such as Marine Corps Base Camp Blaz and Naval Magazine Guam assisted with annual island-wide surveys for the Mariana fruit bat outside of Andersen Air Force Base on Guam. Figure 5 shows the geographic distribution of detections made during the annual counts on Andersen Air Force Base from 2014 to 2020 in relation to the location of the FFTF project site (there are no survey stations within the action area). Since 2020, high bat activity and a roosting colony have been reported approximately six miles north of the action area. Additionally, the 2021 and 2022 surveys documented an increased presence of bats relative to prior years' results (NAVFAC Marianas 2022, pp. 212–213). Regular sightings have not been reported in the action area since 1994 (Mildenstein and Johnson 2017, p. 31); however, there was a recent observation of a Mariana fruit bat flying along Route 3 (which passes through the action area) by a NAVFAC environmental staff member (as reported in the biological evaluation).

The 15 ac (6 ha) of bat habitat within the action area constitutes 0.06% of the total Mariana fruit bat habitat on Guam. Mariana fruit bat habitat within the action area consists of secondary and degraded limestone forest comprised of a mixed community of native and nonnative trees,

suitable for bat roosting, feeding, breeding, transiting, resting, and day roosting. Dominant nonnative trees in the limestone forest within the action area include *Vitex parviflora*, *Leucaena leucocephala* (tangan tangan), and *Carica papaya* (papaya—a preferred fruit of the Mariana fruit bat [Mildenstein and Johnson 2017, p. 39]), which established in the area likely due to past clearing activities and encroachment from developed areas (NAVFAC Marianas 2019, p. 8-12). Native roost tree species *Aglaia mariannensis* and *Neisosperma oppositifolia* (USFWS 2009, p. 14) occur in the limestone forest in the action area, as well as possibly isolated *Cocos nucifera* (coconut) trees (NAVFAC Marianas 2019, p. 8-12). Approximately 0.1 ac (0.04 ha) of forest vegetation will be cleared in the project footprint, while the remaining 9.2 ac (3.72 ha) of the project footprint is previously developed land. A gymnasium, public road, and other private development are also within the developed portion of the action area.

Mariana fruit bats are highly mobile and known to fly the length of Guam. Due to the proximity of high bat activity, and the availability of foraging and roosting resources in the action area, it is reasonable to conclude that individual, or groups of, Mariana fruit bats occur in the action area and will occupy the limestone forest to roost or forage during the project term. During non-peak bat activity, we estimate up to 122 bats occupy Guam. The most recent reported survey data shows these numbers increase during January and February; based on this data, we estimate up to 1,300 bats occupy Guam during these months of peak bat activity.

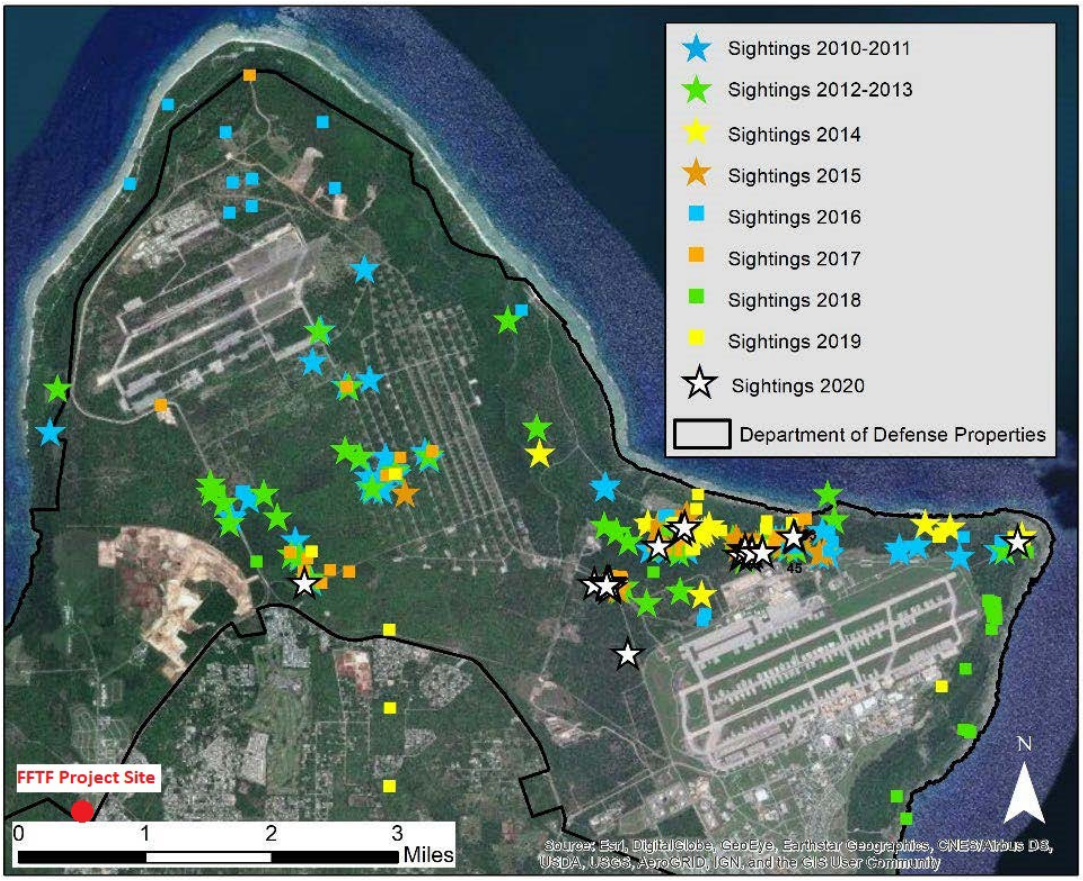

Figure 5: Mariana fruit bat sightings 2014 to 2020 (Department of the Air Force (2021), with the FFTF project site shown with red dot.

Factors affecting species environment within the action area

The primary factors affecting Mariana fruit bats in the action area are loss and degradation of habitat and nonnative snake predation. Brown treesnakes are found within every habitat type on Guam and are present within the action area. Any bat roosting in the action area would be expected to be susceptible to predation by the brown treesnake.

The action area spans Department of Defense (DoD) terrestrial lands managed by Joint Region Marianas. Ongoing habitat restoration made to forest habitat within and adjacent to the action area will improve habitat quality, increase the abundance of resources for bats, and may decrease the number of nonnative species, creating a more favorable environment for Mariana fruit bat feeding, sheltering, and breeding. In particular, brown treesnake suppression, little fire ant control, ungulate fencing and eradication, and limestone forest restoration in the nearby Haputo Ecological Reserve and Caiguat Forest Enhancement Area are expected to increase use of these areas by bats. The project site is not slated for future restoration, and it is more than 492 ft (150 m) away from any such area. However, due to the action area's close proximity to sites where invasive species are being removed to encourage Mariana fruit bat occurrence, bat foraging use of the forest within the action area may be up to two times higher than the bat's average usage of

similar habitat on Guam. Due to the nearby proximity of conservation areas, where threats to the Mariana fruit bat are expected to be controlled, the action area is expected to receive an estimated double the bat visitation rate than similar habitat where invasive species threats are uncontrolled.

The FFTF project footprint is located within the MCBCB main cantonment boundary on land administered by the DoD. MCBCB is currently under construction as part of the Department of the Navy's relocation of U.S. Marine Corps personnel from Okinawa, Japan to Guam. Post-completion of the project, the Department of the Navy expects that the population on Guam will increase by approximately 7,400 people, increasing the need for additional infrastructure throughout the island. Because of the relocation, approximately 1,219 ac (493 ha) of limestone forest in the vicinity of the FFTF project site has already been permanently modified, which has reduced the amount of available and suitable forest habitat for Mariana fruit bats in the north of Guam, and increased the importance of remaining intact forest in the action area to the species. The full effects of the relocation project are analyzed in the *Reinitiation of the 2015 Biological Opinion on the Department of the Navy's Relocation of U.S. Marine Corps from Okinawa to Guam and Associated Activities on Guam* (USFWS 2017).

Effects of the Action to the Mariana fruit bat

Factors considered in construction and operation of the FFTF that can impact the Mariana fruit bat are vegetation clearing, artificial lighting, smoke, wildfire risk, noise, and human disturbance. Effects to the bat from most of these factors are likely to be avoided, except for effects from noise and human disturbance.

Vegetation clearing

The FFTF will primarily be constructed on a previously developed site covered with grasses and a softball field, with 0.1 ac (0.04 ha) of degraded limestone forest to be permanently cleared. In 2017 there were approximately 27,096 ac (10,965 ha) of fruit bat forest habitat on Guam (USFWS 2017, p. 92). The amount of forest habitat is expected to have decreased since 2017 due to development. During site preparation the implementation biosecurity protocols described in the **Description of Proposed Action** will greatly reduce the risk of invasive species introduction so that adverse effects from invasive species beyond the project footprint are not likely. Project-related permanent removal of 0.1 ac (0.04 ha) of bat habitat would not appreciably reduce Mariana fruit bat conservation potential on Guam.

Artificial lighting

All temporary construction lighting and permanently installed artificial lighting utilized at the project site will be shielded to avoid impacts to foraging and roosting Mariana fruit bats in the action area. The Mariana fruit bat is not likely to be exposed to artificial lighting from the project.

Smoke and wildfire risk

Hay and wood pallets ignited in training exercises that will create smoke when burned, and from which loft burning embers can spark wildfire in the adjacent forest vegetation, will be used only in the indoor training tower. Because the fires ignited as part of the action are restricted to the training tower within the paved area of the FFTF, smoke and embers are unlikely to travel into adjacent vegetation and the risk of wildfire is minimized. Similarly, because burning hay and wood pallets will be used only in the indoor training tower, the Mariana fruit bat is unlikely to be exposed to concentrated smoke during training exercises.

Noise and human disturbance

All bats within 492 ft (150 m) of activities are likely to be startled or alarmed by project-related noise and human scent. For the duration of the disturbance, foraging habitat in the area is removed and bats are likely to avoid the area. Noise levels above ambient forest sounds can cause stress reactions, including increases in active thermoregulation, maintenance, locomotion, and alertness. Stress reactions caused by human disturbance such as the activities in the proposed action increase energetic demands, disrupt hormonal balance, and force relocation, which can sometimes be to lower quality habitat (Klose et al. 2006, p. 347; DFW 2010, p. 7).

Actions such as the proposed action have the potential to disperse bats into areas outside these protected lands increase their exposure to additional human disturbance including poaching. All of these factors can lead to reduced time foraging, sheltering, or breeding. Due to the close proximity of attractive conservation habitat, bats disturbed at the project site are most likely to move to the nearby suitable, higher-quality habitat. Survival, reproductive effort, and reproductive success are not expected to be reduced as a result of the disturbance caused by the proposed action. Mariana fruit bat take in the form of harm or harassment is likely as a result of project-related noise and human disturbance.

The public address system speakers are expected to be the loudest component of firefighter training events and are estimated to reach 100 dB. Information on the siting or style of the public address system is not yet known. Therefore, to determine the extent of noise effects of the action, we conservatively assessed the potential placement of speakers from all points on the FFTF perimeter fencing and treated the speakers as an omnidirectional point source from which sound radiates in all directions evenly. This scenario also depicts a free field condition, that is, there are no obstructions to sound travel. However, it is likely the forest vegetation will interfere with sound travel to some extent. Using the inverse square law, every doubling of distance away from the sound source will decrease sound intensity by 6 dB. Based on these conditions, the sound of the public address system will attenuate to 58 dB, within the ambient sound range of limestone forest, at approximately 420 ft (128 m) from the point source, i.e., the speakers. Construction equipment noise can reach 110 dB (OSHA 2011, p. 7) and is projected to attenuate at a similar, or slightly greater, distance than the public address system, in all directions from the construction footprint. These scenarios depict a free field condition, that is, there are no obstructions to sound travel. However, it is likely the forest vegetation will interfere with sound travel to some extent.

The range of human disturbance and noise from construction and operation of the FFTF to bats in shown in Figure 2 (the Action Area map) within the blue dashed line, at 492 ft (150 m) from the project footprint. The 15 ac (6 ha) of impacted forest habitat for the Mariana fruit bat inside this action area is shown as purple crosshatching, which is 0.06 percent of total fruit bat forest habitat on Guam (USFWS 2017, p. 92). Construction noise and human disturbance is a long-term, but not permanent, effect of the project to Mariana fruit bats in the action area. Operational noise from training events will be intermittent, occurring on average one to two times a month, and thus is considered an intermittent but ongoing effect to Mariana fruit bats in the action area. The life expectancy of the FFTF is 25 years.

Project noise and human activity are expected to prevent Mariana fruit bats from establishing a maternal roost within the 15 ac (6 ha) of bat habitat for the 27-year duration of the project. This loss of potential maternal roost habitat is not expected to result in reduced reproductive effort by the Mariana fruit bats because they are expected to roost in nearby sites better suited to support their successful breeding. In 2020, the Service estimated the Mariana fruit bat population to be stable, i.e., not exhibiting an increasing or declining trend; therefore, we calculated the number of bats that would be adversely affected by the proposed action using the current population sizes of 122 bats during non-peak periods, 1,300 bats during peak periods, and a total population on Guam and Rota of 3,000 bats (USFWS 2020, p. 4).

In the 25 years following construction, human activity at the FFTF will occur two times per month, affecting only 0.06 percent of the bat's habitat on Guam. During non-peak bat occurrence periods we expect up to 3 instances of bat harm or harassment due to project disturbance in the 15 ac (6 ha) of affected forest habitat. During peak bat activity periods, when Guam's bat population increases, we expect 32 incidents of bat harm or harassment to result from the project. These numbers are simply calculated based on the total number of bats and total amount of the bat's forest habitat on Guam, incorporating a factor of 2x to account for a two-fold increase in bat occurrence in the project's action area, due to its close proximity to conservation areas that are expected to be occupied by colonies of bats during the period of project implementation, and because double the number of bats occur in the vicinity of the action than in bat habitat elsewhere on Guam.

Bats that smell the scent of a human, hears project noise, or see sees movement of the construction workers or firefighters working in the project footprint are expected to have a stress response during foraging and resting activities. Overall, the action is expected to result in up to 36 instances of Mariana fruit bat harm or harassment during the 27-year project period. Almost all of these instances of harm or harassment are expected to occur during the two years of construction because human disturbance at the site may be frequent and for long durations. The project's impacts to the bat are expected to be considerably reduced during the 25-year operational period because human presence at the site will be so limited in frequency and duration. In most instances, solitary bats are expected to be affected, but multiple instances of harm or harassment may occur simultaneously when more than one bat is in the action area when the human disturbance occurs.

The stress response is expected to include causing these bats to leave the action area. Stress hormones and elevated metabolisms caused by the human disturbance are expected to be temporary and not cause permanent injury to the animal. Increased food intake is expected to be needed by these bats to offset the physiological impacts of the stress response and the additional energy expended due to their expected hastened departure from the area. Due to the close proximity of the action area to areas that are expected to be attractive conservation habitat, the bats disturbed by the proposed action are expected to move to the nearby suitable, higher-quality habitat. Physiological stress hormone impacts to their bodies are expected to be non-lethal. Survival, reproductive effort, and reproductive success are not expected to be reduced as a result of the disturbance caused by the proposed action.

Cumulative Effects

Cumulative effects include the effects of future state, tribal, local, or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

Off-installation private development along Route 3 in the town of Dededo are situated along the eastern edge of the action area, within 492 ft (150 m) of the project footprint. Outdoor human activities and outdoor lighting fixtures in this area are expected to continue to adversely affect any Mariana fruit bat that may occupy the small patches of forest and forest edge habitat in the eastern half of the action area, away from the larger forested areas on the west side of the action area (see Figure 2).

Effects to the bat are expected to be similar in nature to the impacts of the proposed action. Effects to any bat that may occur within the small patches of forest and forest edges in the eastern half of the action area due to disturbance from the existing private development in Dededo are expected to occur during day and night periods spanning all days and years addressed in this consultation. The private development currently, and for the duration of the proposed action, is likely to cause stress responses in any bat that occurs within the forest patches and edges in the eastern half of the action area, in addition to reducing the likelihood of Mariana fruit bat roosting and reproducing in those areas.

Conclusion

After reviewing the current status of the Mariana fruit bat, the environmental baseline for the action area, the effects of the proposed two years of construction and 25 years of operation of the firefighter training facility on Marine Corps Base Camp Blaz, Guam, and the cumulative effects, it is the Service's biological opinion that the action, as proposed, is not likely to jeopardize the continued existence of the Mariana fruit bat. The Service reached this conclusion based on the following information, which is detailed in the **Effects of the Action** and **Cumulative Effects** sections, above.

Mariana fruit bat take in the form of harm or harassment is likely as a result of project-related noise and human disturbance. The action is expected to result in up to 36 instances of Mariana fruit bat harm or harassment during the 27-year project period. Stress reactions caused by project-related human disturbance will adversely affect the fruit bats by increasing energetic demands, disrupting hormonal balance, and forced relocation. The private development along the east edge of the action area, currently, and for the duration of the proposed action, is likely to cause similar and ongoing impacts to any bat using forest patches in the east half of the action area (see Figure 2). Project disturbance, taken together with cumulative effects, will result in reduced time foraging, sheltering, or breeding by bats that occur in the action area during human disturbances. Due to the close proximity of attractive conservation habitat, bats disturbed at the project site are most likely to move to the nearby suitable, higher-quality habitat. Survival, reproductive effort, and reproductive success are not expected to be reduced as a result of the disturbance caused by the proposed action and the cumulative effects.

Project-related permanent removal of 0.1 ac (0.04 ha) of bat habitat would not appreciably reduce the number of bats the remaining habitat on Guam can support. The 15 ac (6 ha) of Mariana fruit bat habitat that will be disturbed by project activities, accounts for 0.06 percent of the bat's habitat on Guam. The degradation and loss of use of this habitat is not expected to result in reduced survival or reproductive effort by the Mariana fruit bats because they are expected to move away to forage and roost in nearby higher-quality habitat. The permanent removal of bat habitat, and the intermittent human disturbance to bats within the action area, would not appreciably reduce Mariana fruit bat conservation potential on Guam. For these reasons, the proposed action is not likely to reduce appreciably the likelihood of the survival and recovery of the Mariana fruit bat in the wild.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act and Federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by FWS to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by FWS as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with the terms and conditions of this incidental take statement.

The measures described below are non-discretionary and must be undertaken by the U.S. Department of the Navy so that they become binding conditions of any grant or permit issued to any applicant, as appropriate, for the exemption in section 7(o)(2) to apply. The U.S. Department

of the Navy has a continuing duty to regulate the activity covered by this incidental take statement. If the U.S. Department of the Navy (1) fails to assume and implement the terms and conditions or (2) fails to require the (applicant) to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the U.S. Department of the Navy must report the progress of the action and its impact on the species to the Service as specified in the incidental take statement [50 CFR §402.14(i)(3)].

Amount or Extent of Take Anticipated

The Service anticipates the proposed action may result in 36 instances of Mariana fruit bat take, in the form of harm or harassment. Human disturbance during two years of construction and two days per month of human occupancy of the proposed facility may cause a temporary stress response to Mariana fruit bats occurring within the small areas of forest within 492 ft (150 m) of the project footprint. The bats are expected to recover from the physiological impacts of project-caused stress responses. No reduction in survival or reproduction are expected to occur as a result of the proposed action.

Effect of the take

In the accompanying biological opinion, the Service determined that this level of anticipated take is not likely to result in jeopardy to the Mariana fruit bat in the wild.

Reasonable and Prudent Measures

Reasonable and Prudent Measures serve to minimize the impacts of anticipated take on listed species, and to establish (through terms and conditions) the requirements for the monitoring of take levels to ensure timely reinitiation of consultation if anticipated take levels are exceeded. The Service believes the following Reasonable and Prudent Measures are necessary and appropriate to minimize and monitor the impacts of incidental take on the Mariana fruit bat:

The Department of the Navy shall monitor the level of incidental take of the Mariana fruit bat.

Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the Act, the U.S. Department of the Navy must comply with the following terms and conditions, which implement the reasonable and prudent measures described above and outline required reporting/monitoring requirements. These terms and conditions are non-discretionary.

Monitoring and Reporting
Report annually to the Pacific Islands Fish and Wildlife Office Field Supervisor in Honolulu, Hawaii, the number of Mariana fruit bats sighted within 492 ft (150 m) of the project footprint,

whether or not the bat seemed to leave the area as a result of the human activity, and the nature of the human activity at the time of the bat sighting.

The Service believes that no more than 36 instances of incidental take of a Mariana fruit bat will occur as a result of the proposed action. This means that while the site is occupied by humans, there are expected to be no more than 36 sightings of a Mariana fruit bat within 492 ft (150 m) of the project footprint during the 27-year project period. The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize the impact of incidental take that might otherwise result from the proposed action. If, during the course of the action, this level of incidental take is exceeded, such incidental take represents new information requiring reinitiation of this consultation and review of the reasonable and prudent measures provided. The Federal agency must immediately provide an explanation of the causes of such taking and review with the Service the need for possible modification of the reasonable and prudent measures.

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

Conservation Recommendations
The Service recommends our standard Mariana fruit bat avoidance measures be implemented throughout project implementation. Avoid human activity within 492 ft (150 m) of a transiting or feeding Mariana fruit bat. During all project work, monitor the project site and areas within 492 ft (150 m) of project activity for the Mariana fruit bat and if a bat moves into the area, delay work until the animal(s) has left the area of its own accord.

In order for the Service to be kept informed of actions minimizing or avoiding adverse effects to, or benefitting, listed species or their habitats, the Service requests notification of the implementation of any conservation recommendations.

Reinitiation Notice

This concludes formal consultation on the actions outlined in this biological opinion. As provided in 50 CFR § 402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained or is authorized by law and: (1) if the amount or extent of taking specified in the incidental take statement is exceeded; (2) if new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered; (3) if the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in the biological opinion; or (4) if a new species is listed or critical habitat designated that may be affected by the identified action.

Thank you for your ongoing efforts to conserve threatened and endangered species. If you have

any questions concerning this Biological Opinion, please contact Lauren Taylor, Fish and Wildlife Biologist, at the letterhead address or by telephone at (808) 792-9528.

Sincerely,

Michelle Bogardus
Deputy Field Supervisor

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F2 Implementation and Tracking Table for Biological Opinions and Associated Conservation Measures

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Requirement	Location	Title	Project BO/BA/BE Date	Mariana fruit bat	Mariana swiftlet	Mariana common moorhen	Mariana crow	Micronesian kingfisher	Guam rail	Micronesian Megapode	Nightingale Reed-warbler	Serianthes nelsonii	Green sea turtle	Hawksbill sea turtle	Scalloped hammerhead	ESA Corals	EFH	Eugenia bryanii	Hedyotis megalantha	Heritiera longipetiolata	Phyllanthus saffordii	Psychotria malaspinae	Solanum guamense	Tinaspora homosepala	Bulbophyllum guamense	Cycas micronesica	Dendrobium guamense	Maesa walkeri	Nervilia jacksoniae	Tabernaemontana rotensis	Tuberolabium guamense	Mariana eight-spot butterfly	Guam tree snail	Humped tree snail	Fragile tree snail	Conservation Measure (One Per Row)
Section 7 formal	AAFB	Establishment of an Intelligence, Surveillance, Reconnaissance, and Strike (ISR/Strike) Operational Capability	3-Oct-06	x			x	x	x																											100% inspection rate by United States (U.S.) Department of Agriculture (USDA)/Wildlife Services for all Air Force cargo leaving Guam (funding should be secured at least 18 months in advance): a. Program sufficient funding annually b. Evaluate effectiveness of BTS interdiction program c. USDA/WS to provide monthly reports of inspection program to Department of Defense (DoD), Air Force, etc. and to be reviewed at the annual BTS meeting in Honolulu, HI.
Section 7 informal	AAFB	Taragues Beach Improvement Project, Andersen Air Force Base, Guam	1-May-08	x	x		x	x	x				x	x																						Adjacent habitat, that is not to be impacted, will be temporarily delineated by orange construction fencing to keep personnel and equipment from damaging the habitat. Signs will be posted indicating that no one is allowed past that boundary. All signs and temporary fencing will be removed from the site after completion of the project.
Section 7 informal	AAFB	Taragues Beach Improvement Project, Andersen Air Force Base, Guam	1-May-08	x	x		x	x	x				x	x																						All project-related materials and equipment (dredges, barges, backhoes, etc.) will be cleaned of pollutants prior to use.
Section 7 informal	AAFB	Taragues Beach Improvement Project, Andersen Air Force Base, Guam	1-May-08	x	x		x	x	x				x	x																						No project-related materials (fill, revetment rock, pipe, etc.) will be stockpiled in the water (intertidal zones, reef flats, stream channels, wetlands, etc.) or where they could be washed into the water from adverse weather or tidal conditions.
Section 7 informal	AAFB	Taragues Beach Improvement Project, Andersen Air Force Base, Guam	1-May-08	x	x		x	x	x				x	x																						All debris removed from the environment will be disposed of at an approved upland landfill site.
Section 7 informal	AAFB	Taragues Beach Improvement Project, Andersen Air Force Base, Guam	1-May-08	x	x		x	x	x				x	x																						No contamination (trash or debris disposal, alien species introductions, etc.) of adjacent terrestrial or marine/aquatic environments (reef flats, channels, open ocean, stream channels, wetlands, etc.) shall result from project-related activities.
Section 7 informal	AAFB	Taragues Beach Improvement Project, Andersen Air Force Base, Guam	1-May-08	x	x		x	x	x				x	x																						The project applicant will prepare and implement a Hazard Analysis and Critical Control Point (HACCP) plan to prevent the introduction and spread of non-native species. The Service can provide guidance and training regarding HACCP planning.
Section 7 informal	AAFB	Taragues Beach Improvement Project, Andersen Air Force Base, Guam	1-May-08	x	x		x	x	x				x	x																						The project applicant shall ensure that any materials exported from Guam are thoroughly searched for brown treesnake presence prior to leaving the island.
Section 7 informal	AAFB	Installation and Operation of a Cellular Communications Tower with an Ultra-high Frequency Conventional Repeater	17-Nov-08	x			x	x	x																											No contamination (trash or debris disposal, alien species introduction, etc.) of adjacent terrestrial or marine/aquatic environments will result from project-related activities.
Section 7 informal	AAFB	Remedial cleanup actions at the Installation Restoration Program (IRP) site 15-Landfill 20, Main Base Operable Unit	25-Feb-09	x			x	x	x																											No contamination (i.e., trash or debris disposal) or introduction of non-native species to adjacent terrestrial environments will result from project-related activities.
Section 7 informal	AAFB	First Reinitiation - Beddown of Training and Support Initiatives at Northwest Field	6-Mar-09	x			x	x	x																											No contamination (i.e., trash or debris disposal) or introduction of non-native species to adjacent terrestrial environments will result from project-related activities.
Section 7 informal	AAFB	Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund) 42 U.S.C. §9601 et seq. (1980) site inspections at multiple munitions response areas	7-May-09	x			x	x	x																											A Hazard Analysis and Critical Control Point Plan (or similar plan) will be prepared and implemented to ensure that no new (i.e., those species not already present at each of the individual sites) non-native invasive species are introduced or become established at or adjacent to these sites.
Section 7 informal	AAFB	Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund) 42 U.S.C. §9601 et seq. (1980) site inspections at multiple munitions response areas	7-May-09	x			x	x	x																											No contamination (i.e., trash or debris disposal) or introduction of non-native species to adjacent terrestrial environments will result from project-related activities.
Section 7 informal	AAFB	Proposed construction of a brown tree snake barrier at the Habitat Management Unit (HMU), and construction of five well sites.	29-May-09	x			x	x	x																											An AAFB biologist or environmental flight personnel will ensure that both sides of the barrier are maintained as frequently as necessary to exclude vegetation within a minimum of 3 feet of the barrier to prevent snakes from climbing and breaching the barrier.
Section 7 informal	AAFB	Second Reinitiation - Beddown of Training and Support Initiatives at Northwest Field	11-Sep-09	x			x	x	x																											No contamination (i.e., trash or debris disposal) or introduction of non-native species to adjacent terrestrial environments will result from project-related activities.
Section 7 informal	AAFB	Third Reinitiation - Beddown of Training and Support Initiatives at Northwest Field	16-Mar-10	x			x	x	x																											No contamination (i.e., trash or debris disposal) or introduction of non-native species to adjacent terrestrial environments will result from project-related activities.
Section 7 informal	AAFB	Anti-Terrorism, Force Protection Perimeter Fence, Andersen Air Force Base	11-May-10	x			x	x	x																											No contamination (i.e., trash or debris disposal) or introduction of non-native species to adjacent terrestrial environments will result from project-related activities.

Requirement	Location	Title	Project BO/BA/BE Date	Mariana fruit bat	Mariana swiftlet	Mariana common moorhen	Mariana crow	Micronesian kingfisher	Guam rail	Micronesian Megapode	Nightingale Reed-warbler	Serianthes nelsonii	Green sea turtle	Hawksbill sea turtle	Scalloped hammerhead	ESA Corals	EFH	Eugenia bryanii	Hedyotis megalantha	Heritiera longipetiolata	Phyllanthus saffordii	Psychotria malaspinae	Solanum guamense	Tinaspora homosepala	Bulbophyllum guamense	Cycas micronesica	Dendrobium guamense	Maesa walkeri	Nervilia jacksoniae	Tabernaemontana rotensis	Tuberolabium guamense	Mariana eight-spot butterfly	Guam tree snail	Humped tree snail	Fragile tree snail	Conservation Measure (One Per Row)
EFH	NBG	Maintenance Dredging of Delta, Echo, Victor, and X-Ray Wharves	12-Apr-11														x																			
Section 7 informal	AAFB	Electrical Upgrades at Tarague Beach, Andersen Air Force Base, Guam	17-Nov-11	x			x	x	x			x	x	x																					The contractor will develop a Hazard Analysis Critical Control Point Plan to minimize and avoid potential contamination from gear brought on site.
Section 7 informal	AAFB	Consultation Regarding the Proposed Short-Range Approach Lighting System for Runway 06L and Vegetation Clearing in the Runway Clear Zone, Andersen Air Force Base	15-May-12				x	x	x																										The Contractor will develop a Hazard Analysis Critical Control Point Plan to minimize and avoid potential contamination from gear brought on site.
Section 7 informal	AAFB	Consultation Regarding the Proposed Short-Range Approach Lighting System for Runway 06L and Vegetation Clearing in the Runway Clear Zone, Andersen Air Force Base	15-May-12				x	x	x																										No contamination of the adjacent terrestrial environment of trash or invasive species will result from project-related activities.
EFH	NBG	X-Ray Wharf Improvements, Naval Base Guam	28-Jan-14														x																			
Section 7 formal	AAFB	Establishment of an Intelligence, Surveillance, Reconnaissance, and Strike (ISR/Strike) Operational Capability	3-Oct-06	x			x	x	x																										1 week prior to clearing and during the first week of construction/clearing, the AF will have a qualified biologist survey the proposed project area and areas within 150 meters (492 feet) of the proposed project site at night and during the day to determine if Mariana fruit bats are present. (If Mariana fruit bats are present in the surveyed area, the Air Force will notify the Service and the Guam Division of Aquatic and Wildlife resources within 2 business days of their observation and construction will be postponed until the bats have left the area and the agencies have been notified.
Section 7 formal	AAFB	Establishment of an Intelligence, Surveillance, Reconnaissance, and Strike (ISR/Strike) Operational Capability	3-Oct-06	x			x	x	x																										Actively seek DoD funding for applied research efforts by USDA/Wildlife Services for development of: a. aerial broadcast techniques for toxicants b. artificial lures and attractants for brown treesnake (BTS) c. more cost-effective strategies for control or elimination of BTS
Section 7 formal	AAFB	Establishment of an Intelligence, Surveillance, Reconnaissance, and Strike (ISR/Strike) Operational Capability	3-Oct-06	x			x	x	x																										Air Force develop and implement measures to control brown treesnakes at a landscape level on Andersen AFB (AAFB) to support recovery efforts for Mariana fruit bat, the Mariana crow, the Guam Micronesian kingfisher, and the Guam rail.
Section 7 formal	AAFB	Establishment of an Intelligence, Surveillance, Reconnaissance, and Strike (ISR/Strike) Operational Capability	3-Oct-06	x			x	x	x																										Air Force eradicates ungulates and implements a native tree reforestation program throughout Andersen AFB to support the recovery of the Mariana fruit bat, the Mariana crow, and the Guam Micronesian kingfisher.
Section 7 formal	AAFB	Establishment of an Intelligence, Surveillance, Reconnaissance, and Strike (ISR/Strike) Operational Capability	3-Oct-06	x			x	x	x																										Air Force will monitor the status of Mariana fruit bats observed within the project site to ensure no additional take of Mariana fruit bats occurs due to construction activities - a qualified biologist must monitor the status of Mariana fruit bats that utilize the Aircraft Staging Area facility area (at a min. of every other day) until 1 year after construction/clearing in Aircraft Staging Area site is completed. The specific methodology utilized for monitoring will be developed by the Adaptive Management Team with input from appropriate species experts 1 year prior to the start of clearing activity at the site. The monitoring methodology should include attempting to capture, mark, and attach a radio transmitter to bats that utilize the Aircraft Staging Area at least 1 month prior to construction/clearing at the project sites. - A report summarizing the methods and results of the monitoring efforts shall be sent to the Service's Pacific Islands Fish and Wildlife Office within 3 months after monitoring is completed. Results will include maps of where individuals were observed before, during, and after construction/clearing.
Section 7 formal	AAFB	Establishment of an Intelligence, Surveillance, Reconnaissance, and Strike (ISR/Strike) Operational Capability	3-Oct-06	x			x	x	x																										Basewide vegetation survey.

Requirement	Location	Title	Project BO/BA/BE Date	Mariana fruit bat	Mariana swiftlet	Mariana common moorhen	Mariana crow	Micronesian kingfisher	Guam rail	Micronesian Megapode	Nightingale Reed-warbler	Serianthes nelsonii	Green sea turtle	Hawksbill sea turtle	Scalloped hammerhead	ESA Corals	EFH	Eugenia bryanii	Hedyotis megalantha	Heritiera longipetiolata	Phyllanthus saffordii	Psychotria malaspinae	Solanum guamense	Tinaspora homosepala	Bulbophyllum guamense	Cycas micronesica	Dendrobium guamense	Maesa walkeri	Nervilia jacksoniae	Tabernaemontana rotensis	Tuberolabium guamense	Mariana eight-spot butterfly	Guam tree snail	Humped tree snail	Fragile tree snail	Conservation Measure (One Per Row)
Section 7 formal	AAFB	Establishment of an Intelligence, Surveillance, Reconnaissance, and Strike (ISR/Strike) Operational Capability	3-Oct-06	x			x	x	x																											Develop Adaptive Management Strategy - DAWR, FWS, DoD. Written plan that will be incorporated or attached to the Andersen Integrated Natural Resources Management Plan (INRMP), and that addresses each mitigation action: a. time frame for completing implementation phase b. identification of priority actions c. methods to minimize/avoid impacts to listed species d. define success for each minimization measure e. methods for monitoring, data tracking, analysis and feed back f. cost estimate – from EPR web g. methods to increase listed species
Section 7 formal	AAFB	Establishment of an Intelligence, Surveillance, Reconnaissance, and Strike (ISR/Strike) Operational Capability	3-Oct-06	x			x	x	x																											During Mariana crow breeding season, the Air Force will increase the ground tracks altitude to at least 305 meters.
Section 7 formal	AAFB	Establishment of an Intelligence, Surveillance, Reconnaissance, and Strike (ISR/Strike) Operational Capability	3-Oct-06	x			x	x	x																											Fence 200 ha (494 ac) Habitat Management Unit (which includes 3400 meters/11,155 feet of fence) to exclude ungulates, BTS, and repel cats a. Eradicate ungulates, BTS and other predators from HMU b. Plant native forage trees bats and crows
Section 7 formal	AAFB	Establishment of an Intelligence, Surveillance, Reconnaissance, and Strike (ISR/Strike) Operational Capability	3-Oct-06	x			x	x	x																											Fenced vegetation plots for fruit bats and crows fenced plots, each 50m square, within the fenced ungulate exclosures a. Planted with native species important to bats and crows, species to be determined by availability b. Control of herbaceous vegetation c. Fenceline maintenance d. Quarterly monitoring for outplanting success
Section 7 formal	AAFB	Establishment of an Intelligence, Surveillance, Reconnaissance, and Strike (ISR/Strike) Operational Capability	3-Oct-06	x			x	x	x																											Funding research projects to refine BTS control techniques with the goal of decreasing mortality of bats.
Section 7 formal	AAFB	Establishment of an Intelligence, Surveillance, Reconnaissance, and Strike (ISR/Strike) Operational Capability	3-Oct-06	x			x	x	x																											Increase patrols by security personnel and conservation officers near all Mariana fruit bat roost sites that are established after the roost site at Pati Point is abandoned.
Section 7 formal	AAFB	Establishment of an Intelligence, Surveillance, Reconnaissance, and Strike (ISR/Strike) Operational Capability	3-Oct-06	x			x	x	x																											Management plan for ungulate control to include: a. Ungulate eradication, depredation and recreational hunting b. Focused on eradication within exclosures and reduction of ungulate densities in non-fenced areas. c. Control and monitoring techniques will be clearly defined in the control plan. d. Ungulate movement studies using radio telemetry or other technologies
Section 7 formal	AAFB	Establishment of an Intelligence, Surveillance, Reconnaissance, and Strike (ISR/Strike) Operational Capability	3-Oct-06	x			x	x	x																											Minimize and avoid impacts of the proposed construction and operation of the Aircraft Staging Area on Mariana fruit bats.
Section 7 formal	AAFB	Establishment of an Intelligence, Surveillance, Reconnaissance, and Strike (ISR/Strike) Operational Capability	3-Oct-06	x			x	x	x																											Minimize, avoid, and/or offset the impacts of increased aircraft operations on Mariana fruit bats.
Section 7 formal	AAFB	Establishment of an Intelligence, Surveillance, Reconnaissance, and Strike (ISR/Strike) Operational Capability	3-Oct-06	x			x	x	x																											No construction activities will occur at night (i.e., between sunset and sunrise).
Section 7 formal	AAFB	Establishment of an Intelligence, Surveillance, Reconnaissance, and Strike (ISR/Strike) Operational Capability	3-Oct-06	x			x	x	x																											Noise study for bats and crows: a. Monitor impacts of aircraft overflights on nesting crows b. Monitor impacts of aircraft overflights on roosting bats
Section 7 formal	AAFB	Establishment of an Intelligence, Surveillance, Reconnaissance, and Strike (ISR/Strike) Operational Capability	3-Oct-06	x			x	x	x																											Notification to the USFWS Pacific Islands Fish and Wildlife Office of any injured Mariana fruit bat or Mariana crow found and the actions taken within 3 working days.
Section 7 formal	AAFB	Establishment of an Intelligence, Surveillance, Reconnaissance, and Strike (ISR/Strike) Operational Capability	3-Oct-06	x			x	x	x																											Remove and transplant approximately 1,500 *Tabernaemontana rotensis* saplings from ISR/Strike area before construction. a. Transplant to outside of construction area b. Collect seeds for outplanting

Requirement	Location	Title	Project BO/BA/BE Date	Mariana fruit bat	Mariana swiftlet	Mariana common moorhen	Mariana crow	Micronesian kingfisher	Guam rail	Micronesian Megapode	Nightingale Reed-warbler	Serianthes nelsonii	Green sea turtle	Hawksbill sea turtle	Scalloped hammerhead	ESA Corals	EFH	Eugenia bryanii	Hedyotis megalantha	Heritiera longipetiolata	Phyllanthus saffordii	Psychotria malaspinae	Solanum guamense	Tinaspora homosepala	Bulbophyllum guamense	Cycas micronesica	Dendrobium guamense	Maesa walkeri	Nervilia jacksoniae	Tabernaemontana rotensis	Tuberolabium guamense	Mariana eight-spot butterfly	Guam tree snail	Humped tree snail	Fragile tree snail	Conservation Measure (One Per Row)
Section 7 formal	AAFB	Establishment of an Intelligence, Surveillance, Reconnaissance, and Strike (ISR/Strike) Operational Capability	3-Oct-06	x			x	x	x																											Shielded lights will be used on the outside of the Aircraft Staging Area.
Section 7 formal	AAFB	Establishment of an Intelligence, Surveillance, Reconnaissance, and Strike (ISR/Strike) Operational Capability	3-Oct-06	x			x	x	x																											The Air Force lease Aguiguan from the Commonwealth of the Northern Mariana Islands and eradicate goats on the island to help support Mariana fruit bat populations and offset the loss of Mariana fruit bats on Guam.
Section 7 formal	AAFB	Establishment of an Intelligence, Surveillance, Reconnaissance, and Strike (ISR/Strike) Operational Capability	3-Oct-06	x			x	x	x																											The Air Force shall inform the Field Supervisor of the Service's Pacific Islands Fish and Wildlife Office in Honolulu, Hawaii in writing of take of any federally listed species within three working days. - the depository designated to receive specimens of any Mariana fruit bats and crows that are killed is the B.P. Bishop Museum.
Section 7 formal	AAFB	Establishment of an Intelligence, Surveillance, Reconnaissance, and Strike (ISR/Strike) Operational Capability	3-Oct-06	x			x	x	x																											The Air Force will implement the BTS control measures being developed at Mariana fruit bat roosts. The implementation of this measure will be part of the Adaptive Management Strategy and will be developed with us to ensure this measure does not adversely impact Mariana fruit bats.
Section 7 formal	AAFB	Establishment of an Intelligence, Surveillance, Reconnaissance, and Strike (ISR/Strike) Operational Capability	3-Oct-06	x			x	x	x																											The Air Force will modify its public hunting program to ensure that public hunting does not occur near any Mariana bat roosts.
Section 7 formal	AAFB	Establishment of an Intelligence, Surveillance, Reconnaissance, and Strike (ISR/Strike) Operational Capability	3-Oct-06	x			x	x	x																											The Air Force will monitor the number of Mariana fruit bats at all roost sites to ensure no additional take of Mariana fruit bats occurs due to aircraft operations associated with the prospective project. - A qualified biologist must monitor the number of Mariana fruit bats at all roost sites until 1 year after the proposed ISR/Strike is fully implemented. Monitoring will occur at a minimum of once a week except after a typhoon event occurs on Rota when monitoring will occur at a minimum of 3 times a week, for 8 weeks after a typhoon, to more accurately monitor potential migration of bats between Rota and Guam. The specific methodology utilized for monitoring will be developed by the Adaptive Management Team with input from appropriate species experts 1 year prior to the increase in aircraft operations (FY09). The monitoring should include direct counts of Mariana fruit bats at roost sites utilizing a spotting scope at an appropriate distance to avoid impacts to the bats. - Reports summarizing the methods and results of the monitoring efforts shall be sent to the Service's Pacific Islands Fish and Wildlife Office every 4 months until the monitoring is completed. Results will include a table of count results and weekly summary of the number of aircraft operations (by aircraft type) over occupied roost sites.
Section 7 formal	AAFB	Establishment of an Intelligence, Surveillance, Reconnaissance, and Strike (ISR/Strike) Operational Capability	3-Oct-06	x			x	x	x																											The Air Force will provide financial assistance to the Service's Law Enforcement Office in Honolulu, Hawaii, to help pay for the travel costs of sending a special agent to Rota after a typhoon to reduce the incidences of illegal hunting on Rota.
Section 7 formal	AAFB	Establishment of an Intelligence, Surveillance, Reconnaissance, and Strike (ISR/Strike) Operational Capability	3-Oct-06	x			x	x	x																											The hiring of a Wildlife Management Specialist to carry out day to day field operations of the conservation program. a. Oversight of barrier construction at mitigation sites b. Coordinator and AF point of contact for ungulate eradication efforts c. Day to day recreational hunt and depredation point of contact d. Fenceline reconnaissance for maintenance needs e. Day to day coordination with FWS and other resource agencies
Section 7 formal	AAFB	Establishment of an Intelligence, Surveillance, Reconnaissance, and Strike (ISR/Strike) Operational Capability	3-Oct-06	x			x	x	x																											Ungulate exclosures: 3 areas approximately 254 ha (701 ac) above Ritidian Point a. fence using suitable posts and materials sufficient to prevent ungulate incursion and withstand Guam's environment b. To be give a special conservation designation with no “incompatible activities” occurring within c. Maintenance
Section 7 formal	AAFB	Establishment of an Intelligence, Surveillance, Reconnaissance, and Strike (ISR/Strike) Operational Capability	3-Oct-06	x			x	x	x																											Ungulate movement studies using radio telemetry or other technologies to be incorporated into the Ungulate Control Plan.

Requirement	Location	Title	Project BO/BA/BE Date	Mariana fruit bat	Mariana swiftlet	Mariana common moorhen	Mariana crow	Micronesian kingfisher	Guam rail	Micronesian Megapode	Nightingale Reed-warbler	Serianthes nelsonii	Green sea turtle	Hawksbill sea turtle	Scalloped hammerhead	ESA Corals	EFH	Eugenia bryanii	Hedyotis megalantha	Heritiera longipetiolata	Phyllanthus saffordii	Psychotria malaspinae	Solanum guamense	Tinaspora homosepala	Bulbophyllum guamense	Cycas micronesica	Dendrobium guamense	Maesa walkeri	Nervilia jacksoniae	Tabernaemontana rotensis	Tuberolabium guamense	Mariana eight-spot butterfly	Guam tree snail	Humped tree snail	Fragile tree snail	Conservation Measure (One Per Row)
EFH	NBG	Kilo Wharf Extension, Apra Harbor, Guam	4-Jun-07														x																			Designate marine areas (e.g., areas with coral density greater than 5 percent mapped as zones 7-9 in the Draft EIS) to be protected on all construction drawings.
EFH	NBG	Kilo Wharf Extension, Apra Harbor, Guam	4-Jun-07														x																			Require contractor to avoid impacting these designated coral reef areas.
EFH	NBG	Kilo Wharf Extension, Apra Harbor, Guam	4-Jun-07														x																			The barge used in the construction of the mooring island(s) would establish anchoring points outside coral reef areas.
EFH	NBG	Kilo Wharf Extension, Apra Harbor, Guam	4-Jun-07														x																			A barge anchoring system that prevents anchor lines from damaging the coral reef community shall be developed and implemented by the construction contractor, subject to Navy approval.
EFH	NBG	Kilo Wharf Extension, Apra Harbor, Guam	4-Jun-07														x																			If chain is required to provide additional stability for the mooring lines, it would be placed on the fossilized reef platform or other non-coral reef areas to avoid scouring coral reef communities.
EFH	NBG	Kilo Wharf Extension, Apra Harbor, Guam	4-Jun-07														x																			Materials and construction equipment for the construction mooring island would be transported to the site in a manner that avoids contact with the coral reef.
EFH	NBG	Kilo Wharf Extension, Apra Harbor, Guam	4-Jun-07														x																			Work barge and scow would be relocated to a safe mooring location in advance of extreme weather conditions (specific condition of readiness to be predetermined by the Navy) to avoid damaging the coral reef and other habitats.
EFH	NBG	Kilo Wharf Extension, Apra Harbor, Guam	4-Jun-07														x																			If required during the construction period, ammunition ship bow anchors to be placed only on sand and rubble areas.
EFH	NBG	Kilo Wharf Extension, Apra Harbor, Guam	4-Jun-07														x																			No blasting would be performed.
EFH	NBG	Kilo Wharf Extension, Apra Harbor, Guam	4-Jun-07														x																			Silt containment devices would be employed as part of the BMPs used for reducing unavoidable turbidity during dredging operations. Precautions would be taken to ensure that the curtains do not encircle turtles when put in place. If a turtle should enter the curtained area, work would be paused and the curtain would be lowered until the turtle voluntarily leaves.
EFH	NBG	Kilo Wharf Extension, Apra Harbor, Guam	4-Jun-07														x																			If a sea turtle is sighted ncar any project activity, and should that activity have a potential to adversely affect the turtle, the action would be paused or modified to avoid any adverse effect. Construction personnel would be informed of the protected nature of these animals and procedures that would be employed should a sea turtle enter a construction area. For example, if a small boat operator sees that the vessel is approaching a sea turtle, the boat's speed would be reduced, the boat would be turned, or other actions would be taken to avoid the turtle.
EFH	NBG	Kilo Wharf Extension, Apra Harbor, Guam	4-Jun-07														x																			Construction-related materials that may pose an entanglement hazard to sea turtles would be removed from the project site if not actively being used and/ or at the conclusion of construction.
Section 7 informal	AAFB	Vegetation Control and Removal within the Flightline Project	7-Jun-07	x	x	x	x	x	x																											Conduct surveys prior to clearing.
Section 7 informal	AAFB	Vegetation Control and Removal within the Flightline Project	7-Jun-07	x	x	x	x	x	x																											No clearing should be accomplished when species are present.
Section 7 informal	AAFB	Vegetation Control and Removal within the Flightline Project	7-Jun-07	x	x	x	x	x	x																											No work should be conducted at night.
Section 7 informal	NBG	Kilo Wharf Extension, Apra Harbor, Guam	29-Jun-07										x	x																						A fuel or other petroleum product spill contingency plan is in place and the Navy maintains materials for cleaning spills nearby within Apra Harbor.
Section 7 informal	NBG	Kilo Wharf Extension, Apra Harbor, Guam	29-Jun-07										x	x																						All construction personnel will be informed of listed turtles in the harbor and required protocols when turtles enter the construction area.
Section 7 informal	NBG	Kilo Wharf Extension, Apra Harbor, Guam	29-Jun-07										x	x																						Appropriate tension of vessel anchor lines to avoid coral damage and entanglement with turtles.
Section 7 informal	NBG	Kilo Wharf Extension, Apra Harbor, Guam	29-Jun-07										x	x																						BMPs to minimize coral damage include anchoring vessels in sandy bottoms, designated areas by the Navy and resource agencies, and beyond designated coral zones.
Section 7 informal	NBG	Kilo Wharf Extension, Apra Harbor, Guam	29-Jun-07										x	x																						During construction, the Navy will implement existing protocols and best management practices (BMPs) to reduce potential in-water impacts to sea turtles in the project vicinity.

Requirement	Location	Title	Project BO/BA/BE Date	Mariana fruit bat	Mariana swiftlet	Mariana common moorhen	Mariana crow	Micronesian kingfisher	Guam rail	Micronesian Megapode	Nightingale Reed-warbler	Serianthes nelsonii	Green sea turtle	Hawksbill sea turtle	Scalloped hammerhead	ESA Corals	EFH	Eugenia bryanii	Hedyotis megalantha	Heritiera longipetiolata	Phyllanthus saffordii	Psychotria malaspinae	Solanum guamense	Tinaspora homosepala	Bulbophyllum guamense	Cycas micronesica	Dendrobium guamense	Maesa walkeri	Nervilia jacksoniae	Tabernaemontana rotensis	Tuberolabium guamense	Mariana eight-spot butterfly	Guam tree snail	Humped tree snail	Fragile tree snail	Conservation Measure (One Per Row)
Section 7 informal	NBG	Kilo Wharf Extension, Apra Harbor, Guam	29-Jun-07										x	x																						If a sea turtle is sighted near any project activity, and should that activity have a potential to adversely affect the turtle, the action will be paused or modified to avoid any adverse effect. Personnel will be informed of the protected nature of these animals and procedures that would be employed should a turtle enter a construction area.
Section 7 informal	NBG	Kilo Wharf Extension, Apra Harbor, Guam	29-Jun-07										x	x																						Implementation of spill contingency plan procedures for any accidental spill of fuel, hydraulic fluids, and petroleum products.
Section 7 informal	NBG	Kilo Wharf Extension, Apra Harbor, Guam	29-Jun-07										x	x																						Monitoring for sea turtles by vessel observers during barge and tug boat operations.
Section 7 informal	NBG	Kilo Wharf Extension, Apra Harbor, Guam	29-Jun-07										x	x																						NMFS staff will be immediately notified when sea turtle injury(ies) occur during construction operations.
Section 7 informal	NBG	Kilo Wharf Extension, Apra Harbor, Guam	29-Jun-07										x	x																						No blasting will be performed.
Section 7 informal	NBG	Kilo Wharf Extension, Apra Harbor, Guam	29-Jun-07										x	x																						Postponing or halting operations to allow turtles to leave the area.
Section 7 informal	NBG	Kilo Wharf Extension, Apra Harbor, Guam	29-Jun-07										x	x																						Project-related debris that may pose an entanglement hazard to sea turtles will be removed from the project site if not actively being used and/or at the conclusion of construction.
Section 7 informal	NBG	Kilo Wharf Extension, Apra Harbor, Guam	29-Jun-07										x	x																						Silt curtains will be deployed as part of the best management practices used ofr reducing turbidity. Precautions will be taken to ensure that the silt curtains do not encircle turtles when put in place. Should, however, a turtle enter the curtained area, work would be paused until the turtle voluntarily leaves.
Section 7 informal	NBG	Kilo Wharf Extension, Apra Harbor, Guam	29-Jun-07										x	x																						Slow vessel speeds to avoid turtles.
Section 7 informal	NBG	Kilo Wharf Extension, Apra Harbor, Guam	29-Jun-07										x	x																						The Navy will mitigate for the direct loss of corals and sea turtle forage areas from the wharf expansion activities. Mitigation may include the reforestation of 500 acres in the Ceti Bay watershed in southern Guam. Anticipated activities include monitoring of implemented mitigation and achievement of performance goals, including coral restoration.
Section 7 informal	AAFB	Operation and Maintenance ofthe North Runway Approach Lights	19-Feb-08	x			x	x	x																											All maintenance of the lights and access areas, other work or deliveries will begin no earlier than one hour after sunrise or 7 am, which ever is later. This will ensure that the majority of bats that were out foraging at night have returned to the roosting area for the day.
Section 7 informal	AAFB	Operation and Maintenance ofthe North Runway Approach Lights	19-Feb-08	x			x	x	x																											All maintenance will be completed 1 hour before sunset or at 4:30 pm, which ever is earlier, so that the bats are not disturbed while foraging at night. No night time work will occur. Any requests to work at night with lighting must be coordinated with the Service.
Section 7 informal	AAFB	Operation and Maintenance ofthe North Runway Approach Lights	19-Feb-08	x			x	x	x																											All unused materials and waste will be removed from the job site and disposed of properly. Material must be removed without damage to adjacent areas, including native forest. Any damage resulting from removal shall be repaired.
Section 7 informal	AAFB	Operation and Maintenance ofthe North Runway Approach Lights	19-Feb-08	x			x	x	x																											The job site will be maintained free of waste, trash, debris, and rubbish caused by maintenance and operations personal. This will help deter the attraction of predators and poachers.
Section 7 informal	AAFB	Operation and Maintenance ofthe North Runway Approach Lights	19-Feb-08	x			x	x	x																											Security patrols will occur along the cliffline to ensure that no poaching of the bat colony occurs. If unauthorized personnel are found they will be escorted out of the area and prosecuted if poaching occurred.
Section 7 informal	AAFB	Operation and Maintenance ofthe North Runway Approach Lights	19-Feb-08	x			x	x	x																											Restore and maintain the graded area with non-invasive plant material and low growing native forest species. This will limit invasion of surrounding native forest by non-native species; may provide foraging habitat for the three listed species; and ensure lighting needs are not compromised. Quarterly inspections will occur to evaluate the presence of non-native invasive plant species and to remove any when detected. Once native species are established, the Air Force will coordinate with the Service to determine the duration of the invasive plant monitoring and control program.
Section 7 informal	AAFB	Operation and Maintenance ofthe North Runway Approach Lights	19-Feb-08	x			x	x	x																											Lights should be shielded such that when the lights are on, they are visible by aircraft but not on the ground.
Section 7 informal	NBG	Construction and operation of two anemometer towers	7-Mar-08	x	x	x																														No lighting will be added to the towers because they are less than 200 feet high.

Requirement	Location	Title	Project BO/BA/BE Date	Mariana fruit bat	Mariana swiftlet	Mariana common moorhen	Mariana crow	Micronesian kingfisher	Guam rail	Micronesian Megapode	Nightingale Reed-warbler	Serianthes nelsonii	Green sea turtle	Hawksbill sea turtle	Scalloped hammerhead	ESA Corals	EFH	Eugenia bryanii	Hedyotis megalantha	Heritiera longipetiolata	Phyllanthus saffordii	Psychotria malaspinae	Solanum guamense	Tinaspora homosepala	Bulbophyllum guamense	Cycas micronesica	Dendrobium guamense	Maesa walkeri	Nervilia jacksoniae	Tabernaemontana rotensis	Tuberolabium guamense	Mariana eight-spot butterfly	Guam tree snail	Humped tree snail	Fragile tree snail	Conservation Measure (One Per Row)
Section 7 informal	NBG	Construction and operation of two anemometer towers	8-Mar-08	x	x	x																														Bird diverters constructed from white, 25-millimeter polyvinyl tape, will be used on all guy wires. The polyvinyl tape should be cut into 2-meter segments, folded in half over the wire, and attached using zip ties every 10 meters along each guy wire. Zip ties should be resistant to ultra-violet light so that maintenance is reduced. Bird diverters will remain in working order for the life of the anemometer towers. This increased guy wire visibility should reduce the likelihood of bird and fruit bat collisions with towers.
Section 7 informal	NBG	Construction and operation of two anemometer towers	9-Mar-08	x	x	x																														Post-construction monitoring will be conducted at each of the proposed towers during the period of operation. Bird diverters should minimize the likelihood of injury to both the fruit bat and birds; however, this mechanism has not been specifically tested on fruit bats. Monitoring will help to demonstrate if any listed species or seabird has collided with the tower or guy wires.
Section 7 informal	NBG	Construction and operation of two anemometer towers	10-Mar-08	x	x	x																														Changed circumstances such as hurricanes, major storms, fire, and other such events could alter the timing of the surveys. If the anemometer towers are not accessible as a result of storm events or road conditions, the surveys should continue as soon as is safety permits. The Navy will coordinate with the Service on such changed circumstances as soon as possible.
Section 7 informal	NBG	Construction and operation of two anemometer towers	11-Mar-08	x	x	x																														All project staff and consultants will be trained by the project lead on how to handle any downed wildlife or carcasses found anywhere within the project area.
Section 7 informal	NBG	Construction and operation of two anemometer towers	12-Mar-08	x	x	x																														
Section 7 informal	AAFB	Tarague Beach Improvement Project, Andersen Air Force Base, Guam	1-May-08	x	x		x	x	x				x	x																						No activities will occur at night so that crows, bats, and sea turtles are not disturbed. All work will be conducted between 8:00 am and 4:00 pm.
Section 7 informal	AAFB	Tarague Beach Improvement Project, Andersen Air Force Base, Guam	1-May-08	x	x		x	x	x				x	x																						To avoid impacts to nesting crows, one week prior to clearing vegetation, a qualified biologist will survey the proposed project site and adjacent areas to determine if crows are present. If crows are nesting (male/female) within30D ill (984 £1) of the project site, clearing and other activities within 300 m (984 ft) of the nest will be postponed until the breeding attempt is completed, resulting in either successful fledging or nest failure.
Section 7 informal	AAFB	Tarague Beach Improvement Project, Andersen Air Force Base, Guam	1-May-08	x	x		x	x	x				x	x																						To avoid impacts to roosting bats, a qualified biologist will survey the project area and areas within 150 m (492 £1) of these proposed project sites to determine ifbats are present. Ifbats are observed within 150 m (492 ft) of the project site, activities will be delayed within 150 m (492 ft) of the bates) until the bates) have left thg arga. This survey should be completed one week prior to clearing vegetation at a site.
Section 7 informal	AAFB	Tarague Beach Improvement Project, Andersen Air Force Base, Guam	1-May-08	x	x		x	x	x				x	x																						To avoid impacts to sea turtle nests, nesting adults, and hatchlings, AAFB will contact Guam Division ofAquatic and Wildlife Resources (DAWR) to determine the sighting of the storage shed to avoid known nests and during construction shed so that equipment will avoid any known nests. AAFB will have DAWR on site during construction so that in the unlikely event that a turtle nest is discovered while excavating for the shed, immediate on-site advice can be provided to protect the nest. If a nest is discovered during excavation, excavation will stop, AAFB will contact the Service to re-initiate consultation and AAFB will immediately work with DAWR to protect the nest.
Section 7 informal	AAFB	Tarague Beach Improvement Project, Andersen Air Force Base, Guam	1-May-08	x	x		x	x	x				x	x																						To avoid impacts to sea turtle nests, nesting adults, and hatchlings, AAFB will prohibit recreational driving on the beach. Pole barriers have already been installed to prevent vehicle access. Additional signs will be posted and violators may be fined. Security forces will assist with the no vehicle policy.

Requirement	Location	Title	Project BO/BA/BE Date	Mariana fruit bat	Mariana swiftlet	Mariana common moorhen	Mariana crow	Micronesian kingfisher	Guam rail	Micronesian Megapode	Nightingale Reed-warbler	Serianthes nelsonii	Green sea turtle	Hawksbill sea turtle	Scalloped hammerhead	ESA Corals	EFH	Eugenia bryanii	Hedyotis megalantha	Heritiera longipetiolata	Phyllanthus saffordii	Psychotria malaspinae	Solanum guamense	Tinaspora homosepala	Bulbophyllum guamense	Cycas micronesica	Dendrobium guamense	Maesa walkeri	Nervilia jacksoniae	Tabernaemontana rotensis	Tuberolabium guamense	Mariana eight-spot butterfly	Guam tree snail	Humped tree snail	Fragile tree snail	Conservation Measure (One Per Row)
Section 7 informal	AAFB	Tarague Beach Improvement Project, Andersen Air Force Base, Guam	1-May-08	x	x		x	x	x				x	x																						A sea turtle monitoring program will be established and implemented by AAFB. The program should be approved by the Service and DAWR and will incorporate a person walking the entire beach from sunrise to approximately 8 am to search for crawls and other evidence of sea turtle use. When crawls or evidence of turtle use is detected, DAWR should be contacted immediately. The location ofthe potential nest site will be documented with GPS coordinates and the nest marked, if necessary. The sea turtle monitor will also look for evidence of beach erosion and document the source of the erosion.
Section 7 informal	AAFB	Tarague Beach Improvement Project, Andersen Air Force Base, Guam	1-May-08	x	x		x	x	x				x	x																						AAFB will install sea turtle lighting where lighting is necessary, which will involve the replacement of existing fixtures or bulbs. Lights have already been angled toward the cliff and away from the ocean. This will reduce the direct and ambient lighting of the beach habitats within and adjacent to the project site. Security lighting should be turned off five days prior to an expected nest hatching and remain off five days after hatching.
Section 7 informal	AAFB	Tarague Beach Improvement Project, Andersen Air Force Base, Guam	1-May-08	x	x		x	x	x				x	x																						AAFB has implemented and will request annual sea turtle awareness training (or upon hiring ofnew staff or new volunteers) for all lifeguards and beach patrol personnel that work the Tarague Beach Area.
Section 7 informal	AAFB	Tarague Beach Improvement Project, Andersen Air Force Base, Guam	1-May-08	x	x		x	x	x				x	x																						AAFB hired a beach patrol person to assist with enforcement of guidelines for the Tarague Beach area.
Section 7 informal	AAFB	Tarague Beach Improvement Project, Andersen Air Force Base, Guam	1-May-08	x	x		x	x	x				x	x																						No insecticides will be used around forested habitats, so that swiftlet prey items are not affected.
Section 7 informal	AAFB	Tarague Beach Improvement Project, Andersen Air Force Base, Guam	1-May-08	x	x		x	x	x				x	x																						AAFB will prohibit the free movement of pets in beach habitats. Personnel and beach users will be instructed not to encourage (feed) feral cats in the area.
Section 7 informal	AAFB	Tarague Beach Improvement Project, Andersen Air Force Base, Guam	1-May-08	x	x		x	x	x				x	x																						AAFB will provide sturdy animal-proof garbage containers to prevent the invasion of house mice and their predators.
Section 7 informal	AAFB	Tarague Beach Improvement Project, Andersen Air Force Base, Guam	1-May-08	x	x		x	x	x				x	x																						AAFB will restrict beach access each night to prevent harassment and mortality of bats and sea turtles.
Section 7 informal	AAFB	Tarague Beach Improvement Project, Andersen Air Force Base, Guam	1-May-08	x	x		x	x	x				x	x																						AAFB has minimized the project footprint to reduce overall impacts to beach, coastal, and forest habitats.
Section 7 informal	AAFB	Tarague Beach Improvement Project, Andersen Air Force Base, Guam	1-May-08	x	x		x	x	x				x	x																						Heavy equipment will not be used for grading. No track vehicles are allowed and only vehicles with rubber tires will be used.
Section 7 informal	AAFB	Tarague Beach Improvement Project, Andersen Air Force Base, Guam	1-May-08	x	x		x	x	x				x	x																						Understory vegetation on the beach has already been cleared. Sea turtles use understory vegetation, particularly vines, shrubby grasses and shrubs as a cue to determine appropriate areas for nesting. Without these cues, the turtles continue to head inland to nest which increase their energy use, may discourage nesting, exposes the adults to predators and other risks, and exposes any hatchlings to increased predation and stress try to reach the water. Therefore, no additional tree, shrub, grass or ground cover removal will occur north of the parking lot and vines will be allowed to grow back under the tree canopy and onto the beach.
Section 7 informal	AAFB	Tarague Beach Improvement Project, Andersen Air Force Base, Guam	1-May-08	x	x		x	x	x				x	x																						Within the area proposed for clearing, trees larger than 10 centimeters (4 inches) in diameter at breast height (DBH) will not be disturbed, other than coconut and ironwood trees. Trees of this size and greater are appropriate for bat roosts and foraging, crow nests and foraging, and represent habitat for the kingfisher and rail. Selected coconut trees will be relocated at the project site and twelve young Daok trees (Calophyllum inopyllum) will be planted on site. Coconut seedlings will be planted within the power line easement. Where feasible, AAFB will plant native vegetation species used by bats, crows, rails, kingfishers.

Requirement	Location	Title	Project BO/BA/BE Date	Mariana fruit bat	Mariana swiftlet	Mariana common moorhen	Mariana crow	Micronesian kingfisher	Guam rail	Micronesian Megapode	Nightingale Reed-warbler	Serianthes nelsonii	Green sea turtle	Hawksbill sea turtle	Scalloped hammerhead	ESA Corals	EFH	Eugenia bryanii	Hedyotis megalantha	Heritiera longipetiolata	Phyllanthus saffordii	Psychotria malaspinae	Solanum guamense	Tinaspora homosepala	Bulbophyllum guamense	Cycas micronesica	Dendrobium guamense	Maesa walkeri	Nervilia jacksoniae	Tabernaemontana rotensis	Tuberolabium guamense	Mariana eight-spot butterfly	Guam tree snail	Humped tree snail	Fragile tree snail	Conservation Measure (One Per Row)
Section 7 informal	AAFB	Taragues Beach Improvement Project, Andersen Air Force Base, Guam	1-May-08	x	x		x	x	x				x	x																						The project applicant will prepare and implement an erosion control and restoration plan to control short-term and long-term erosion and sedimentation effects. The plan will includle all the necessary local jurisdiction requirements regarding erosion control and will implement Best Management Practices (BMPs) for erosion and sediment control as required. Work will be curtailed during adverse weather or tidal conditions to prevent erosion. Existing erosion from the parking lot will be stopped and an appropriate mechanism should be used to ensure additional erosion from the parking lot does not occur.
Section 7 informal	AAFB	Taragues Beach Improvement Project, Andersen Air Force Base, Guam	1-May-08	x	x		x	x	x				x	x																						All vehicle parking will be restricted to previously determined areas or existing roads. Necessary vehicles belonging to the biological monitors and construction supervisors will be parked at the nearest point on existing access roads.
Section 7 informal	AAFB	Taragues Beach Improvement Project, Andersen Air Force Base, Guam	1-May-08	x	x		x	x	x				x	x																						Erosion control devices will be monitored on a weekly basis and augmented as necessary ifnewerosionpointsarediscovered. In the event ofpendingstorms,erosioncontrol devices will be inspected to ensure that such devices are in place and are functional. If erosion control devices are found to be non-functional, they will be fixed within 24 hours. Monitoring and maintenance of erosion control devices and adjacent disturbed areas will continue during and immediately after significant storm events.
Section 7 informal	AAFB	Taragues Beach Improvement Project, Andersen Air Force Base, Guam	1-May-08	x	x		x	x	x				x	x																						The stockpiling of any materials, during project implementation, will be located a minimum of 50 meters away from buffer zones or areas of potential runoff. All stockpiles will be removed or covered and protected with soil stabilization measures, and a temporary perimeter sediment barrier, prior to the onset of precipitation.
Section 7 informal	AAFB	Taragues Beach Improvement Project, Andersen Air Force Base, Guam	1-May-08	x	x		x	x	x				x	x																						Stockpiles of "cold mix" asphalt materials will be placed on and covered with plastic or comparable material prior to the onset of precipitation.
Section 7 informal	AAFB	Taragues Beach Improvement Project, Andersen Air Force Base, Guam	1-May-08	x	x		x	x	x				x	x																						Any soil exposed near water as part ofthe project shall be protected from erosion (with plastic sheeting, filter fabric, etc.) after exposure and stabilized as soon as practicable (with vegetation matting, hydroseeding, etc.).
Section 7 informal	AAFB	Taragues Beach Improvement Project, Andersen Air Force Base, Guam	1-May-08	x	x		x	x	x				x	x																						The project applicant will prepare a spill prevention and clean-up plan. Spill control BMP's will be implemented anytime chemicals and/or hazardous substances are stored or used on the projects. Employees shall be educated in proper material handling, spill prevention, and clean-up. Clean-up materials shall be on-site and located near material storage and use.
Section 7 informal	AAFB	Taragues Beach Improvement Project, Andersen Air Force Base, Guam	1-May-08	x	x		x	x	x				x	x																						Dedicated fueling areas and refueling practices will be designated and a contingency plan to control petroleum products accidentally spilled during the project shall be developed. If possible, dedicated refueling 'areas will be located at least 50 meters from any buffer zones, aquatic habitats, or habitats supporting listed species. The fueling areas will have signs posted designating the area and listing BMPs for fueling. Drip pans, absorbent pads, and containment booms shall be stored on-site, if appropriate, to facilitate the cleanup of accidental petroleum releases.
Section 7 informal	AAFB	Taragues Beach Improvement Project, Andersen Air Force Base, Guam	1-May-08	x	x		x	x	x				x	x																						A litter control program shall be instituted at the entire project site. All workers ensure their food scraps, paper wrappers, food containers, cans, bottles, and other trash from the project area are deposited in covered or closed trash containers. The trash containers shall be removed from the project area at the end of each working day.
Section 7 informal	AAFB	Taragues Beach Improvement Project, Andersen Air Force Base, Guam	1-May-08	x	x		x	x	x				x	x																						All tools, gear, and construction scrap will be removed upon completion of work in order to prevent the attraction of non-native pests (i.e., rats).
Section 7 informal	AAFB	Taragues Beach Improvement Project, Andersen Air Force Base, Guam	1-May-08	x	x		x	x	x				x	x																						All onsite personnel will receive instruction regarding the browntree snake and what to do in case of a sighting.
Section 7 informal	AAFB	Taragues Beach Improvement Project, Andersen Air Force Base, Guam	1-May-08	x	x		x	x	x				x	x																						All BMPs and conservation measures will be made available on the project site and will be reviewed with all workers. This includes species and habitat specific measures, the erosion control plan, spill prevention and control plan, and HACCP plan.

Requirement	Location	Title	Project BO/BA/BE Date	Mariana fruit bat	Mariana swiftlet	Mariana common moorhen	Mariana crow	Micronesian kingfisher	Guam rail	Micronesian Megapode	Nightingale Reed-warbler	Serianthes nelsonii	Green sea turtle	Hawksbill sea turtle	Scalloped hammerhead	ESA Corals	EFH	Eugenia bryanii	Hedyotis megalantha	Heritiera longipetiolata	Phyllanthus saffordii	Psychotria malaspinae	Solanum guamense	Tinaspora homosepala	Bulbophyllum guamense	Cycas micronesica	Dendrobium guamense	Maesa walkeri	Nervilia jacksoniae	Tabernaemontana rotensis	Tuberolabium guamense	Mariana eight-spot butterfly	Guam tree snail	Humped tree snail	Fragile tree snail	Conservation Measure (One Per Row)
Section 7 informal	AAFB	Tarague Beach Improvement Project, Andersen Air Force Base, Guam	1-May-08	x	x		x	x	x				x	x																						A qualified biologist approved by the Service and DAWR (biological monitor) will train all project staff regarding the presence of listed species and the importance of avoiding impacts to these species and their habitat, habitat sensitivity, and required practices before the start of construction. The training shall include the general measures that are being implemented to conserve these species as they relate to the project, the penalties for non-compliance, and the boundaries of the project area.
Section 7 informal	AAFB	Tarague Beach Improvement Project, Andersen Air Force Base, Guam	1-May-08	x	x		x	x	x				x	x																						Upon completion of all worker education described above, workers will sign a form stating that they attend the training and understand and will implement all the conservation measures and protection measures. Training shall be conducted in languages other than English, as appropriate.
Section 7 informal	AAFB	Tarague Beach Improvement Project, Andersen Air Force Base, Guam	1-May-08	x	x		x	x	x				x	x																						Kiosks will be posted to describe the sensitive species and their habitats and appropriate ways that individuals can use the project area without damaging resources.
Section 7 informal	AAFB	Paving of Munitions Storage Area 1, Andersen Air Force Base, Guam	3-Nov-08	x			x	x	x																											All on-site personnel will receive instruction regarding endangered species and the brown treesnake *(Boiga irregularis),* and what to do in case of a sighting.
Section 7 informal	AAFB	Paving of Munitions Storage Area 1, Andersen Air Force Base, Guam	3-Nov-08	x			x	x	x																											A litter-control program will be instituted; all trash will be bagged and disposed of offsite at the end of each day.
Section 7 informal	AAFB	Paving of Munitions Storage Area 1, Andersen Air Force Base, Guam	3-Nov-08	x			x	x	x																											All tools, gear, construction scrap, and vegetation clippings will be removed upon completion of work in order to prevent the attraction of non-native pests (i.e., rats).
Section 7 informal	AAFB	Paving of Munitions Storage Area 1, Andersen Air Force Base, Guam	3-Nov-08	x			x	x	x																											All work will be conducted between the hours of7:00 am and 4:00pm. No activities will occur at night.
Section 7 informal	AAFB	Paving of Munitions Storage Area 1, Andersen Air Force Base, Guam	3-Nov-08	x			x	x	x																											Existing disturbed areas will be used for staging and equipment storage; therefore, no habitat will be removed.
Section 7 informal	AAFB	Paving of Munitions Storage Area 1, Andersen Air Force Base, Guam	3-Nov-08	x			x	x	x																											Habitat adjacent to the roadway that is not to be trimmed, pruned, or cut will be temporarily delineated by orange construction fencing to keep personnel and equipment from damaging the habitat. Signs will be posted indicating that no one is allowed past the boundary. All signs and temporary fencing will be removed from the site after completion of the project.
Section 7 informal	AAFB	Paving of Munitions Storage Area 1, Andersen Air Force Base, Guam	3-Nov-08	x			x	x	x																											Immediately prior to vegetation trimming, pruning or cutting, a biologist or environmental flight personnel will examine the vegetation, including a 150-meter buffer area around the subject vegetation, for Mariana fruit bats. If individual bats are found roosting within 150-meter buffer area, the area will be avoided until the bat leaves of its own volition.
Section 7 informal	AAFB	Paving of Munitions Storage Area 1, Andersen Air Force Base, Guam	3-Nov-08	x			x	x	x																											Immediately prior to vegetation trimming, pruning, or cutting, a biologist or environmental flight personnel will examine the vegetation, including a 300-meter buffer area around the subject vegetation, for Mariana crows. If a male/female nesting crow pair are found within 300-meter buffer area, the area will be avoided until the crows have completed the breeding attempt, resulting in either successful fledging or nest failure.
Section 7 informal	AAFB	Paving of Munitions Storage Area 1, Andersen Air Force Base, Guam	3-Nov-08	x			x	x	x																											Some trees or shrubs may be pruned or removed where they overlay the roadway. Trees larger than 10 centimeters (4 inches) in diameter at breast height (DBH) will not be removed. Trees of this size and greater are appropriate for bat roosts and foraging, crow nests and foraging, and represent habitat for the kingfisher and rail.
Section 7 informal	AAFB	Installation and Operation of a Cellular Communications Tower with an Ultra-high Frequency Conventional Repeater	17-Nov-08	x			x	x	x																											All onsite personnel will receive instruction from AAFB environmental flight personnel regarding endangered species and BTS and what to do in case of a sighting.
Section 7 informal	AAFB	Installation and Operation of a Cellular Communications Tower with an Ultra-high Frequency Conventional Repeater	17-Nov-08	x			x	x	x																											A litter-control program will be implemented during construction. All trash will be bagged and disposed of offsite at the end of each day.
Section 7 informal	AAFB	Installation and Operation of a Cellular Communications Tower with an Ultra-high Frequency Conventional Repeater	17-Nov-08	x			x	x	x																											All antenna transmission lines will be attached to the concrete pole and all electrical power lines will be run underground.
Section 7 informal	AAFB	Installation and Operation of a Cellular Communications Tower with an Ultra-high Frequency Conventional Repeater	17-Nov-08	x			x	x	x																											All construction work will begin just after dawn and will end prior to dusk, between the hours of7:00 am and 4:00 pm. No activities will occur at night.

Requirement	Location	Title	Project BO/BA/BE Date	Mariana fruit bat	Mariana swiftlet	Mariana common moorhen	Mariana crow	Micronesian kingfisher	Guam rail	Micronesian Megapode	Nightingale Reed-warbler	Serianthes nelsonii	Green sea turtle	Hawksbill sea turtle	Scalloped hammerhead	ESA Corals	EFH	Eugenia bryanii	Hedyotis megalantha	Heritiera longipetiolata	Phyllanthus saffordii	Psychotria malaspinae	Solanum guamense	Tinaspora homosepala	Bulbophyllum guamense	Cycas micronesica	Dendrobium guamense	Maesa walkeri	Nervilia jacksoniae	Tabernaemontana rotensis	Tuberolabium guamense	Mariana eight-spot butterfly	Guam tree snail	Humped tree snail	Fragile tree snail	Conservation Measure (One Per Row)
Section 7 informal	AAFB	Installation and Operation of a Cellular Communications Tower with an Ultra-high Frequency Conventional Repeater	17-Nov-08	x			x	x	x																											All tools, gear, and construction scrap will be removed upon completion of work in order to prevent the attraction of non-native pests (i.e., rats).
Section 7 informal	AAFB	Installation and Operation of a Cellular Communications Tower with an Ultra-high Frequency Conventional Repeater	17-Nov-08	x			x	x	x																											No chemicals will be used onsite.
Section 7 informal	AAFB	Installation and Operation of a Cellular Communications Tower with an Ultra-high Frequency Conventional Repeater	17-Nov-08	x			x	x	x																											No guy wires or lighting will be used on the monopole.
Section 7 informal	AAFB	Installation and Operation of a Cellular Communications Tower with an Ultra-high Frequency Conventional Repeater	17-Nov-08	x			x	x	x																											No staging areas or access roads will be constructed. Existing roads and disturbed areas will be used.
Section 7 informal	AAFB	Installation and Operation of a Cellular Communications Tower with an Ultra-high Frequency Conventional Repeater	17-Nov-08	x			x	x	x																											Only grass and scrub/shrub vegetation will be cleared. No forest vegetation will be removed.
Section 7 informal	AAFB	Installation and Operation of a Cellular Communications Tower with an Ultra-high Frequency Conventional Repeater	17-Nov-08	x			x	x	x																											The air conditioning system running at maximum power will have noise levels of 66 A-weighted decibels from a distance of 5 feet or less.
Section 7 informal	AAFB	Remedial cleanup actions at the Installation Restoration Program (IRP) site 15-Landfill 20, Main Base Operable Unit	25-Feb-09	x			x	x	x																											All on-site personnel will receive instruction from AAFB environmental flight personnel regarding endangered species and brown treesnake (*Boiga irregularis*) and what to do in case of a sighting.
Section 7 informal	AAFB	Remedial cleanup actions at the Installation Restoration Program (IRP) site 15-Landfill 20, Main Base Operable Unit	25-Feb-09	x			x	x	x																											A litter-control program will be implemented during construction. All trash will be bagged and disposed of off-site at the end of each day.
Section 7 informal	AAFB	Remedial cleanup actions at the Installation Restoration Program (IRP) site 15-Landfill 20, Main Base Operable Unit	25-Feb-09	x			x	x	x																											All construction work will begin just after dawn and will end prior to dusk, between the hours of 7:00 am and 4:00 pm. No activities will occur at night.
Section 7 informal	AAFB	Remedial cleanup actions at the Installation Restoration Program (IRP) site 15-Landfill 20, Main Base Operable Unit	25-Feb-09	x			x	x	x																											All tools, gear, and construction scrap will be removed upon completion of work in order to prevent the attraction of non-native pests (i.e., rats).
Section 7 informal	AAFB	Remedial cleanup actions at the Installation Restoration Program (IRP) site 15-Landfill 20, Main Base Operable Unit	25-Feb-09	x			x	x	x																											Although not anticipated, if a roosting bat is present, workers will not conduct any activities within a 150 meter radius around the bat until the bat leaves on its own volition. Inspections will be completed by AAFB biologists.
Section 7 informal	AAFB	Remedial cleanup actions at the Installation Restoration Program (IRP) site 15-Landfill 20, Main Base Operable Unit	25-Feb-09	x			x	x	x																											Although not anticipated, if nesting crows are detected, workers will avoid the nesting crows by 300 meters until the nest has fledged or has been abandoned. Inspections will be completed by AAFB biologists.
Section 7 informal	AAFB	Remedial cleanup actions at the Installation Restoration Program (IRP) site 15-Landfill 20, Main Base Operable Unit	25-Feb-09	x			x	x	x																											No new staging areas or access roads will be constructed. Existing roads and disturbed areas will be used. Silt fencing will be installed and maintained until the ground is vegetated to prevent erosion from occurring off-site.
Section 7 informal	AAFB	Remedial cleanup actions at the Installation Restoration Program (IRP) site 15-Landfill 20, Main Base Operable Unit	25-Feb-09	x			x	x	x																											The area will be backfilled with clean coral material and restoration of disturbed areas, by planting native trees, will occur at the site. Liquid Fence Deer and Rabbit Repellent will be applied around the tree bases to deter ungulate foraging.
Section 7 informal	AAFB	Remedial cleanup actions at the Installation Restoration Program (IRP) site 15-Landfill 20, Main Base Operable Unit	25-Feb-09	x			x	x	x																											The presence ofthe bat or crow will be reported to the U.S. Fish and Wildlife Service and Guam Division of Aquatic and Wildlife Resources immediately, but the location of the bat will not be revealed to any other outside party.
Section 7 informal	AAFB	Remedial cleanup actions at the Installation Restoration Program (IRP) site 15-Landfill 20, Main Base Operable Unit	25-Feb-09	x			x	x	x																											Vegetative debris will be left on site for natural decomposition.
Section 7 informal	AAFB	First Reinitiation - Beddown of Training and Support Initiatives at Northwest Field	6-Mar-09	x			x	x	x																											All onsite personnel will receive instruction from AAFB environmental flight personnel regarding endangered species and brown treesnake (*Boiga irregularis*) and what to do in case of a sighting.
Section 7 informal	AAFB	First Reinitiation - Beddown of Training and Support Initiatives at Northwest Field	6-Mar-09	x			x	x	x																											A litter-control program will be implemented during construction. All trash will be bagged and disposed of offsite at the end of each day.

Requirement	Location	Title	Project BO/BA/BE Date	Mariana fruit bat	Mariana swiftlet	Mariana common moorhen	Mariana crow	Micronesian kingfisher	Guam rail	Micronesian Megapode	Nightingale Reed-warbler	Serianthes nelsonii	Green sea turtle	Hawksbill sea turtle	Scalloped hammerhead	ESA Corals	EFH	Eugenia bryanii	Hedyotis megalantha	Heritiera longipetiolata	Phyllanthus saffordii	Psychotria malaspinae	Solanum guamense	Tinaspora homosepala	Bulbophyllum guamense	Cycas micronesica	Dendrobium guamense	Maesa walkeri	Nervilia jacksoniae	Tabernaemontana rotensis	Tuberolabium guamense	Mariana eight-spot butterfly	Guam tree snail	Humped tree snail	Fragile tree snail	Conservation Measure (One Per Row)
Section 7 informal	AAFB	First Reinitiation - Beddown of Training and Support Initiatives at Northwest Field	6-Mar-09	x			x	x	x																											A qualified biologist will survey the project site and a 150-meter buffer zone around the project site, each morning, prior to any vegetation clearing. If a roosting bat is present, workers will not conduct any activities, including vegetation removal within the 150-meter buffer radius until the bat leaves on its own volition.
Section 7 informal	AAFB	First Reinitiation - Beddown of Training and Support Initiatives at Northwest Field	6-Mar-09	x			x	x	x																											All conservation measures identified in the prior Beddown Project informal consultation (Service File No. 2006-1-0281) will still be implemented as described in the prior consultation.
Section 7 informal	AAFB	First Reinitiation - Beddown of Training and Support Initiatives at Northwest Field	6-Mar-09	x			x	x	x																											All construction work will begin just after dawn and will end prior to dusk, between the hours of 7:00 am and 4:00 pm. No activities will occur at night.
Section 7 informal	AAFB	First Reinitiation - Beddown of Training and Support Initiatives at Northwest Field	6-Mar-09	x			x	x	x																											All tools, gear, and construction scrap will be removed upon completion of work in order to prevent the attraction of non-native pests (i.e., rats).
Section 7 informal	AAFB	First Reinitiation - Beddown of Training and Support Initiatives at Northwest Field	6-Mar-09	x			x	x	x																											Although not anticipated, if nesting crows are detected, workers will avoid the crows by 300 meters.
Section 7 informal	AAFB	First Reinitiation - Beddown of Training and Support Initiatives at Northwest Field	6-Mar-09	x			x	x	x																											Native landscape vegetation will be planted on the facility's grounds at completion of the construction of the buildings. The contractor will select vegetation from the list of recommended vegetation provided by the Guam Department of Agriculture, Forestry Division.
Section 7 informal	AAFB	First Reinitiation - Beddown of Training and Support Initiatives at Northwest Field	6-Mar-09	x			x	x	x																											No chemicals will be used on site.
Section 7 informal	AAFB	First Reinitiation - Beddown of Training and Support Initiatives at Northwest Field	6-Mar-09	x			x	x	x																											No new staging areas or access roads will be constructed. Existing roads and disturbed areas will be used.
Section 7 informal	AAFB	First Reinitiation - Beddown of Training and Support Initiatives at Northwest Field	6-Mar-09	x			x	x	x																											The presence of the bat or crow will be reported to the Service and the Guam Division of Aquatic and Wildlife Resources immediately, but the location of the bat or crow will not be revealed to any other outside party.
Section 7 informal	AAFB	Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund) 42 U.S.C. §9601 et seq. (1980) site inspections at multiple munitions response areas	7-May-09	x			x	x	x																											All on-site personnel will receive instruction from AAFB environmental flight personnel regarding endangered species and the BTS and what to do in case of a sighting.
Section 7 informal	AAFB	Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund) 42 U.S.C. §9601 et seq. (1980) site inspections at multiple munitions response areas	7-May-09	x			x	x	x																											A litter-control program will be instituted; all trash will be bagged and disposed of offsite at the end of the each day.
Section 7 informal	AAFB	Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund) 42 U.S.C. §9601 et seq. (1980) site inspections at multiple munitions response areas	7-May-09	x			x	x	x																											A qualified biologist will survey the project site and a 150-meter buffer zone around the project site, each morning, prior to any vegetation clearing. If a roosting bat is present, workers will not conduct any activities, including vegetation removal within the 150-meter buffer radius until the bat leaves on its own volition.
Section 7 informal	AAFB	Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund) 42 U.S.C. §9601 et seq. (1980) site inspections at multiple munitions response areas	7-May-09	x			x	x	x																											All tools, gear, construction scrap will be removed upon completion of work.
Section 7 informal	AAFB	Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund) 42 U.S.C. §9601 et seq. (1980) site inspections at multiple munitions response areas	7-May-09	x			x	x	x																											All vegetation removal and field work will begin just after dawn and will end prior to dusk, between the hours of 7:00 am and 4:30 pm. No activities will occur at night.
Section 7 informal	AAFB	Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund) 42 U.S.C. §9601 et seq. (1980) site inspections at multiple munitions response areas	7-May-09	x			x	x	x																											Although not anticipated, if nesting crows are detected, workers will avoid the crows by 300 meters.
Section 7 informal	AAFB	Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund) 42 U.S.C. §9601 et seq. (1980) site inspections at multiple munitions response areas	7-May-09	x			x	x	x																											No chemicals will be used on the sites.
Section 7 informal	AAFB	Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund) 42 U.S.C. §9601 et seq. (1980) site inspections at multiple munitions response areas	7-May-09	x			x	x	x																											No new staging areas or access roads will be constructed. Existing roads and disturbed areas will be used.

Requirement	Location	Title	Project BO/BA/BE Date	Mariana fruit bat	Mariana swiftlet	Mariana common moorhen	Mariana crow	Micronesian kingfisher	Guam rail	Micronesian Megapode	Nightingale Reed-warbler	Serianthes nelsonii	Green sea turtle	Hawksbill sea turtle	Scalloped hammerhead	ESA Corals	EFH	Eugenia bryanii	Hedyotis megalantha	Heritiera longipetiolata	Phyllanthus saffordii	Psychotria malaspinae	Solanum guamense	Tinaspora homosepala	Bulbophyllum guamense	Cycas micronesica	Dendrobium guamense	Maesa walkeri	Nervilia jacksoniae	Tabernaemontana rotensis	Tuberolabium guamense	Mariana eight-spot butterfly	Guam tree snail	Humped tree snail	Fragile tree snail	Conservation Measure (One Per Row)
Section 7 informal	AAFB	Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund) 42 U.S.C. §9601 et seq. (1980) site inspections at multiple munitions response areas	7-May-09	x			x	x	x																											Once the site investigations are complete, the contractor will provide AAFB with recommendations for each site (i.e., further investigation, removal actions, remedial actions, presumptive remedies, administrative actions, or no further action.) For those sites where any other action (other than no further action) may occur, AAFB will initiate consultation with the Service to evaluated any additional adverse affects that may occur from the proposed action. Because each of the possible recommendations (other than no further action) may involve vegetation removal, any new request for consultation will include a native vegetation restoration plan.
Section 7 informal	AAFB	Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund) 42 U.S.C. §9601 et seq. (1980) site inspections at multiple munitions response areas	7-May-09	x			x	x	x																											Roots of the vegetation will remain in place and will not be damaged so that vegetation growth can occur.
Section 7 informal	AAFB	Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund) 42 U.S.C. §9601 et seq. (1980) site inspections at multiple munitions response areas	7-May-09	x			x	x	x																											The presence of the bat or crow will be reported to the Service and the Guam Division of Aquatic and Wildlife Resources immediately, but the locaton of the bat or crow will not be revealed to any other outside party.
Section 7 informal	AAFB	Proposed construction of a brown tree snake barrier at the Habitat Management Unit (HMU), and construction of five well sites.	29-May-09	x			x	x	x																											8. A biologist from the Guam Division of Aquatic and Wildlife Resources will accompany AAFB and contractor personnel to coordinate regarding large trees that are proposed for removal as part of HMU perimeter clearing, to identify possible means to avoid removal of these trees.
Section 7 informal	AAFB	Proposed construction of a brown tree snake barrier at the Habitat Management Unit (HMU), and construction of five well sites.	29-May-09	x			x	x	x																											1. All work will be conducted between the hours of 7:00 am and 4:00 pm. No activities will occur at night.
Section 7 informal	AAFB	Proposed construction of a brown tree snake barrier at the Habitat Management Unit (HMU), and construction of five well sites.	29-May-09	x			x	x	x																											3. A litter-control program will be instituted; all trash will be bagged and disposed of offsite at the end of the each day.
Section 7 informal	AAFB	Proposed construction of a brown tree snake barrier at the Habitat Management Unit (HMU), and construction of five well sites.	29-May-09	x			x	x	x																											4. All on-site personnel will receive instruction regarding endangered species and what to do in case of a sighting.
Section 7 informal	AAFB	Proposed construction of a brown tree snake barrier at the Habitat Management Unit (HMU), and construction of five well sites.	29-May-09	x			x	x	x																											2. All tools, gear, construction scrap, and vegetation clippings will be removed upon completion of work in order to prevent the attraction on non-native pests (i.e., rats).
Section 7 informal	AAFB	Proposed construction of a brown tree snake barrier at the Habitat Management Unit (HMU), and construction of five well sites.	29-May-09	x			x	x	x																											5. Existing developed areas (delineated on the project map provided with the May 26, 2009 request for consultation) will be used for staging and equipment storage and temporary laydown of cut vegetation prior to disposal. Vegetation clearing will be minimized as much as possible.
Section 7 informal	AAFB	Proposed construction of a brown tree snake barrier at the Habitat Management Unit (HMU), and construction of five well sites.	29-May-09	x			x	x	x																											6. Immediately prior to vegetation trimming, pruning or cutting, a biologist or environmental flight personnel will examine the vegeration, including a 150-meter buffer area around the subject vegetation, for Mariana fruit bats. If individual bats are found roosting within 150-meter buffer area, the area will be avoided until the bat leaves of its own volition.
Section 7 informal	AAFB	Proposed construction of a brown tree snake barrier at the Habitat Management Unit (HMU), and construction of five well sites.	29-May-09	x			x	x	x																											7. Immediately prior to vegetation trimming, pruning or cutting, a biologist or environmental flight personnel will examine the vegeration, including a 300-meter buffer area around the subject vegetation, for Marianacrows. If a male/female nesting crow pair are found within 300-meter buffer area, the area will be avoided until the crows have completed the breeding attempt, resulting in either successful fledging or nest failure.
Section 7 informal	AAFB	Proposed construction of a brown tree snake barrier at the Habitat Management Unit (HMU), and construction of five well sites.	29-May-09	x			x	x	x																											9. Once constructed, an AAFB biologist or environmental flight personnel will patrol the outside of the barrier weekly by vehicle, twice per month on foot for chain link sections, and at least every three months on foot for concrete sections, to inspect the fence for damage and detect and remove mantis egg cases or other attached items that could compromise the smoothness of the barrier surface and allow snakes to climb over. Personnel from the U.S. Geological Survey Brown Treesnake Program will train AAFB personnel in maintenance techniques.

Requirement	Location	Title	Project BO/BA/BE Date	Mariana fruit bat	Mariana swiftlet	Mariana common moorhen	Mariana crow	Micronesian kingfisher	Guam rail	Micronesian Megapode	Nightingale Reed-warbler	Serianthes nelsonii	Green sea turtle	Hawksbill sea turtle	Scalloped hammerhead	ESA Corals	EFH	Eugenia bryanii	Hedyotis megalantha	Heritiera longipetiolata	Phyllanthus saffordii	Psychotria malaspinae	Solanum guamense	Tinaspora homosepala	Bulbophyllum guamense	Cycas micronesica	Dendrobium guamense	Maesa walkeri	Nervilia jacksoniae	Tabernaemontana rotensis	Tuberolabium guamense	Mariana eight-spot butterfly	Guam tree snail	Humped tree snail	Fragile tree snail	Conservation Measure (One Per Row)
Section 7 informal	AAFB	Proposed construction of a brown tree snake barrier at the Habitat Management Unit (HMU), and construction of five well sites.	29-May-09	x			x	x	x																											11. Once constructed, an AAFB Wildlife Management Specialist, coordinating with member of the AAFB Adaptive Management Team, will develop and implement methods and schedules to remove snakes and ungulates from the HMU.
Section 7 informal	AAFB	Proposed construction of a brown tree snake barrier at the Habitat Management Unit (HMU), and construction of five well sites.	29-May-09	x			x	x	x																											The area within the exclosure will be maintained in perpetuity as a special use conservation area, with vegetation control, maintenance and repairs as needed to prevent ingress (as described in #9 above) and forest restoration as needed to improve bat and crow habitat, as stated on page 2-21 of the Environmental Assessment for Beddown of Training and Support Initiatives at Northwest Field, AAFB.
Section 7 informal	NBG	Water Line Replacement Between Fena Reservoir and the Fena Water Treatment Plant	10-Aug-09	x			x	x	x																											Upon the completion of the water pipeline repair, the dirt pile will be levelled over the site and seeded with grass to stabilize the soil.
Section 7 informal	NBG	Water Line Replacement Between Fena Reservoir and the Fena Water Treatment Plant	10-Aug-09	x			x	x	x																											At the beginning of the following wet season in June 2010, a variety of native forest species present on the Naval Ordnance Site will be planted to reforest the site (see initiation email for details). The restoration plan (ie., species composition, planting density, monitoring, etc.) will follow the guidelines in the "Cetti Watershed Reforestation Implementation Plan" dated December 2008.
Section 7 informal	NBG	Water Line Replacement Between Fena Reservoir and the Fena Water Treatment Plant	10-Aug-09	x			x	x	x																											Fencing will be provided to protect seedlings from browsing, or protector tubes will be used on each sapling if fencing is precluded by permits.
Section 7 informal	AAFB	Second Reinitiation - Beddown of Training and Support Initiatives at Northwest Field	11-Sep-09	x			x	x	x																											All onsite personnel will receive instruction from AAFB environmental flight personnel regarding endangered species and brown treesnake (*Boiga irregularis*) and what to do in case ofa sighting.
Section 7 informal	AAFB	Second Reinitiation - Beddown of Training and Support Initiatives at Northwest Field	11-Sep-09	x			x	x	x																											A litter-control program will be implemented during construction. All trash will be bagged and disposed of offsite at the end ofeach day.
Section 7 informal	AAFB	Second Reinitiation - Beddown of Training and Support Initiatives at Northwest Field	11-Sep-09	x			x	x	x																											A qualified biologist or environmental flight personnel will survey the project site and a 1 50-meter buffer zone around the project site, each morning, prior to any vegetation clearing. Ifa roosting bat is present, workers will not conduct any activities, including vegetation removal within the 150-meter buffer radius until the bat leaves on its own volition.
Section 7 informal	AAFB	Second Reinitiation - Beddown of Training and Support Initiatives at Northwest Field	11-Sep-09	x			x	x	x																											All conservation measures identified in the prior Beddown Project informal consultation (Service File No. 2006-1-0281 and 2009-1-0112) will still be implemented as described in the prior consultations.
Section 7 informal	AAFB	Second Reinitiation - Beddown of Training and Support Initiatives at Northwest Field	11-Sep-09	x			x	x	x																											All construction work will begin just after dawn and will end prior to dusk, between the hours of 8:00 am and 4:30 pm. No activities will occur at night.
Section 7 informal	AAFB	Second Reinitiation - Beddown of Training and Support Initiatives at Northwest Field	11-Sep-09	x			x	x	x																											All tools, gear, and construction scrap will be removed upon completion of work in order to prevent the attraction of non-native pests (i.e., rats).
Section 7 informal	AAFB	Second Reinitiation - Beddown of Training and Support Initiatives at Northwest Field	11-Sep-09	x			x	x	x																											All vegetation planted in the area, including the utility corridor, will be selected from the Guam Division of Forestry approved list of native and endemic species.
Section 7 informal	AAFB	Second Reinitiation - Beddown of Training and Support Initiatives at Northwest Field	11-Sep-09	x			x	x	x																											All vegetation removed will be burned and excess topsoil will be taken to the quarry.
Section 7 informal	AAFB	Second Reinitiation - Beddown of Training and Support Initiatives at Northwest Field	11-Sep-09	x			x	x	x																											Although not anticipated, ifnesting crows are detected, workers will avoid the crows by 300 meters.
Section 7 informal	AAFB	Second Reinitiation - Beddown of Training and Support Initiatives at Northwest Field	11-Sep-09	x			x	x	x																											No chemicals will be used onsite.
Section 7 informal	AAFB	Second Reinitiation - Beddown of Training and Support Initiatives at Northwest Field	11-Sep-09	x			x	x	x																											No staging areas or access roads will be constructed. Existing roads and disturbed areas will be used.
Section 7 informal	AAFB	Second Reinitiation - Beddown of Training and Support Initiatives at Northwest Field	11-Sep-09	x			x	x	x																											No trees that are considered essential to the recovery ofthe bat, crow, kingfisher, and rail will be removed for the BDOCF area.
Section 7 informal	AAFB	Second Reinitiation - Beddown of Training and Support Initiatives at Northwest Field	11-Sep-09	x			x	x	x																											The presence of the bat or crow will be reported to the Service and the Guam Division of Aquatic and Wildlife Resources immediately, but the location ofthe bat or crow will not be revealed to any other outside party.

Requirement	Location	Title	Project BO/BA/BE Date	Mariana fruit bat	Mariana swiftlet	Mariana common moorhen	Mariana crow	Micronesian kingfisher	Guam rail	Micronesian Megapode	Nightingale Reed-warbler	Serianthes nelsonii	Green sea turtle	Hawksbill sea turtle	Scalloped hammerhead	ESA Corals	EFH	Eugenia bryanii	Hedyotis megalantha	Heritiera longipetiolata	Phyllanthus saffordii	Psychotria malaspinae	Solanum guamense	Tinaspora homosepala	Bulbophyllum guamense	Cycas micronesica	Dendrobium guamense	Maesa walkeri	Nervilia jacksoniae	Tabernaemontana rotensis	Tuberolabium guamense	Mariana eight-spot butterfly	Guam tree snail	Humped tree snail	Fragile tree snail	Conservation Measure (One Per Row)
Section 7 informal	AAFB	Second Reinitiation - Beddown of Training and Support Initiatives at Northwest Field	11-Sep-09	x			x	x	x																											To minimize impacts to adjacent habitat, blaze orange construction fencing will be used to delineate the construction site and signs will be posted indicating no one is allowed beyond the barriers to prohibit personnel or equipment from damaging the habitat. These barriers will be removed upon project completion.
Section 7 informal	AAFB	Third Reinitiation - Beddown of Training and Support Initiatives at Northwest Field	16-Mar-10	x			x	x	x																											All onsite personnel will receive instruction from AAFB environmental flight personnel regarding endangered species and brown treesnake (*Boiga irregularis*) and what to do in case of a sighting.
Section 7 informal	AAFB	Third Reinitiation - Beddown of Training and Support Initiatives at Northwest Field	16-Mar-10	x			x	x	x																											A litter-control program will be implemented during construction. All trash will be bagged and disposed of offsite at the end of each day.
Section 7 informal	AAFB	Third Reinitiation - Beddown of Training and Support Initiatives at Northwest Field	16-Mar-10	x			x	x	x																											A qualified biologist or environmental flight personnel will survey the project site and a 1 50-meter buffer zone around the project site, each morning, prior to any vegetation clearing. If a roosting bat is present, workers will not conduct any activities, including vegetation removal within the 150-meter buffer radius until the bat leaves on its own volition.
Section 7 informal	AAFB	Third Reinitiation - Beddown of Training and Support Initiatives at Northwest Field	16-Mar-10	x			x	x	x																											All conservation measures identified in the prior Beddown Project informal consultation (Service File No. 2006-1-0281 and 2009-1-0112, and 2009-I-0294) will still be implemented as described in the prior consultations.
Section 7 informal	AAFB	Third Reinitiation - Beddown of Training and Support Initiatives at Northwest Field	16-Mar-10	x			x	x	x																											All construction work will begin just after dawn and will end prior to dusk, between the hours of 7:00 am and 4:30 pm. No activities will occur at night.
Section 7 informal	AAFB	Third Reinitiation - Beddown of Training and Support Initiatives at Northwest Field	16-Mar-10	x			x	x	x																											All tools, gear, and construction scrap will be removed upon completion of work in order to prevent the attraction of non-native pests (i.e., rats).
Section 7 informal	AAFB	Third Reinitiation - Beddown of Training and Support Initiatives at Northwest Field	16-Mar-10	x			x	x	x																											Although not anticipated, if nesting crows are detected, workers will avoid the crows by 300 meters.
Section 7 informal	AAFB	Third Reinitiation - Beddown of Training and Support Initiatives at Northwest Field	16-Mar-10	x			x	x	x																											Native landscape vegetation will be planted on the facility's grounds at completion of the construction of the buildings. The contractor will select vegetation from the list of recommended vegetation provided by the Guam Department of Agriculture, Forestry Division.
Section 7 informal	AAFB	Third Reinitiation - Beddown of Training and Support Initiatives at Northwest Field	16-Mar-10	x			x	x	x																											No chemicals will be used onsite.
Section 7 informal	AAFB	Third Reinitiation - Beddown of Training and Support Initiatives at Northwest Field	16-Mar-10	x			x	x	x																											No new staging areas or access roads will be constructed. Existing roads and disturbed areas will be used.
Section 7 informal	AAFB	Third Reinitiation - Beddown of Training and Support Initiatives at Northwest Field	16-Mar-10	x			x	x	x																											The presence of the bat or crow will be reported to the Service and the Guam Division of Aquatic and Wildlife Resources immediately, but the location ofthe bat or crow will not be revealed to any other outside party.
Section 7 informal	AAFB	Anti-Terrorism, Force Protection Perimeter Fence, Andersen Air Force Base	11-May-10	x			x	x	x																											Coordination with the Service and the Guam Division of Aquatic and Wildlife Resources will be sought to develop a multi-year ungulate control plan in FYI 0. The plan will be designed to guide AAFB ungulate eradication, depredation, and recreational hunting issues managed by the proposed Wildlife Management Specialist. Consultants, with appropriate and recognized experience, will be used to develop the plan. The plan will be implemented by the proposed AAFB Wildlife Management Specialist, conservation officers, and other management stakeholders. Control and monitoring techniques will be clearly defined in the ungulate control plan.
Section 7 informal	AAFB	Anti-Terrorism, Force Protection Perimeter Fence, Andersen Air Force Base	11-May-10	x			x	x	x																											All construction work will begin just after dawn and will end prior to dusk, between the hours of 7:00 am and 5:00pm. No activities will occur at night.
Section 7 informal	AAFB	Anti-Terrorism, Force Protection Perimeter Fence, Andersen Air Force Base	11-May-10	x			x	x	x																											Construction of the fence and access road construction is limited to Route 3A and the adjacent utility corridor. No new staging areas or access roads will be constructed.

Requirement	Location	Title	Project BO/BA/BE Date	Mariana fruit bat	Mariana swiftlet	Mariana common moorhen	Mariana crow	Micronesian kingfisher	Guam rail	Micronesian Megapode	Nightingale Reed-warbler	Serianthes nelsonii	Green sea turtle	Hawksbill sea turtle	Scalloped hammerhead	ESA Corals	EFH	Eugenia bryanii	Hedyotis megalantha	Heritiera longipetiolata	Phyllanthus saffordii	Psychotria malaspinae	Solanum guamense	Tinaspora homosepala	Bulbophyllum guamense	Cycas micronesica	Dendrobium guamense	Maesa walkeri	Nervilia jacksoniae	Tabernaemontana rotensis	Tuberolabium guamense	Mariana eight-spot butterfly	Guam tree snail	Humped tree snail	Fragile tree snail	Conservation Measure (One Per Row)
Section 7 informal	AAFB	Anti-Terrorism, Force Protection Perimeter Fence, Andersen Air Force Base	11-May-10	x			x	x	x																										One week prior to clearing, the proposed project site and adjacent areas will be surveyed (by a biologist approved by the Service and the Guam Division of Aquatic and Wildlife Resources). If crows are nesting within 300 meters of the project site, construction/clearing activities within 300 meters of the nest will be postponed until the breeding attempt is completed, resulting in either successful fledging or nest failure.
Section 7 informal	AAFB	Anti-Terrorism, Force Protection Perimeter Fence, Andersen Air Force Base	11-May-10	x			x	x	x																										One week prior to clearing, the Air Force will have a biologist (approved by the Service and Guam Division of Aquatic and Wildlife Resources) survey areas within 150 meters of the proposed project site to determine if Mariana fruit bats are in the area. If Mariana fruit bats are observed within 150 meters of the project site, construction within 150 meters of the animal will be delayed until the bat(s) have left the area.
Section 7 informal	AAFB	Anti-Terrorism, Force Protection Perimeter Fence, Andersen Air Force Base	11-May-10	x			x	x	x																										The presence of the bat or crow will be reported to the Service and the Guam Division of Aquatic and Wildlife Resources immediately, but the location of the bat or crow will not be revealed to any other outside party.
Section 7 informal	AAFB	Anti-Terrorism, Force Protection Perimeter Fence, Andersen Air Force Base	11-May-10	x			x	x	x																										Where feasible, native vegetation species used by bats, crows, rails and kingfishers will be planted. Species include ahgao, fadang, yoga, faniok, fagot and umumu.
Section 7 informal	AAFB	Anti-Terrorism, Force Protection Perimeter Fence, Andersen Air Force Base	11-May-10	x			x	x	x																										No chemicals will be used on site.
Section 7 informal	AAFB	Anti-Terrorism, Force Protection Perimeter Fence, Andersen Air Force Base	11-May-10	x			x	x	x																										A litter-control program will be implemented during construction. All trash will be bagged and disposed of offsite at the end of each day.
Section 7 informal	AAFB	Anti-Terrorism, Force Protection Perimeter Fence, Andersen Air Force Base	11-May-10	x			x	x	x																										All tools, gear, and construction scrap will be removed upon completion of work in order to prevent the attraction of non-native pests (i.e., rats).
Section 7 informal	AAFB	Anti-Terrorism, Force Protection Perimeter Fence, Andersen Air Force Base	11-May-10	x			x	x	x																										All onsite personnel will receive instruction to immediately kill any brown treesnakes (*Boiga irregularis*) found on the property.
Section 7 informal	AAFB	Anti-Terrorism, Force Protection Perimeter Fence, Andersen Air Force Base	11-May-10	x			x	x	x																										Adjacent habitat, that is not to be impacted, will be temporarily delineated by orange construction fencing to keep personnel and equipment from damaging the habitat. Signs will be posted indicating that no one is allowed past that boundary. All signs and temporary fencing will be removed from the site after completion of the project.
Section 7 informal	AAFB	Anti-Terrorism, Force Protection Perimeter Fence, Andersen Air Force Base	11-May-10	x			x	x	x																										All project staff will be trained by a qualified biologist regarding the presence of listed species and the importance of avoiding impacts to these species and their habitat, habitat sensitivity, and required practices before the start of construction.
Section 7 informal	NBG	Maintenance Dredging of Delta, Echo, Victor, and X-Ray Wharves	10-Mar-11										x	x																					A contingency plan to control petroleum products accidentally spilled during the project has been developed. Appropriate materials to contain and clean potential spills will be stored and readily available at the work site.
Section 7 informal	NBG	Maintenance Dredging of Delta, Echo, Victor, and X-Ray Wharves	10-Mar-11										x	x																					A contingency plan will be in place for the removal and adequate securing of equipment in the event of approaching storms.
Section 7 informal	NBG	Maintenance Dredging of Delta, Echo, Victor, and X-Ray Wharves	10-Mar-11										x	x																					A plan will be developed and implemented to prevent construction debris from entering or remaining in the marine environment during the project.
Section 7 informal	NBG	Maintenance Dredging of Delta, Echo, Victor, and X-Ray Wharves	10-Mar-11										x	x																					All project-related materials and equipment placed in the water will be free of pollutants. The project manager and the heavy equipment operator will perform daily pre-work equipment inspections for cleanliness and leaks. All heavy equipment operations will be postponed or halted should a leak be detected, and will not proceed until the leak is repaired and equipment cleaned.
Section 7 informal	NBG	Maintenance Dredging of Delta, Echo, Victor, and X-Ray Wharves	10-Mar-11										x	x																					All work will cease if sea turtles enter within 50 yards of the work area.
Section 7 informal	NBG	Maintenance Dredging of Delta, Echo, Victor, and X-Ray Wharves	10-Mar-11										x	x																					Competent observers will be designated to visually survey the marine areas adjacent to the proposed action for protected species.

Requirement	Location	Title	Project BO/BA/BE Date	Mariana fruit bat	Mariana swiftlet	Mariana common moorhen	Mariana crow	Micronesian kingfisher	Guam rail	Micronesian Megapode	Nightingale Reed-warbler	Serianthes nelsonii	Green sea turtle	Hawksbill sea turtle	Scalloped hammerhead	ESA Corals	EFH	Eugenia bryanii	Hedyotis megalantha	Heritiera longipetiolata	Phyllanthus saffordii	Psychotria malaspinae	Solanum guamense	Tinaspora homosepala	Bulbophyllum guamense	Cycas micronesica	Dendrobium guamense	Maesa walkeri	Nervilia jacksoniae	Tabernaemontana rotensis	Tuberolabium guamense	Mariana eight-spot butterfly	Guam tree snail	Humped tree snail	Fragile tree snail	Conservation Measure (One Per Row)
Section 7 informal	NBG	Maintenance Dredging of Delta, Echo, Victor, and X-Ray Wharves	10-Mar-11										x	x																						Dredging will commence using a ramp-up technique at the start of each work day or following a break of more than 30 minutes. Dredging will commence with slow and deliberate deployment of the bucket to the bottom for the first several cycles to alert protected species and allow them an opportunity to vacate the area prior to full-intensity operations.
Section 7 informal	NBG	Maintenance Dredging of Delta, Echo, Victor, and X-Ray Wharves	10-Mar-11										x	x																						If a vessel is approached by a marine mammal or turtle, the engine will be put in neutral and the animal allowed to pass.
Section 7 informal	NBG	Maintenance Dredging of Delta, Echo, Victor, and X-Ray Wharves	10-Mar-11										x	x																						Marine mammals and sea turtles will not be encircled or trapped between multiple vessels or between vessels and the shore.
Section 7 informal	NBG	Maintenance Dredging of Delta, Echo, Victor, and X-Ray Wharves	10-Mar-11										x	x																						No dredging will be conducted after dark unless that work has proceeded uninterrupted since at least 1 hour prior to sunset, and no protected species have been observed near the 50-yard safety range for that work.
Section 7 informal	NBG	Maintenance Dredging of Delta, Echo, Victor, and X-Ray Wharves	10-Mar-11										x	x																						No marine mammals or sea turtles may be within 50 yards of dredging operations. All dredging will be postponed or halted until the animals have voluntarily moved beyond 50 yards.
Section 7 informal	NBG	Maintenance Dredging of Delta, Echo, Victor, and X-Ray Wharves	10-Mar-11										x	x																						No one on site or associated with this project will attempt to feed, touch, ride, or otherwise intentionally interact with any protected species.
Section 7 informal	NBG	Maintenance Dredging of Delta, Echo, Victor, and X-Ray Wharves	10-Mar-11										x	x																						Observers will remain continuously alert for protected species starting 60 minutes prior to commencement of dredging through 30 minutes after shut-down. Resumption of work following a break of 30 minutes or more requires a 60 minute pre-work area visual search.
Section 7 informal	NBG	Maintenance Dredging of Delta, Echo, Victor, and X-Ray Wharves	10-Mar-11										x	x																						Reduce vessel speed to 5 knots or less when piloting vessels in the proximity of sea turtles. If practicable, reduce vessel speed to 5 knots or less when piloting vessels in areas of known or suspected turtle activity.
Section 7 informal	NBG	Maintenance Dredging of Delta, Echo, Victor, and X-Ray Wharves	10-Mar-11										x	x																						Should a sheen be observed on the water surface, Absorbent pads will be used to remove the petroleum product prior to removing the silt containment structures.
Section 7 informal	NBG	Maintenance Dredging of Delta, Echo, Victor, and X-Ray Wharves	10-Mar-11										x	x																						Turbidity and siltation from project-related work will be minimized and contained through the appropriate use of effective silt containment devices and the curtailment of work during adverse tidal and weather conditions. Silt curtains will completely enclose dredging operations.
Section 7 informal	NBG	Maintenance Dredging of Delta, Echo, Victor, and X-Ray Wharves	10-Mar-11										x	x																						When piloting vessels, vessel operators shall alter course to remain at least 100 yards from whales, and at least 50 yards from other marine mammals and sea turtles.
Section 7 informal	NBG	Maintenance Dredging of Delta, Echo, Victor, and X-Ray Wharves	10-Mar-11										x	x																						Whenever possible fueling of project-related vehicles and equipment will take place at least 50 feet away from the water.
Section 7 informal	NBG	Maintenance Dredging of Delta, Echo, Victor, and X-Ray Wharves	10-Mar-11										x	x																						With the exception of dredging, all in-water work will be postponed or halted when protected species are within 50 feet of the proposed work, and will only begin/resume after the animals have voluntarily departed the area.
Section 7 informal	AAFB	Detonation of Two Unexploded Ordinances at Andersen Air Force Base	5/15/2011									x																								The existing ungulate exclosure fence around the last remaining mature *Serianthes nelsonii* on Guam will be reconstructed and regularly maintained. Half ofthe materials have been ordered.
Section 7 informal	AAFB	Detonation of Two Unexploded Ordinances at Andersen Air Force Base	5/15/2011									x																								The site will be monitored monthly for new saplings, non-native plant removal and fence maintenance. Data will be collected on seedling survival, insect damage, seed collection.
Section 7 informal	AAFB	Detonation of Two Unexploded Ordinances at Andersen Air Force Base	5/15/2011									x																								Any surviving saplings will be enclosed in protective, insect netting.
Section 7 informal	AAFB	Detonation of Two Unexploded Ordinances at Andersen Air Force Base	5/15/2011									x																								AAFB will continue to work with the Guam Plant Extinction Program to monitor the tree and seedlings.
Section 7 informal	AAFB	Detonation of Two Unexploded Ordinances at Andersen Air Force Base	5/15/2011									x																								AAFB will continue to coordinate with GNWR and the University of Guam to monitor and protect the Tarague saplings. University of Guam currently has a research permit.
Section 7 informal	AAFB	Detonation of Two Unexploded Ordinances at Andersen Air Force Base	5/15/2011									x																								AAFB will monitor the vegetation at the blast sites a minimum oftwice a year and remove all invasive species to encourage native limestone forest regeneration. Recovery will be documented and shared with the Service upon request.

Requirement	Location	Title	Project BO/BA/BE Date	Mariana fruit bat	Mariana swiftlet	Mariana common moorhen	Mariana crow	Micronesian kingfisher	Guam rail	Micronesian Megapode	Nightingale Reed-warbler	Serianthes nelsonii	Green sea turtle	Hawksbill sea turtle	Scalloped hammerhead	ESA Corals	EFH	Eugenia bryanii	Hedyotis megalantha	Heritiera longipetiolata	Phyllanthus saffordii	Psychotria malaspinae	Solanum guamense	Tinaspora homosepala	Bulbophyllum guamense	Cycas micronesica	Dendrobium guamense	Maesa walkeri	Nervilia jacksoniae	Tabernaemontana rotensis	Tuberolabium guamense	Mariana eight-spot butterfly	Guam tree snail	Humped tree snail	Fragile tree snail	Conservation Measure (One Per Row)
EFH	NBG	Maintenance Dredging of Romeo, Sierra, Tango, and Uniform Wharves	10-Jun-11														x																		A contingency plan to control petroleum products accidentally spilled during the project has been developed. Appropriate materials to contain and clean potential spills will be stored and readily available at the work site.
EFH	NBG	Maintenance Dredging of Romeo, Sierra, Tango, and Uniform Wharves	10-Jun-11														x																		A contingency plan will be in place for the removal and adequate securing of equipment in the event of approaching storms.
EFH	NBG	Maintenance Dredging of Romeo, Sierra, Tango, and Uniform Wharves	10-Jun-11														x																		A plan will be developed and implemented to prevent construction debris from entering or remaining in the marine environment during the project.
EFH	NBG	Maintenance Dredging of Romeo, Sierra, Tango, and Uniform Wharves	10-Jun-11														x																		All project-related materials and equipment placed in the water will be free of pollutants. The project manager and the heavy equipment operator will perform daily pre-work equipment inspections for cleanliness and leaks. All heavy equipment operations will be postponed or halted should a leak be detected, and will not proceed until the leak is repaired and equipment cleaned.
EFH	NBG	Maintenance Dredging of Romeo, Sierra, Tango, and Uniform Wharves	10-Jun-11														x																		Dredging will commence using a ramp-up technique at the start of each work day or following a break of more than 30 minutes. Dredging will commence with slow and deliberate deployment of the bucket to the bottom for the first several cycles to alert protected and other species and allow them an opportunity to vacate the area prior to full-intensity operations.
EFH	NBG	Maintenance Dredging of Romeo, Sierra, Tango, and Uniform Wharves	10-Jun-11														x																		No in-water work will be conducted during the peak coral spawning period. (This period covers July 15 through August 5 for hard corals during the 2011 calendar year, NMFS PIRO HCD Guam Field Office will be consulted for spawning dates beyond 2011 if needed.)
EFH	NBG	Maintenance Dredging of Romeo, Sierra, Tango, and Uniform Wharves	10-Jun-11														x																		Should a sheen be observed on the water surface, Absorbent pads will be used to remove the petroleum product prior to removing the silt containment structures.
EFH	NBG	Maintenance Dredging of Romeo, Sierra, Tango, and Uniform Wharves	10-Jun-11														x																		Turbidity and siltation from project-related work will be minimized and contained through the appropriate use of effective silt containment devices and the curtailment of work during adverse tidal and weather conditions. Silt curtains will completely enclose dredging operations.
EFH	NBG	Maintenance Dredging of Romeo, Sierra, Tango, and Uniform Wharves	10-Jun-11														x																		Whenever possible fueling of project-related vehicles and equipment will take place at least 50 feet away from the water.
Section 7 informal	NBG	Maintenance Dredging of Romeo, Sierra, Tango, and Uniform Wharves	30-Jun-11										x	x																					A contingency plan to control petroleum products accidentally spilled during the project has been developed. Appropriate materials to contain and clean potential spills will be stored and readily available at the work site.
Section 7 informal	NBG	Maintenance Dredging of Romeo, Sierra, Tango, and uniform Wharves	30-Jun-11										x	x																					A contingency plan will be in place for the removal and adequate securing of equipment in the event of approaching storms.
Section 7 informal	NBG	Maintenance Dredging of Romeo, Sierra, Tango, and Uniform Wharves	30-Jun-11										x	x																					A plan will be developed and implemented to prevent construction debris from entering or remaining in the marine environment during the project.
Section 7 informal	NBG	Maintenance Dredging of Romeo, Sierra, Tango, and Uniform Wharves	30-Jun-11										x	x																					All project-related materials and equipment placed in the water will be free of pollutants. The project manager and the heavy equipment operator will perform daily pre-work equipment inspections for cleanliness and leaks. All heavy equipment operations will be postponed or halted should a leak be detected, and will not proceed until the leak is repaired and equipment cleaned.
Section 7 informal	NBG	Maintenance Dredging of Romeo, Sierra, Tango, and Uniform Wharves	30-Jun-11										x	x																					All work will cease if sea turtles enter within 50 yards of the work area.
Section 7 informal	NBG	Maintenance Dredging of Romeo, Sierra, Tango, and Uniform Wharves	30-Jun-11										x	x																					Competent observers will be designated to visually survey the marine areas adjacent to the proposed action for protected species.
Section 7 informal	NBG	Maintenance Dredging of Romeo, Sierra, Tango, and Uniform Wharves	30-Jun-11										x	x																					Dredging will commence using a ramp-up technique at the start of each work day or following a break of more than 30 minutes. Dredging will commence with slow and deliberate deployment of the bucket to the bottom for the first several cycles to alert protected species and allow them an opportunity to vacate the area prior to full-intensity operations.
Section 7 informal	NBG	Maintenance Dredging of Romeo, Sierra, Tango, and Uniform Wharves	30-Jun-11										x	x																					If a vessel is approached by a marine mammal or turtle, the engine will be put in neutral and the animal allowed to pass.

Requirement	Location	Title	Project BO/BA/BE Date	Mariana fruit bat	Mariana swiftlet	Mariana common moorhen	Mariana crow	Micronesian kingfisher	Guam rail	Micronesian Megapode	Nightingale Reed-warbler	Serianthes nelsonii	Green sea turtle	Hawksbill sea turtle	Scalloped hammerhead	ESA Corals	EFH	Eugenia bryanii	Hedyotis megalantha	Heritiera longipetiolata	Phyllanthus saffordii	Psychotria malaspinae	Solanum guamense	Tinaspora homosepala	Bulbophyllum guamense	Cycas micronesica	Dendrobium guamense	Maesa walkeri	Nervilia jacksoniae	Tabernaemontana rotensis	Tuberolabium guamense	Mariana eight-spot butterfly	Guam tree snail	Humped tree snail	Fragile tree snail	Conservation Measure (One Per Row)
Section 7 informal	NBG	Maintenance Dredging of Romeo, Sierra, Tango, and Uniform Wharves	30-Jun-11										x	x																						Marine mammals and sea turtles will not be encircled or trapped between multiple vessels or between vessels and the shore.
Section 7 informal	NBG	Maintenance Dredging of Romeo, Sierra, Tango, and Uniform Wharves	30-Jun-11										x	x																						No dredging will be conducted after dark unless that work has proceeded uninterrupted since at least 1 hour prior to sunset, and no protected species have been observed near the 50-yard safety range for that work.
Section 7 informal	NBG	Maintenance Dredging of Romeo, Sierra, Tango, and Uniform Wharves	30-Jun-11										x	x																						No marine mammals or sea turtles may be within 50 yards of dredging operations. All dredging will be postponed or halted until the animals have voluntarily moved beyond 50 yards.
Section 7 informal	NBG	Maintenance Dredging of Romeo, Sierra, Tango, and Uniform Wharves	30-Jun-11										x	x																						No one on site or associated with this project will attempt to feed, touch, ride, or otherwise intentionally interact with any protected species.
Section 7 informal	NBG	Maintenance Dredging of Romeo, Sierra, Tango, and Uniform Wharves	30-Jun-11										x	x																						Observers will remain continuously alert for protected species starting 60 minutes prior to commencement of dredging through 30 minutes after shut-down. Resumption of work following a break of 30 minutes or more requires a 60 minute pre-work area visual search.
Section 7 informal	NBG	Maintenance Dredging of Romeo, Sierra, Tango, and Uniform Wharves	30-Jun-11										x	x																						Reduce vessel speed to 5 knots or less when piloting vessels in the proximity of sea turtles. If practicable, reduce vessel speed to 5 knots or less when piloting vessels in areas of known or suspected turtle activity.
Section 7 informal	NBG	Maintenance Dredging of Romeo, Sierra, Tango, and Uniform Wharves	30-Jun-11										x	x																						Should a sheen be observed on the water surface, absorbent pads will be used to remove the petroleum product prior to removing the silt containment structures.
Section 7 informal	NBG	Maintenance Dredging of Romeo, Sierra, Tango, and Uniform Wharves	30-Jun-11										x	x																						Turbidity and siltation from project-related work will be minimized and contained through the appropriate use of effective silt containment devices and the curtailment of work during adverse tidal and weather conditions. Silt curtains will completely enclose dredging operations.
Section 7 informal	NBG	Maintenance Dredging of Romeo, Sierra, Tango, and Uniform Wharves	30-Jun-11										x	x																						When piloting vessels, vessel operators shall alter course to remain at least 100 yards from whales, and at least 50 yards from other marine mammals and sea turtles.
Section 7 informal	NBG	Maintenance Dredging of Romeo, Sierra, Tango, and Uniform Wharves	30-Jun-11										x	x																						Whenever possible fueling of project-related vehicles and equipment will take place at least 50 feet away from the water.
Section 7 informal	NBG	Maintenance Dredging of Romeo, Sierra, Tango, and Uniform Wharves	30-Jun-11										x	x																						With the exception of dredging, all in-water work will be postponed or halted when protected species are within 50 feet of the proposed work, and will only begin/resume after the animals have voluntarily departed the area.
Section 7 formal	NBG	Sumay Cove Repair and Modernization	11-Aug-11										x	x																						A contingency plan will be in place for the removal and adequate securing of equipment in the event of approaching storms.
Section 7 formal	NBG	Sumay Cove Repair and Modernization	11-Aug-11										x	x																						A plan will be developed and implemented to prevent construction debris from entering or remaining in the marine environment during the project.
Section 7 formal	NBG	Sumay Cove Repair and Modernization	11-Aug-11										x	x																						All construction project-related materials and equipment placed in the water will be free of pollutants. The project manager and heavy equipment operators will perform daily pre-work equipment inspections for cleanliness and leaks. All heavy equipment operations will be postponed or halted should a leak be detected, and will not proceed until the leak is repaired and equipment cleaned. This information is written into the construction contract conditions.
Section 7 formal	NBG	Sumay Cove Repair and Modernization	11-Aug-11										x	x																						Biological observations will be made using binoculars during daylight hours. If pile-driving commences during daylight hours, pile driving may continue into nighttime hours provided there has been no interruption in activity (NMFS, 2007).
Section 7 formal	NBG	Sumay Cove Repair and Modernization	11-Aug-11										x	x																						Contractors are required to have and to implement a contingency plan to control and contain toxic spills, including petroleum products. Appropriate materials to contain and clean potential spills will be maintained and readily available at the work site.
Section 7 formal	NBG	Sumay Cove Repair and Modernization	11-Aug-11										x	x																						Contractors will be informed of ESA laws: no attempt should be made to feed, touch, ride or otherwise intentionally interact with any ESA-listed sea turtles.

Requirement	Location	Title	Project BO/BA/BE Date	Mariana fruit bat	Mariana swiftlet	Mariana common moorhen	Mariana crow	Micronesian kingfisher	Guam rail	Micronesian Megapode	Nightingale Reed-warbler	Serianthes nelsonii	Green sea turtle	Hawksbill sea turtle	Scalloped hammerhead	ESA Corals	EFH	Eugenia bryanii	Hedyotis megalantha	Heritiera longipetiolata	Phyllanthus saffordii	Psychotria malaspinae	Solanum guamense	Tinaspora homosepala	Bulbophyllum guamense	Cycas micronesica	Dendrobium guamense	Maesa walkeri	Nervilia jacksoniae	Tabernaemontana rotensis	Tuberolabium guamense	Mariana eight-spot butterfly	Guam tree snail	Humped tree snail	Fragile tree snail	Conservation Measure (One Per Row)
Section 7 formal	NBG	Sumay Cove Repair and Modernization	11-Aug-11										x	x																					Fueling of construction project-related vehicles and equipment will take place at least 50 feet away from the water, preferably over an impervious surface. With respect to construction equipment (barges), that cannot be fueled out of the water spill prevention booms will be employed to contain any potential spills. Any fuel spilled will be cleaned up immediately.
Section 7 formal	NBG	Sumay Cove Repair and Modernization	11-Aug-11										x	x																					If a sea turtle or other listed species is found injured within the vicinity of the action area, all in water piling driving construction activities shall cease immediately, regardless of their effect to the noted. The contractor will report to the Navy all incidents of known or possible project-related turtle injuries and any incidents of obvious behavioral disturbance. The Navy will continue to report any turtle stranding events to Shaun Wusstig, Guam Department of Agriculture Division of Aquatics and Wildlife Resources, coordinate on the identification of species, possible cause of physical harm, and disposition of remains if needed.
Section 7 formal	NBG	Sumay Cove Repair and Modernization	11-Aug-11										x	x																					If approached by a sea turtle within Apra Harbor, construction related vessel operators will put the engine in neutral and allow the animal to pass.
Section 7 formal	NBG	Sumay Cove Repair and Modernization	11-Aug-11										x	x																					No pile driving will be conducted after dark unless that work has proceeded uninterrupted since at least one hours prior to sunset, and no protected species have been observed near the perspective safety range for that work.
Section 7 formal	NBG	Sumay Cove Repair and Modernization	11-Aug-11										x	x																					Pile driving observers shall remain continuously alert for protected species starting 30 minutes prior to the commencement of work through 30 minutes after shut-down. This includes any break in operations expected to last an hour or less. Resumption of work following a break of an hour or more requires a 60 minute pre-work area search.
Section 7 formal	NBG	Sumay Cove Repair and Modernization	11-Aug-11										x	x																					Pile driving will commence work using soft-start or ramp-up techniques at the start of each work day or following a break of more than 30 minutes. Pile driving will employ a slow increase in hammering to alert species and allow them an opportunity to vacate the area prior to full-intensity operations.
Section 7 formal	NBG	Sumay Cove Repair and Modernization	11-Aug-11										x	x																					Preliminary shutdown safety zones corresponding to where sea turtles could be injured or harassed would be established at 50 yards from the construction work.
Section 7 formal	NBG	Sumay Cove Repair and Modernization	11-Aug-11										x	x																					Prior to the start of pile driving activity, the safety zone will be monitored for 60 minutes to ensure it is clear of sea turtles. Pile driving will not commence until the observers have declared the safety zone clear of sea turtles. If a sea turtle is found within the safety zone, pile driving of the segment will be delayed until either the animals have been visually confirmed beyond the impact zone or 30 minutes have passed without re-detection of the animal.
Section 7 formal	NBG	Sumay Cove Repair and Modernization	11-Aug-11										x	x																					Sea turtles should not be encircled or trapped between multiple vessels or between vessels and the shore.
Section 7 formal	NBG	Sumay Cove Repair and Modernization	11-Aug-11										x	x																					Should a sheen be observed on the water surface, Absorbent pads will be used to remove the petroleum product prior to removing the silt containment structures.
Section 7 formal	NBG	Sumay Cove Repair and Modernization	11-Aug-11										x	x																					SPLs will be monitored/recorded on the first day of pile driving activity to ensure that turtles are not present within the 50 yard safety zone. The contractor will record all turtle sightings that occur during the proposed project. Information collected will include: species, gender, relative size, and any recognizable individual characteristics if possible to discern; time, location and approximated distance from the observer to the turtle; turtle behavior; any impact the sighting had on work activities such as delays, shutdowns, and whether the turtle was at a sufficient distance that work continued. A report of all observations will be delivered to the Navy and to NOAA in a post-construction report within six weeks of project completion.

Requirement	Location	Title	Project BO/BA/BE Date	Mariana fruit bat	Mariana swiftlet	Mariana common moorhen	Mariana crow	Micronesian kingfisher	Guam rail	Micronesian Megapode	Nightingale Reed-warbler	Serianthes nelsonii	Green sea turtle	Hawksbill sea turtle	Scalloped hammerhead	ESA Corals	EFH	Eugenia bryanii	Hedyotis megalantha	Heritiera longipetiolata	Phyllanthus saffordii	Psychotria malaspinae	Solanum guamense	Tinaspora homosepala	Bulbophyllum guamense	Cycas micronesica	Dendrobium guamense	Maesa walkeri	Nervilia jacksoniae	Tabernaemontana rotensis	Tuberolabium guamense	Mariana eight-spot butterfly	Guam tree snail	Humped tree snail	Fragile tree snail	Conservation Measure (One Per Row)
Section 7 formal	NBG	Sumay Cove Repair and Modernization	11-Aug-11										x	x																					The contractor will record all turtle sightings that occur during the proposed project. Information collected will include: species, gender, relative size, and any recognizable individual characteristics if possible to discern; time, location and approximated distance from the observer to the turtle; turtle behavior; any impact the sighting had on work activities such as delays, shutdowns, and whether the turtle was at a sufficient distance that work continued. A report of all observations will be delivered to the Navy and to NOAA in a post-construction report within six weeks of project completion.
Section 7 formal	NBG	Sumay Cove Repair and Modernization	11-Aug-11										x	x																					The project manager shall designate competent observers to survey the marine areas adjacent to the proposed action for ESA-listed sea turtle species. A minimum of two observers will be posted at each pile driving site. Multiple teams may be required if pile driving is occurring at multiple locations at the same time. Observers will be posted along the sea walls and will focus on the majority of their attention on the area within 50-yard range with periodic scans beyond 50 yards to maintain situational awareness. If a turtle is seen in the water, the mandatory shutdown zone set at 50 yards. App project personnel will be tasked with reporting sea turtles if they are observed in the area.
Section 7 formal	NBG	Sumay Cove Repair and Modernization	11-Aug-11										x	x																					Turbidity and siltation from project-related work will be minimized and contained through the appropriate use of effective silt containment devices and the curtailment of work during adverse tidal and weather conditions. Silt curtains will completely enclose the operations.
Section 7 formal	NBG	Sumay Cove Repair and Modernization	11-Aug-11										x	x																					When piloting construction related vessels within Apra Harbor, construction related vessel operators shall alter course to remain at least 50 yards from sea turtles.
Section 7 formal	NBG	Sumay Cove Repair and Modernization	11-Aug-11										x	x																					Within Apra Harbor, reduce construction related vessel speed to 10 knots of less when piloting vessels in the proximity of sea turtles. If practicable, reduce construction related vessel speed to 5 knots or less when piloting vessels in areas of known of suspected sea turtle activity.
EFH	NBG	Sumay Cove Repair and Modernization	23-Aug-11														x																		A contingency plan will be in place for the removal and adequate securing of equipment in the event of approaching storms.
EFH	NBG	Sumay Cove Repair and Modernization	23-Aug-11														x																		A plan will be developed and implemented to prevent construction debris from entering or remaining in the marine environment during the project.
EFH	NBG	Sumay Cove Repair and Modernization	23-Aug-11														x																		All construction project-related materials and equipment placed in the water will be free of pollutants. The project manager and heavy equipment operators will perform daily pre-work equipment inspections for cleanliness and leaks. All heavy equipment operations will be postponed or halted should a leak be detected, and will not proceed until the leak is repaired and equipment cleaned. This information is written into the construction contract conditions.
EFH	NBG	Sumay Cove Repair and Modernization	23-Aug-11														x																		Contractor will cease any activities that result in sediment/pollutant discharges during July 15, 2011, through August 5, 2011, the primary coral spawning events each year for scleractinian corals. NMFS PIRO HCD Guam Field Office will be consulted for information on spawning dates for 2012 and 2013, if necessary.
EFH	NBG	Sumay Cove Repair and Modernization	23-Aug-11														x																		Contractors are required to have and to implement a contingency plan to control and contain toxic spills, including petroleum products. Appropriate materials to contain and clean potential spills will be maintained and readily available at the work site.
EFH	NBG	Sumay Cove Repair and Modernization	23-Aug-11														x																		Fueling of construction project-related vehicles and equipment will take place at least 50 feet away from the water, preferably over an impervious surface. With respect to construction equipment (barges), that cannot be fueled out of the water spill prevention booms will be employed to contain any potential spills. Any fuel spilled will be cleaned up immediately.

Requirement	Location	Title	Project BO/BA/BE Date	Mariana fruit bat	Mariana swiftlet	Mariana common moorhen	Mariana crow	Micronesian kingfisher	Guam rail	Micronesian Megapode	Nightingale Reed-warbler	Serianthes nelsonii	Green sea turtle	Hawksbill sea turtle	Scalloped hammerhead	ESA Corals	EFH	Eugenia bryanii	Hedyotis megalantha	Heritiera longipetiolata	Phyllanthus saffordii	Psychotria malaspinae	Solanum guamense	Tinaspora homosepala	Bulbophyllum guamense	Cycas micronesica	Dendrobium guamense	Maesa walkeri	Nervilia jacksoniae	Tabernaemontana rotensis	Tuberolabium guamense	Mariana eight-spot butterfly	Guam tree snail	Humped tree snail	Fragile tree snail	Conservation Measure (One Per Row)
EFH	NBG	Sumay Cove Repair and Modernization	23-Aug-11														x																			Pile driving will commence work using soft-start or ramp-up techniques at the start of each work day or following a break of more than 30 minutes. Pile driving will employ a slow increase in hammering to alert species and allow them an opportunity to vacate the area prior to full-intensity operations.
EFH	NBG	Sumay Cove Repair and Modernization	23-Aug-11														x																			Should a sheen be observed on the water surface, absorbent pads will be used to remove the petroleum product prior to removing the silt containment structures.
EFH	NBG	Sumay Cove Repair and Modernization	23-Aug-11														x																			Turbidity and siltation from project-related work will be minimized and contained through the appropriate use of effective silt containment devices and the curtailment of work during adverse tidal and weather conditions. Silt curtains will completely enclose the operations.
Section 7 informal	NBG	Increased Brown Treesnake Control at Mahlac Cave on Naval Base Guam, Munitions Site, Guam	7-Nov-11		x																														Efforts will be made to conduct activities outside the cave entrances as appropriate (i.e. preparation of equipment).
Section 7 informal	NBG	Increased Brown Treesnake Control at Mahlac Cave on Naval Base Guam, Munitions Site, Guam	7-Nov-11		x																														No smoking will occur at the project site.
Section 7 informal	NBG	Increased Brown Treesnake Control at Mahlac Cave on Naval Base Guam, Munitions Site, Guam	7-Nov-11		x																														The number of people inside the cave during installation and maintenance of BTS control devices will be limited to one. The number of people inside the cave during visual searches will be limited to two.
Section 7 informal	NBG	Increased Brown Treesnake Control at Mahlac Cave on Naval Base Guam, Munitions Site, Guam	7-Nov-11		x																														Upon arrival at the caves, personnel will sit quietly outside the cave for five minutes to minimize disturbance created during approach.
Section 7 informal	NBG	Increased Brown Treesnake Control at Mahlac Cave on Naval Base Guam, Munitions Site, Guam	7-Nov-11		x																														While inside the cave personnel will minimize movement and move cautiously.
Section 7 informal	AAFB	Electrical Upgrades at Tarague Beach, Andersen Air Force Base, Guam	17-Nov-11	x			x	x	x			x	x	x																					Each morning during the construction period, a qualified biologist will survey for bats within 150 meters (492 feet) of the site. If a bat is observed in the area, construction will not begin until the individual leaves the area of its own volition. This conservation measure is intended to reduce potential noise impacts to solitary roosting bats.
Section 7 informal	AAFB	Electrical Upgrades at Tarague Beach, Andersen Air Force Base, Guam	17-Nov-11	x			x	x	x			x	x	x																					All construction work will begin after sunrise, conclude prior to sunset, and occur between the hours of 0700 and 1730. No activities will occur at night.
Section 7 informal	AAFB	Electrical Upgrades at Tarague Beach, Andersen Air Force Base, Guam	17-Nov-11	x			x	x	x			x	x	x																					Adjacent habitat that is not to be impacted will be temporarily delineated by orange construction fencing or flagging tape to keep personnel and equipment from damaging the habitat. Signs will be posted indicating that no one is allowed past the boundary. All signs and temporary fencing will be removed from the site after project completion.
Section 7 informal	AAFB	Electrical Upgrades at Tarague Beach, Andersen Air Force Base, Guam	17-Nov-11	x			x	x	x			x	x	x																					No staging areas or access roads will be constructed. All vehicle parking will be restricted to previously determined areas or existing roads. No vehicles will be operated or allowed on the beach.
Section 7 informal	AAFB	Electrical Upgrades at Tarague Beach, Andersen Air Force Base, Guam	17-Nov-11	x			x	x	x			x	x	x																					No contamination (trash or debtis disposal. alien species introductions, etc.) of adjacent terrestrial environment will result from project-related activities.
Section 7 informal	AAFB	Electrical Upgrades at Tarague Beach, Andersen Air Force Base, Guam	17-Nov-11	x			x	x	x			x	x	x																					A litter control program will be implemented during construction. All trash will be bagged and disposed of offsite at the end of each day.
Section 7 informal	AAFB	Electrical Upgrades at Tarague Beach, Andersen Air Force Base, Guam	17-Nov-11	x			x	x	x			x	x	x																					All tools, gear, and construction scrap generated from this project will be removed upon completion of work to prevent the attraction of invasive pests.
Section 7 informal	AAFB	Electrical Upgrades at Tarague Beach, Andersen Air Force Base, Guam	17-Nov-11	x			x	x	x			x	x	x																					The applicant will develop and implement an Environmental Protection Plan addressing erosion control and measures to avoid contamination of adjacent aquatic habitats. The Service will be provided a copy of this plan once it is complete.
Section 7 informal	AAFB	Electrical Upgrades at Tarague Beach, Andersen Air Force Base, Guam	17-Nov-11	x			x	x	x			x	x	x																					One week prior to and again immediately before construction, trained personnel from either AAFB or DAWR will conduct a thorough survey of the beach for the presence of sea turtles or nesting activity within 100 meters (492 feet) of the project site. If a recent nest is identified, construction will be delayed until the hatchlings have vacated the nest.
EFH	NBG	Victor Wharf and Sierra Wharf Repairs	28-Nov-11														x																			A plan will be developed and implemented to prevent construction debris from entering or remaining in the marine environment during the project.

Requirement	Location	Title	Project BO/BA/BE Date	Mariana fruit bat	Mariana swiftlet	Mariana common moorhen	Mariana crow	Micronesian kingfisher	Guam rail	Micronesian Megapode	Nightingale Reed-warbler	Serianthes nelsonii	Green sea turtle	Hawksbill sea turtle	Scalloped hammerhead	ESA Corals	EFH	Eugenia bryanii	Hedyotis megalantha	Heritiera longipetiolata	Phyllanthus saffordii	Psychotria malaspinae	Solanum guamense	Tinaspora homosepala	Bulbophyllum guamense	Cycas micronesica	Dendrobium guamense	Maesa walkeri	Nervilia jacksoniae	Tabernaemontana rotensis	Tuberolabium guamense	Mariana eight-spot butterfly	Guam tree snail	Humped tree snail	Fragile tree snail	Conservation Measure (One Per Row)
Section 7 informal	NBG	Victor Wharf and Sierra Wharf Repairs	28-Nov-11										x	x																						A plan will be developed and implemented to prevent construction debris from entering or remaining in the marine environment during the project.
Section 7 informal	NBG	Victor Wharf and Sierra Wharf Repairs	28-Nov-11										x	x																						All in-water work will be postponed or halted when protected species are within 50 feet of the proposed work, and will only begin/resume after the animals have voluntarily departed the area.
Section 7 informal	NBG	Victor Wharf and Sierra Wharf Repairs	28-Nov-11										x	x																						All in-water work will cease if sea turtles enter within 50 yards of the work area.
Section 7 informal	NBG	Victor Wharf and Sierra Wharf Repairs	28-Nov-11										x	x																						All project-related materials and equipment placed in the water will be free of pollutants. The project manager will perform daily pre-work equipment inspections for cleanliness and leaks. All heavy equipment operations will be postponed or halted should a leak be detected, and will not proceed until the leak is repaired and equipment cleaned.
EFH	NBG	Victor Wharf and Sierra Wharf Repairs	28-Nov-11														x																			All project-related materials and equipment placed in the water will be free of pollutants. The project manager will perform daily pre-work equipment inspections for cleanliness and leaks. All heavy equipment operations will be postponed or halted should a leak be detected, and will not proceed until the leak is repaired and equipment cleaned.
EFH	NBG	Victor Wharf and Sierra Wharf Repairs	28-Nov-11														x																			Appropriate materials to contain and clean potential spills will be stored and readily available at the work site.
Section 7 informal	NBG	Victor Wharf and Sierra Wharf Repairs	28-Nov-11										x	x																						Appropriate materials to contain and clean potential spills will be stored and readily available at the work site.
Section 7 informal	NBG	Victor Wharf and Sierra Wharf Repairs	28-Nov-11										x	x																						Competent observers will be designated to visually survey the marine areas adjacent to the proposed action for protected species.
EFH	NBG	Victor Wharf and Sierra Wharf Repairs	28-Nov-11														x																			Containment/catchment devices will be used to prevent concrete chips and debris from dispersing into the water during repair work on the wharves.
Section 7 informal	NBG	Victor Wharf and Sierra Wharf Repairs	28-Nov-11										x	x																						No in-water work will be conducted after dark unless that work has proceeded uninterrupted since at least 1 hour prior to sunset, and no protected species have been observed near the 50-yard safety range for that work.
Section 7 informal	NBG	Victor Wharf and Sierra Wharf Repairs	28-Nov-11										x	x																						No marine mammals or sea turtles may be within 50 yards of dredging operations. All in-water activities will be postponed or halted until the animals have voluntarily moved beyond 50 yards.
Section 7 informal	NBG	Victor Wharf and Sierra Wharf Repairs	28-Nov-11										x	x																						No one on site or associated with this project will attempt to feed, touch, ride, or otherwise intentionally interact with any protected species.
EFH	NBG	Victor Wharf and Sierra Wharf Repairs	28-Nov-11														x																			Should a sheen be observed on the water surface, absorbent pads will be used to remove the petroleum product prior to removing the silt containment structures.
Section 7 informal	NBG	Victor Wharf and Sierra Wharf Repairs	28-Nov-11										x	x																						Should a sheen be observed on the water surface, absorbent pads will be used to remove the petroleum product prior to removing the silt containment structures.
EFH	NBG	Victor Wharf and Sierra Wharf Repairs	28-Nov-11														x																			Whenever possible fueling of project-related vehicles and equipment will take place at least 50 feet away from the water.
Section 7 informal	NBG	Victor Wharf and Sierra Wharf Repairs	28-Nov-11										x	x																						Whenever possible fueling of project-related vehicles and equipment will take place at least 50 feet away from the water.
Section 7 informal	NBG	Erosion Repairs Along San Luis, Naval Base Guam	10-Apr-12										x	x																						A contingency plan to control petroleum products accidentally spilled during the project has been developed. Appropriate materials to contain and clean potential spills will be stored and readily available at the work site.
Section 7 informal	NBG	Erosion Repairs Along San Luis, Naval Base Guam	10-Apr-12										x	x																						A contingency plan will be in place for the removal and adequate securing of equipment in the event of approaching storms.
Section 7 informal	NBG	Erosion Repairs Along San Luis, Naval Base Guam	10-Apr-12										x	x																						A plan will be developed and implemented to prevent construction debris from entering or remaining in the marine environment during the project.
Section 7 informal	NBG	Erosion Repairs Along San Luis, Naval Base Guam	10-Apr-12										x	x																						All in-water work will be postponed or halted when protected species are within 50 yards of the proposed work, and will only begin/resume after the animals have voluntarily departed the area.

Requirement	Location	Title	Project BO/BA/BE Date	Mariana fruit bat	Mariana swiftlet	Mariana common moorhen	Mariana crow	Micronesian kingfisher	Guam rail	Micronesian Megapode	Nightingale Reed-warbler	Serianthes nelsonii	Green sea turtle	Hawksbill sea turtle	Scalloped hammerhead	ESA Corals	EFH	Eugenia bryanii	Hedyotis megalantha	Heritiera longipetiolata	Phyllanthus saffordii	Psychotria malaspinae	Solanum guamense	Tinaspora homosepala	Bulbophyllum guamense	Cycas micronesica	Dendrobium guamense	Maesa walkeri	Nervilia jacksoniae	Tabernaemontana rotensis	Tuberolabium guamense	Mariana eight-spot butterfly	Guam tree snail	Humped tree snail	Fragile tree snail	Conservation Measure (One Per Row)
Section 7 informal	NBG	Erosion Repairs Along San Luis, Naval Base Guam	10-Apr-12										x	x																						All objects will be lowered to the bottom in a controlled manner with the use of equipment that effect positive control over the rate of decent.
Section 7 informal	NBG	Erosion Repairs Along San Luis, Naval Base Guam	10-Apr-12										x	x																						All project-related materials and equipment placed in the water will be free of pollutants. The project manager and the heavy equipment operator will perform daily pre-work equipment inspections for cleanliness and leaks. All heavy equipment operations will be postponed or halted should a leak be detected, and will not proceed until the leak is repaired and equipment cleaned.
Section 7 informal	NBG	Erosion Repairs Along San Luis, Naval Base Guam	10-Apr-12										x	x																						All work will cease if sea turtles enter within 50 yards of the work area.
Section 7 informal	NBG	Erosion Repairs Along San Luis, Naval Base Guam	10-Apr-12										x	x																						Competent observers will be designated to visually survey the marine areas adjacent to the proposed action for protected species.
Section 7 informal	NBG	Erosion Repairs Along San Luis, Naval Base Guam	10-Apr-12										x	x																						If a vessel is approached by a marine mammal or turtle, the engine will be put in neutral and the animal allowed to pass.
Section 7 informal	NBG	Erosion Repairs Along San Luis, Naval Base Guam	10-Apr-12										x	x																						Marine mammals and sea turtles will not be encircled or trapped between multiple vessels or between vessels and the shore.
Section 7 informal	NBG	Erosion Repairs Along San Luis, Naval Base Guam	10-Apr-12										x	x																						No in-water will be conducted after dark unless that work has proceeded uninterrupted since at least 1 hour prior to sunset, and no protected species have been observed near the 50-yard safety range for that work.
Section 7 informal	NBG	Erosion Repairs Along San Luis, Naval Base Guam	10-Apr-12										x	x																						No marine mammals or sea turtles may be within 50 yards of in-water operations. All in-water activities will be postponed or halted until the animals have voluntarily moved beyond 50 yards.
Section 7 informal	NBG	Erosion Repairs Along San Luis, Naval Base Guam	10-Apr-12										x	x																						No one on site or associated with this project will attempt to feed, touch, ride, or otherwise intentionally interact with any protected species.
Section 7 informal	NBG	Erosion Repairs Along San Luis, Naval Base Guam	10-Apr-12										x	x																						Reduce vessel speed to 5 knots or less when piloting vessels in the proximity of sea turtles. If practicable, reduce vessel speed to 5 knots or less when piloting vessels in areas of known or suspected turtle activity.
Section 7 informal	NBG	Erosion Repairs Along San Luis, Naval Base Guam	10-Apr-12										x	x																						Should a sheen be observed on the water surface, absorbent pads will be used to remove the petroleum product prior to removing the silt containment structures.
Section 7 informal	NBG	Erosion Repairs Along San Luis, Naval Base Guam	10-Apr-12										x	x																						Special attention will be given to verify that no sea turtles are in the area where equipment, anchors, or materials are expected to contact the substrate before that equipment may enter the water.
Section 7 informal	NBG	Erosion Repairs Along San Luis, Naval Base Guam	10-Apr-12										x	x																						Turbidity and siltation from project-related work will be minimized and contained through the appropriate use of effective silt containment devices and the curtailment of work during adverse tidal and weather conditions. Silt curtains will completely enclose in-water operations.
Section 7 informal	NBG	Erosion Repairs Along San Luis, Naval Base Guam	10-Apr-12										x	x																						When piloting vessels, vessel operators shall alter course to remain at least 100 yards from whales, and at least 50 yards from other marine mammals and sea turtles.
Section 7 informal	NBG	Erosion Repairs Along San Luis, Naval Base Guam	10-Apr-12										x	x																						Whenever possible fueling of project-related vehicles and equipment will take place at least 50 feet away from the water.
Section 7 informal	AAFB	Consultation Regarding the Proposed Short-Range Approach Lighting System for Runway 06L and Vegetation Clearing in the Runway Clear Zone, Andersen Air Force Base	15-May-12				x	x	x																											All construction work will begin after sunrise and will conclude prior to sunset (between 0700 and 1730 hours). No activities will occur at night.
Section 7 informal	AAFB	Consultation Regarding the Proposed Short-Range Approach Lighting System for Runway 06L and Vegetation Clearing in the Runway Clear Zone, Andersen Air Force Base	15-May-12				x	x	x																											Adjacent habitat that will not be impacted will be temporarily delineated by orange construction fencing or flagging tape to keep personnel and equipment from damaging the habitat. Signs will be posted indicating that no one is allowed past the boundary. All signs and temporary fencing will be removed from the site after project completion.
Section 7 informal	AAFB	Consultation Regarding the Proposed Short-Range Approach Lighting System for Runway 06L and Vegetation Clearing in the Runway Clear Zone, Andersen Air Force Base	15-May-12				x	x	x																											No staging areas or access roads will be constructed. Existing roads and disturbed areas will be used for staging and access.

Requirement	Location	Title	Project BO/BA/BE Date	Mariana fruit bat	Mariana swiftlet	Mariana common moorhen	Mariana crow	Micronesian kingfisher	Guam rail	Micronesian Megapode	Nightingale Reed-warbler	Serianthes nelsonii	Green sea turtle	Hawksbill sea turtle	Scalloped hammerhead	ESA Corals	EFH	Eugenia bryanii	Hedyotis megalantha	Heritiera longipetiolata	Phyllanthus saffordii	Psychotria malaspinae	Solanum guamense	Tinaspora homosepala	Bulbophyllum guamense	Cycas micronesica	Dendrobium guamense	Maesa walkeri	Nervilia jacksoniae	Tabernaemontana rotensis	Tuberolabium guamense	Mariana eight-spot butterfly	Guam tree snail	Humped tree snail	Fragile tree snail	Conservation Measure (One Per Row)
Section 7 informal	AAFB	Consultation Regarding the Proposed Short-Range Approach Lighting System for Runway 06L and Vegetation Clearing in the Runway Clear Zone, Andersen Air Force Base	15-May-12				x	x	x																											A litter control program shall be instituted at the entire project site. All workers will ensure their food scraps, paper wrappers, food containers, cans, bottles, and other trash from the project area are deposited in covered or closed trash containers. The trash containers shall be removed from the project area at the end of each working day.
Section 7 informal	AAFB	Consultation Regarding the Proposed Short-Range Approach Lighting System for Runway 06L and Vegetation Clearing in the Runway Clear Zone, Andersen Air Force Base	15-May-12				x	x	x																											All construction scrap, debris, tools and leftover materials will be cleaned from the site upon project completion to prevent the attraction of invasive pests.
Section 7 informal	AAFB	Consultation Regarding the Proposed Short-Range Approach Lighting System for Runway 06L and Vegetation Clearing in the Runway Clear Zone, Andersen Air Force Base	15-May-12				x	x	x																											Prior to vegetation clearing, an approved biologist will survey for Mariana fruit bats or Mariana crows within 300 meters of the site to verify their presence/absence. If a bat or crow is observed in the area clearing will not begin until the individual leaves the area of their own volition.
Section 7 informal	AAFB	Installation of an Ungulate Exclosure Fence at Ritidian Point	7/3/2012	x			x	x	x			x																								To avoid the removal of high value tree species, final placement of the fence will be flagged by Environmental Flight staff prior to construction.
Section 7 informal	AAFB	Installation of an Ungulate Exclosure Fence at Ritidian Point	7/3/2012	x			x	x	x			x																								There is a potential for Mariana fruit bats to be present in the project area. One week prior to project execution. the proposed project site and adjacent areas will be surveyed by a qualified biologist to determine if bats arc present. If bats are observed within 492 feet (150 meters) of the project site. All activities will be delayed until the animal(s) have left the area of their own volition.
Section 7 informal	AAFB	Installation of an Ungulate Exclosure Fence at Ritidian Point	7/3/2012	x			x	x	x			x																								Herbicide will be used and applied according to AAFB standards for pesticide use.
Section 7 informal	AAFB	Installation of an Ungulate Exclosure Fence at Ritidian Point	7/3/2012	x			x	x	x			x																								A litter control program will be instituted by the contractor at the project site and enforced by Environmental Flight staff.
Section 7 informal	AAFB	Installation of an Ungulate Exclosure Fence at Ritidian Point	7/3/2012	x			x	x	x			x																								All construction scrap, debris, tools, and leftover materials will be cleaned from the site upon project completion.
Section 7 informal	AAFB	Installation of an Ungulate Exclosure Fence at Ritidian Point	7/3/2012	x			x	x	x			x																								Adjacent forested areas that are not impacted will be temporarily delineated to prevent personnel and equipment from damaging important wildlife habitat. Signs will be posted indicating that no one is allowed past that boundary. All signs will be removed from the site after completion of the project.
Section 7 informal	AAFB	Installation of an Ungulate Exclosure Fence at Ritidian Point	7/3/2012	x			x	x	x			x																								Before start of construction, all project personnel will be briefed by the Environmental flight staff regarding the presence of listed species and the importance of avoiding impacts to these species and their habitat.
Section 7 informal	NBG	Repair of Glass Breakwater North, Naval Base Guam	27-Dec-12										x	x																						A contingency plan to control petroleum products accidentally spilled during the project has been developed. Appropriate materials to contain and clean potential spills will be stored and readily available at the work site.
Section 7 informal	NBG	Repair of Glass Breakwater North, Naval Base Guam	27-Dec-12										x	x																						A contingency plan will be in place for the removal and adequate securing of equipment in the event of approaching storms.
Section 7 informal	NBG	Repair of Glass Breakwater North, Naval Base Guam	27-Dec-12										x	x																						All in-water work will be postponed or halted when protected species are within 50 yards of the proposed work, and will only begin/resume after the animals have voluntarily departed the area.
Section 7 informal	NBG	Repair of Glass Breakwater North, Naval Base Guam	27-Dec-12										x	x																						All project-related materials and equipment placed in the water will be free of pollutants. The project manager and the heavy equipment operator will perform daily pre-work equipment inspections for cleanliness and leaks. All heavy equipment operations will be postponed or halted should a leak be detected, and will not proceed until the leak is repaired and equipment cleaned.
Section 7 informal	NBG	Repair of Glass Breakwater North, Naval Base Guam	27-Dec-12										x	x																						All work will cease if sea turtles enter within 50 yards of the work area.
Section 7 informal	NBG	Repair of Glass Breakwater North, Naval Base Guam	27-Dec-12										x	x																						Competent observers will be designated to visually survey the marine areas adjacent to the proposed action for protected species.
Section 7 informal	NBG	Repair of Glass Breakwater North, Naval Base Guam	27-Dec-12										x	x																						Construction debris will be prevented from entering or remaining in the marine environment during the project.

Requirement	Location	Title	Project BO/BA/BE Date	Mariana fruit bat	Mariana swiftlet	Mariana common moorhen	Mariana crow	Micronesian kingfisher	Guam rail	Micronesian Megapode	Nightingale Reed-warbler	Serianthes nelsonii	Green sea turtle	Hawksbill sea turtle	Scalloped hammerhead	ESA Corals	EFH	Eugenia bryanii	Hedyotis megalantha	Heritiera longipetiolata	Phyllanthus saffordii	Psychotria malaspinae	Solanum guamense	Tinaspora homosepala	Bulbophyllum guamense	Cycas micronesica	Dendrobium guamense	Maesa walkeri	Nervilia jacksoniae	Tabernaemontana rotensis	Tuberolabium guamense	Mariana eight-spot butterfly	Guam tree snail	Humped tree snail	Fragile tree snail	Conservation Measure (One Per Row)
Section 7 informal	NBG	Repair of Glass Breakwater North, Naval Base Guam	27-Dec-12										x	x																					No in-water will be conducted after dark unless that work has proceeded uninterrupted since at least 1 hour prior to sunset, and no protected species have been observed near the 50-yard safety range for that work.
Section 7 informal	NBG	Repair of Glass Breakwater North, Naval Base Guam	27-Dec-12										x	x																					No marine mammals or sea turtles may be within 50 yards of in-water operations. All in-water activities will be postponed or halted until the animals have voluntarily moved beyond 50 yards.
Section 7 informal	NBG	Repair of Glass Breakwater North, Naval Base Guam	27-Dec-12										x	x																					No one on site or associated with this project will attempt to feed, touch, ride, or otherwise intentionally interact with any protected species.
Section 7 informal	NBG	Repair of Glass Breakwater North, Naval Base Guam	27-Dec-12										x	x																					Should a sheen be observed on the water surface, absorbent pads will be used to remove the petroleum product prior to removing the silt containment structures.
Section 7 informal	NBG	Repair of Glass Breakwater North, Naval Base Guam	27-Dec-12										x	x																					Whenever possible fueling of project-related vehicles and equipment will take place at least 50 feet away from the water.
EFH	NBG	Repair of Glass Breakwater (North Shore), Naval Base Guam	1-Feb-13														x																		A contingency plan to control petroleum products accidentally spilled during the project has been developed. Appropriate materials to contain and clean potential spills will be stored and readily available at the work site.
EFH	NBG	Repair of Glass Breakwater (North Shore), Naval Base Guam	1-Feb-13														x																		A contingency plan will be in place for the removal and adequate securing of equipment in the event of approaching storms.
EFH	NBG	Repair of Glass Breakwater (North Shore), Naval Base Guam	1-Feb-13														x																		All project-related materials and equipment placed in the water will be free of pollutants. The project manager and the heavy equipment operator will perform daily pre-work equipment inspections for cleanliness and leaks. All heavy equipment operations will be postponed or halted should a leak be detected, and will not proceed until the leak is repaired and equipment cleaned.
EFH	NBG	Repair of Glass Breakwater (North Shore), Naval Base Guam	1-Feb-13														x																		Construction debris will be prevented from entering or remaining in the marine environment during the project.
EFH	NBG	Repair of Glass Breakwater (North Shore), Naval Base Guam	1-Feb-13														x																		Should a sheen be observed on the water surface, absorbent pads will be used to remove the petroleum product prior to removing the silt containment structures.
EFH	NBG	Repair of Glass Breakwater (North Shore), Naval Base Guam	1-Feb-13														x																		Whenever possible fueling of project-related vehicles and equipment will take place at least 50 feet away from the water.
Section 7 informal	NBG	Repair of Glass Breakwater West, Naval Base Guam	5-Feb-13										x	x																					A contingency plan to control petroleum products accidentally spilled during the project has been developed. Appropriate materials to contain and clean potential spills will be stored and readily available at the work site.
Section 7 informal	NBG	Repair of Glass Breakwater West, Naval Base Guam	5-Feb-13										x	x																					A contingency plan will be in place for the removal and adequate securing of equipment in the event of approaching storms.
Section 7 informal	NBG	Repair of Glass Breakwater West, Naval Base Guam	5-Feb-13										x	x																					All in-water work will be postponed or halted when protected species are within 50 yards of the proposed work, and will only begin/resume after the animals have voluntarily departed the area.
Section 7 informal	NBG	Repair of Glass Breakwater West, Naval Base Guam	5-Feb-13										x	x																					All project-related materials and equipment placed in the water will be free of pollutants. The project manager and the heavy equipment operator will perform daily pre-work equipment inspections for cleanliness and leaks. All heavy equipment operations will be postponed or halted should a leak be detected, and will not proceed until the leak is repaired and equipment cleaned.
Section 7 informal	NBG	Repair of Glass Breakwater West, Naval Base Guam	5-Feb-13										x	x																					All waste and trash will be controlled and removed for proper disposal at an approved upland facility.
Section 7 informal	NBG	Repair of Glass Breakwater West, Naval Base Guam	5-Feb-13										x	x																					All work will cease if sea turtles enter within 50 yards of the work area.
Section 7 informal	NBG	Repair of Glass Breakwater West, Naval Base Guam	5-Feb-13										x	x																					Competent observers will be designated to visually survey the marine areas adjacent to the proposed action for protected species.
Section 7 informal	NBG	Repair of Glass Breakwater West, Naval Base Guam	5-Feb-13										x	x																					Construction debris will be prevented from entering or remaining in the marine environment during the project.
Section 7 informal	NBG	Repair of Glass Breakwater West, Naval Base Guam	5-Feb-13										x	x																					No marine mammals or sea turtles may be within 50 yards of in-water operations. All in-water activities will be postponed or halted until the animals have voluntarily moved beyond 50 yards.

Requirement	Location	Title	Project BO/BA/BE Date	Mariana fruit bat	Mariana swiftlet	Mariana common moorhen	Mariana crow	Micronesian kingfisher	Guam rail	Micronesian Megapode	Nightingale Reed-warbler	Serianthes nelsonii	Green sea turtle	Hawksbill sea turtle	Scalloped hammerhead	ESA Corals	EFH	Eugenia bryanii	Hedyotis megalantha	Heritiera longipetiolata	Phyllanthus saffordii	Psychotria malaspinae	Solanum guamense	Tinaspora homosepala	Bulbophyllum guamense	Cycas micronesica	Dendrobium guamense	Maesa walkeri	Nervilia jacksoniae	Tabernaemontana rotensis	Tuberolabium guamense	Mariana eight-spot butterfly	Guam tree snail	Humped tree snail	Fragile tree snail	Conservation Measure (One Per Row)
Section 7 informal	NBG	Repair of Glass Breakwater West, Naval Base Guam	5-Feb-13										x	x																						No one on site or associated with this project will attempt to feed, touch, ride, or otherwise intentionally interact with any protected species.
Section 7 informal	NBG	Repair of Glass Breakwater West, Naval Base Guam	5-Feb-13										x	x																						No work will be conducted after dark and artificial lighting will not be used.
Section 7 informal	NBG	Repair of Glass Breakwater West, Naval Base Guam	5-Feb-13										x	x																						Should a sheen be observed on the water surface, absorbent pads will be used to remove the petroleum product prior to removing the silt containment structures.
Section 7 informal	NBG	Repair of Glass Breakwater West, Naval Base Guam	5-Feb-13										x	x																						Whenever possible fueling of project-related vehicles and equipment will take place at least 50 feet away from the water.
EFH	NBG	Repair of Glass Breakwater West, Naval Base Guam	25-Feb-13														x																			A contingency plan to control petroleum products accidentally spilled during the project has been developed. Appropriate materials to contain and clean potential spills will be stored and readily available at the work site.
EFH	NBG	Repair of Glass Breakwater West, Naval Base Guam	25-Feb-13														x																			A contingency plan will be in place for the removal and adequate securing of equipment in the event of approaching storms.
EFH	NBG	Repair of Glass Breakwater West, Naval Base Guam	25-Feb-13														x																			All project-related materials and equipment placed in the water will be free of pollutants. The project manager and the heavy equipment operator will perform daily pre-work equipment inspections for cleanliness and leaks. All heavy equipment operations will be postponed or halted should a leak be detected, and will not proceed until the leak is repaired and equipment cleaned.
EFH	NBG	Repair of Glass Breakwater West, Naval Base Guam	25-Feb-13														x																			Construction debris will be prevented from entering or remaining in the marine environment during the project.
EFH	NBG	Repair of Glass Breakwater West, Naval Base Guam	25-Feb-13														x																			Should a sheen be observed on the water surface, absorbent pads will be used to remove the petroleum product prior to removing the silt containment structures.
EFH	NBG	Repair of Glass Breakwater West, Naval Base Guam	25-Feb-13														x																			Whenever possible fueling of project-related vehicles and equipment will take place at least 50 feet away from the water.
Section 7 informal	NBG	Re-Initiation of Informal Section 7 for Increased Brown Treesnake Control at Mahlac Cave on Naval Base Guam, Munitions Site, Guam	4-Apr-13		x																															Efforts will be made to conduct activities outside the cave entrances as appropriate (i.e. preparation of equipment).
Section 7 informal	NBG	Re-Initiation of Informal Section 7 for Increased Brown Treesnake Control at Mahlac Cave on Naval Base Guam, Munitions Site, Guam	4-Apr-13		x																															Observers will use night vision and headlamps with red lenses.
Section 7 informal	NBG	Re-Initiation of Informal Section 7 for Increased Brown Treesnake Control at Mahlac Cave on Naval Base Guam, Munitions Site, Guam	4-Apr-13		x																															The Navy will take the same measures identified in the initial consultation to minimize disturbance to swiftlets.
Section 7 informal	NBG	Re-Initiation of Informal Section 7 for Increased Brown Treesnake Control at Mahlac Cave on Naval Base Guam, Munitions Site, Guam	4-Apr-13		x																															The number of people inside the cave during visual searches will be limited to two.
Section 7 informal	NBG	Re-Initiation of Informal Section 7 for Increased Brown Treesnake Control at Mahlac Cave on Naval Base Guam, Munitions Site, Guam	4-Apr-13		x																															While inside the cave personnel will minimize movement and move cautiously.
Section 7 informal	NBG	Vegetation Removal at Spanish Steps, Naval Base Guam	15-Apr-13																																	All work will cease if sea turtles (adults or hatchlings) are observed within the project site.
Section 7 informal	NBG	Vegetation Removal at Spanish Steps, Naval Base Guam	15-Apr-13																																	Competent observers will be designated to visually survey the project site for sea turtle nesting activity prior to commencement of work each day.
Section 7 informal	NBG	Vegetation Removal at Spanish Steps, Naval Base Guam	15-Apr-13										x	x																						Debris, materials, and trash will be prevented from remaining on the beach or entering the marine environment during the project.
Section 7 informal	NBG	Vegetation Removal at Spanish Steps, Naval Base Guam	15-Apr-13																																	No artificial lighting will be used and no work will be conducted after dark.
Section 7 informal	NBG	Vegetation Removal at Spanish Steps, Naval Base Guam	15-Apr-13										x	x																						No ground work will occur within 3 meters of sea turtle nests or body pits.
Section 7 informal	NBG	Vegetation Removal at Spanish Steps, Naval Base Guam	15-Apr-13										x	x																						No one on site or associated with this project will attempt to touch or otherwise intentionally interact with any protected species (including sea turtle nests).
Section 7 informal	NBG	Vegetation Removal at Spanish Steps, Naval Base Guam	15-Apr-13										x	x																						Removal of vegetation will occur between 1 July and 28 February, outside of peak nesting season (1 March – 30 June).
Section 7 informal	NBG	Construction of Radome Antennas, Naval Base Guam Telecommunications Site	20-Jun-13	x																																A litter control program will be implemented at the project site. Construction debris and trash will be prevented from entering or remaining on site or in adjacent areas to the project site.

Requirement	Location	Title	Project BO/BA/BE Date	Mariana fruit bat	Mariana swiftlet	Mariana common moorhen	Mariana crow	Micronesian kingfisher	Guam rail	Micronesian Megapode	Nightingale Reed-warbler	Serianthes nelsonii	Green sea turtle	Hawksbill sea turtle	Scalloped hammerhead	ESA Corals	EFH	Eugenia bryanii	Hedyotis megalantha	Heritiera longipetiolata	Phyllanthus saffordii	Psychotria malaspinae	Solanum guamense	Tinaspora homosepala	Bulbophyllum guamense	Cycas micronesica	Dendrobium guamense	Maesa walkeri	Nervilia jacksoniae	Tabernaemontana rotensis	Tuberolabium guamense	Mariana eight-spot butterfly	Guam tree snail	Humped tree snail	Fragile tree snail	Conservation Measure (One Per Row)
Section 7 informal	NBG	Construction of Radome Antennas, Naval Base Guam Telecommunications Site	20-Jun-13	x																																Adjacent forested areas that are not impacted from the proposed action will be temporarily delineated by orange construction fencing or flagging tape to keep personnel and equipment from damaging the habitat. All flagging and temporary fencing will be removed from the site after project completion.
Section 7 informal	NBG	Construction of Radome Antennas, Naval Base Guam Telecommunications Site	20-Jun-13	x																																All construction work will begin after dawn and will end prior to dusk; no activities will occur at night.
Section 7 informal	NBG	Construction of Radome Antennas, Naval Base Guam Telecommunications Site	20-Jun-13	x																																All equipment, materials, debris, and vegetation clippings will be removed upon completion of work.
Section 7 informal	NBG	Construction of Radome Antennas, Naval Base Guam Telecommunications Site	20-Jun-13	x																																All on-site personnel will receive instruction regarding ESA-listed species and what to do in case of sightings.
Section 7 informal	NBG	Construction of Radome Antennas, Naval Base Guam Telecommunications Site	20-Jun-13	x																																No new staging areas or access roads will be constructed. Existing roads and disturbed areas will be used.
Section 7 informal	NBG	Construction of Radome Antennas, Naval Base Guam Telecommunications Site	20-Jun-13	x																																The presence of any ESA-listed species will be reported to the Service and Guam Division of Aquatic and Wildlife Resources within 48 hours, but the location of species will not be revealed to any other outside party.
Section 7 informal	NBG	Construction of Radome Antennas, Naval Base Guam Telecommunications Site	20-Jun-13	x																																To avoid impacts to roosting bats, a qualified biologist will survey the project site and areas within 150 meters of the site to determine if Mariana fruit bats are in the area. This survey will be completed one week prior to clearing vegetation at a site.
Section 7 informal	NBG	Construction of Radome Antennas, Naval Base Guam Telecommunications Site	20-Jun-13	x																																Work will be postponed or halted if Mariana fruit bats are observed within 150 meters of the project site and will only begin/resume after the bat(s) have voluntarily departed the area.
Section 7 formal	NBG	X-Ray Wharf Improvements, Naval Base Guam	16-Aug-13										x	x																						A contingency plan to control and contain toxic spills, including petroleum products, will be developed. Appropriate materials to contain and clean potential spills will be stored and readily available at the work site.
EFH	NBG	X-Ray Wharf Improvements, Naval Base Guam	16-Aug-13														x																			A contingency plan to control and contain toxic spills, including petroleum products, will be developed. Appropriate materials to contain and clean potential spills will be stored and readily available at the work site.
Section 7 formal	NBG	X-Ray Wharf Improvements, Naval Base Guam	16-Aug-13										x	x																						A contingency plan will be in place for the removal and adequate securing of equipment in the event of approaching storms.
EFH	NBG	X-Ray Wharf Improvements, Naval Base Guam	16-Aug-13														x																			A contingency plan will be in place for the removal and adequate securing of equipment in the event of approaching storms.
Section 7 formal	NBG	X-Ray Wharf Improvements, Naval Base Guam	16-Aug-13										x	x																						A plan will be developed and implemented to prevent construction debris from entering or remaining in the marine environment during the project.
EFH	NBG	X-Ray Wharf Improvements, Naval Base Guam	16-Aug-13														x																			A plan will be developed and implemented to prevent construction debris from entering or remaining in the marine environment during the project.
Section 7 formal	NBG	X-Ray Wharf Improvements, Naval Base Guam	16-Aug-13										x	x																						All project-related materials and equipment placed in the water will be free of pollutants. The project manager and the heavy equipment operator will perform daily pre-work equipment inspections for cleanliness and leaks. All heavy equipment operations will be postponed or halted should a leak be detected, and will not proceed until the leak is repaired and equipment cleaned.
EFH	NBG	X-Ray Wharf Improvements, Naval Base Guam	16-Aug-13														x																			All project-related materials and equipment placed in the water will be free of pollutants. The project manager and the heavy equipment operator will perform daily pre-work equipment inspections for cleanliness and leaks. All heavy equipment operations will be postponed or halted should a leak be detected, and will not proceed until the leak is repaired and equipment cleaned.
Section 7 formal	NBG	X-Ray Wharf Improvements, Naval Base Guam	16-Aug-13										x	x																						Competent observers will be designated to visually survey the marine areas within and adjacent to the project footprint for protected species.
Section 7 formal	NBG	X-Ray Wharf Improvements, Naval Base Guam	16-Aug-13										x	x																						Construction activities that result in sediment/pollutant discharges (dredging and pile driving) will cease during the primary coral spawning events each year for scleractinian corals. NMFS PIRO HCD Guam Field Office will be consulted for information on spawning dates.

Requirement	Location	Title	Project BO/BA/BE Date	Mariana fruit bat	Mariana swiftlet	Mariana common moorhen	Mariana crow	Micronesian kingfisher	Guam rail	Micronesian Megapode	Nightingale Reed-warbler	Serianthes nelsonii	Green sea turtle	Hawksbill sea turtle	Scalloped hammerhead	ESA Corals	EFH	Eugenia bryanii	Hedyotis megalantha	Heritiera longipetiolata	Phyllanthus saffordii	Psychotria malaspinae	Solanum guamense	Tinaspora homosepala	Bulbophyllum guamense	Cycas micronesica	Dendrobium guamense	Maesa walkeri	Nervilia jacksoniae	Tabernaemontana rotensis	Tuberolabium guamense	Mariana eight-spot butterfly	Guam tree snail	Humped tree snail	Fragile tree snail	Conservation Measure (One Per Row)
EFH	NBG	X-Ray Wharf Improvements, Naval Base Guam	16-Aug-13														x																			Construction activities that result in sediment/pollutant discharges (dredging and pile driving) will cease during the primary coral spawning events each year for scleractinian corals. NMFS PIRO HCD Guam Field Office will be consulted for information on spawning dates.
Section 7 formal	NBG	X-Ray Wharf Improvements, Naval Base Guam	16-Aug-13										x	x																						Construction related vessels will be operated at 10 knots or less in areas of known or suspected turtle activity. If practicable, speed of construction related vessel will be reduced to 5 knots or less.
Section 7 formal	NBG	X-Ray Wharf Improvements, Naval Base Guam	16-Aug-13										x	x																						Fueling of construction project related vehicles and equipment will take place at least 50 feet away from the water, preferably over an impervious surface. With respect to construction equipment (e.g., dredging barges) that cannot be fueled out of the water, spill prevention booms will be employed to contain any potential spills. Any fuel spilled will be cleaned up immediately.
EFH	NBG	X-Ray Wharf Improvements, Naval Base Guam	16-Aug-13														x																			Fueling of construction project-related vehicles and equipment will take place at least 50 feet away from the water, preferably over an impervious surface. With respect to construction equipment (e.g., dredging barges) that cannot be fueled out of the water, spill prevention booms will be employed to contain any potential spills. Any fuel spilled will be cleaned up immediately.
Section 7 formal	NBG	X-Ray Wharf Improvements, Naval Base Guam	16-Aug-13										x	x																						If approached by a sea turtle within Apra Harbor, construction related vessel operators will put the engine in neutral and allow the animal to pass.
Section 7 formal	NBG	X-Ray Wharf Improvements, Naval Base Guam	16-Aug-13										x	x																						No marine mammals or sea turtles may be within 50 yards of pile driving and dredging operations. All pile driving and dredging will be postponed or halted until the animals have voluntarily moved beyond 50 yards.
Section 7 formal	NBG	X-Ray Wharf Improvements, Naval Base Guam	16-Aug-13										x	x																						No one on site or associated with this project will attempt to feed, touch, ride, or otherwise intentionally interact with any protected species.
Section 7 formal	NBG	X-Ray Wharf Improvements, Naval Base Guam	16-Aug-13										x	x																						No pile driving or dredging will be conducted after dark unless that work has proceeded uninterrupted since at least 1 hour prior to sunset, and no protected species have been observed near the 50-yard safety range for that work.
Section 7 formal	NBG	X-Ray Wharf Improvements, Naval Base Guam	16-Aug-13										x	x																						Pile driving and dredging will commence using a ramp-up technique at the start of each work day or following a break of more than 30 minutes or longer. Pile driving will employ a slow increase in hammering, whereas dredging will commence with slow and deliberate deployment of the bucket or chisel to the bottom for the first several cycles to alert protected species and allow them an opportunity to vacate the area prior to full-intensity operations.
EFH	NBG	X-Ray Wharf Improvements, Naval Base Guam	16-Aug-13														x																			Pile driving will commence work using soft-start or ramp-up techniques at the start of each work day or following a break of more than 30 minutes. Pile driving will employ a slow increase in hammering to alert marine species and allow them an opportunity to vacate the area prior to full-intensity operations.
Section 7 formal	NBG	X-Ray Wharf Improvements, Naval Base Guam	16-Aug-13										x	x																						Project related vessel operators to maintain constant vigilance for, and avoid all marine mammals and sea turtles while piloting their vessels. This must include the tug and scow operators that would transit between the inner harbor and the ODMDS.
Section 7 formal	NBG	X-Ray Wharf Improvements, Naval Base Guam	16-Aug-13										x	x																						Sea turtles should not be encircled or trapped between multiple vessels or between vessels and the shore.
Section 7 formal	NBG	X-Ray Wharf Improvements, Naval Base Guam	16-Aug-13										x	x																						Transportation of dredged material to G-ODMDS will only occur when weather and sea state conditions will not interfere with safe transportation and will not create risk or spillage, leak, or other loss of dredged material in transit. No disposal vessel trips will be initiated when the National Weather Service has issued a gale warning for local waters during the time period necessary to complete dumping operations.

Requirement	Location	Title	Project BO/BA/BE Date	Mariana fruit bat	Mariana swiftlet	Mariana common moorhen	Mariana crow	Micronesian kingfisher	Guam rail	Micronesian Megapode	Nightingale Reed-warbler	Serianthes nelsonii	Green sea turtle	Hawksbill sea turtle	Scalloped hammerhead	ESA Corals	EFH	Eugenia bryanii	Hedyotis megalantha	Heritiera longipetiolata	Phyllanthus saffordii	Psychotria malaspinae	Solanum guamense	Tinaspora homosepala	Bulbophyllum guamense	Cycas micronesica	Dendrobium guamense	Maesa walkeri	Nervilia jacksoniae	Tabernaemontana rotensis	Tuberolabium guamense	Mariana eight-spot butterfly	Guam tree snail	Humped tree snail	Fragile tree snail	Conservation Measure (One Per Row)
EFH	NBG	X-Ray Wharf Improvements, Naval Base Guam	16-Aug-13														x																			Transportation of dredged material to G-ODMDS will only occur when weather and sea state conditions will not interfere with safe transportation and will not create risk or spillage, leak, or other loss of dredged material in transit. No disposal vessel trips will be initiated when the National Weather Service has issued a gale warning for local waters during the time period necessary to complete dumping operations.
Section 7 formal	NBG	X-Ray Wharf Improvements, Naval Base Guam	16-Aug-13										x	x																						Turbidity and siltation from project related work will be minimized and contained through the appropriate use of effective silt containment devices and the curtailment of work during adverse tidal and weather conditions. Silt curtains will completely enclose dredging and pile driving operations to the maximum extent practicable.
EFH	NBG	X-Ray Wharf Improvements, Naval Base Guam	16-Aug-13														x																			Turbidity and siltation from project related work will be minimized and contained through the appropriate use of effective silt containment devices and the curtailment of work during adverse tidal and weather conditions. Silt curtains will completely enclose dredging and pile driving operations to the maximum extent practicable.
Section 7 formal	NBG	X-Ray Wharf Improvements, Naval Base Guam	16-Aug-13										x	x																						When piloting vessels, vessel operators shall alter course to remain at least 100 yards from whales, and at least 50 yards from other marine mammals and sea turtles. When dumping the scow at the ODMDS, a 100 yard standoff for all protected marine species will be maintained.
Section 7 formal	NBG	X-Ray Wharf Improvements, Naval Base Guam	16-Aug-13										x	x																						With the exception of pile driving and dredging, all in-water work will be postponed or halted when protected species are within 50 feet of the proposed work, and will only begin/resume after the animals have voluntarily departed the area.
Section 7 formal	NBG	X-Ray Wharf Improvements, Naval Base Guam	16-Aug-13										x	x																						With the exception of pile driving and dredging, observers will visually survey the project area each day beginning 30 minutes prior to the start of work, and repeated frequently throughout the day.
Section 7 formal	NBG	X-Ray Wharf Improvements, Naval Base Guam	9-Jan-14										x	x																						
Section 7 informal	NBG	Vegetation Removal at Fena Reservoir, Naval Base Guam	3-Apr-14	x	x	x																														A litter control program will be implemented at the project site. Construction debris and trash will be prevented from entering or remaining on site or in adjacent areas to the project site.
Section 7 informal	NBG	Vegetation Removal at Fena Reservoir, Naval Base Guam	3-Apr-14	x	x	x																														A qualified biologist will conduct a survey of the project site to determine if ESA-listed species are in the area. This survey will be completed one week prior to cutting and removal of vegetation at the site. Any observations of ESA-listed species, including nests, will be reported to the Service prior to construction activity. A qualified biologist will continue to survey the site at two-week intervals throughout the duration of the project.
Section 7 informal	NBG	Vegetation Removal at Fena Reservoir, Naval Base Guam	3-Apr-14	x	x	x																														All construction work will begin after dawn and will end prior to dusk; no activities will occur at night.
Section 7 informal	NBG	Vegetation Removal at Fena Reservoir, Naval Base Guam	3-Apr-14	x	x	x																														All equipment, materials, debris, and vegetation clippings will be removed upon completion of work.
Section 7 informal	NBG	Vegetation Removal at Fena Reservoir, Naval Base Guam	3-Apr-14	x	x	x																														All on-site personnel will receive instruction regarding ESA-listed species and actions to take in case of sightings.
Section 7 informal	NBG	Vegetation Removal at Fena Reservoir, Naval Base Guam	3-Apr-14	x	x	x																														No new staging areas or access roads will be constructed. Existing roads and disturbed areas will be used.
Section 7 informal	NBG	Vegetation Removal at Fena Reservoir, Naval Base Guam	3-Apr-14	x	x	x																														Prior to conducting work each day the site will be visually surveyed at and around planned project activities for the presence of ESA-listed species.
Section 7 informal	NBG	Vegetation Removal at Fena Reservoir, Naval Base Guam	3-Apr-14	x	x	x																														The Navy will continue to maintain vigilance for ESA-listed species while conducting maintenance and will use data from regular surveys (point counts and transects) performed by qualified biologists in the project area. If moorhen nests are observed the Navy will avoid conducting maintenance in that area and notify USFWS.
Section 7 informal	NBG	Vegetation Removal at Fena Reservoir, Naval Base Guam	3-Apr-14	x	x	x																														The Navy will use qualified biologists prior to executing this project to assure no moorhen nests are present within the project footprint.

Requirement	Location	Title	Project BO/BA/BE Date	Mariana fruit bat	Mariana swiftlet	Mariana common moorhen	Mariana crow	Micronesian kingfisher	Guam rail	Micronesian Megapode	Nightingale Reed-warbler	Serianthes nelsonii	Green sea turtle	Hawksbill sea turtle	Scalloped hammerhead	ESA Corals	EFH	Eugenia bryanii	Hedyotis megalantha	Heritiera longipetiolata	Phyllanthus saffordii	Psychotria malaspinae	Solanum guamense	Tinaspora homosepala	Bulbophyllum guamense	Cycas micronesica	Dendrobium guamense	Maesa walkeri	Nervilia jacksoniae	Tabernaemontana rotensis	Tuberolabium guamense	Mariana eight-spot butterfly	Guam tree snail	Humped tree snail	Fragile tree snail	Conservation Measure (One Per Row)
Section 7 informal	NBG	Vegetation Removal at Fena Reservoir, Naval Base Guam	3-Apr-14	x	x	x																														The presence of any ESA-listed species will be reported to the Service within 48 hours, but the location of species will not be revealed to any other outside party.
Section 7 informal	NBG	Vegetation Removal at Fena Reservoir, Naval Base Guam	3-Apr-14	x	x	x																														Vegetation along the south edge of the spillway, where Mariana common moorhen have been observed in the past, will be selectively cut targeting overhanging vegetation that obstructs view of the spillway. Ground cover will be preserved whenever possible in this area.
Section 7 informal	NBG	Vegetation Removal at Fena Reservoir, Naval Base Guam	3-Apr-14	x	x	x																														Work will be postponed or halted if Mariana common moorhen are observed within 50 yards (150 feet) of the project activities and will only begin/resume after the moorhen have voluntarily departed the area.
Section 7 informal	NBG	Vegetation Removal at Fena Reservoir, Naval Base Guam	3-Apr-14	x	x	x																														Work will be postponed or halted if Mariana fruit bats are observed within 150 yards (450 feet) of the project activities and will only begin/resume after the bat(s) have voluntarily departed the area.
EFH	NBG	Romeo Wharf Reparis	13-Aug-14														x																			A contingency plan to control and contain toxic spills, including petroleum products, will be developed. Appropriate materials to contain and clean potential spills will be stored and readily available at the work site.
EFH	NBG	Romeo Wharf Reparis	13-Aug-14														x																			A contingency plan will be in place for the removal and adequate securing of equipment in the event of approaching storms.
EFH	NBG	Romeo Wharf Reparis	13-Aug-14														x																			A plan will be developed and implemented to prevent construction debris from entering or remaining in the marine environment during the project.
EFH	NBG	Romeo Wharf Reparis	13-Aug-14														x																			All project-related materials and equipment placed in the water will be free of pollutants. The project manager and the heavy equipment operator will perform daily pre-work equipment inspections for cleanliness and leaks. All heavy equipment operations will be postponed or halted should a leak be detected, and will not proceed until the leak is repaired and equipment cleaned.
EFH	NBG	Romeo Wharf Reparis	13-Aug-14														x																			Construction activities that result in sediment/pollutant discharges (dredging and pile driving) will cease during the primary coral spawning events each year for scleractinian corals. NMFS PIRO HCD Guam Field Office will be consulted for information on spawning dates.
EFH	NBG	Romeo Wharf Reparis	13-Aug-14														x																			Fueling of construction project-related vehicles and equipment will take place at least 50 feet away from the water, preferably over an impervious surface. With respect to construction equipment (e.g., dredging barges) that cannot be fueled out of the water, spill prevention booms will be employed to contain any potential spills. Any fuel spilled will be cleaned up immediately.
EFH	NBG	Romeo Wharf Reparis	13-Aug-14														x																			Pile driving will commence work using soft-start or ramp-up techniques at the start of each work day or following a break of more than 30 minutes. Pile driving will employ a slow increase in hammering to alert marine species and allow them an opportunity to vacate the area prior to full-intensity operations.
EFH	NBG	Romeo Wharf Reparis	13-Aug-14														x																			Turbidity and siltation from project related work will be minimized and contained through the appropriate use of effective silt containment devices and the curtailment of work during adverse tidal and weather conditions. Silt curtains will completely enclose dredging and pile driving operations to the maximum extent practicable.
Section 7 informal	NBG	Romeo Wharf Reparis	10-Sep-14										x	x																						A contingency plan to control and contain toxic spills, including petroleum products, will be developed. Appropriate materials to contain and clean potential spills will be stored and readily available at the work site.
Section 7 informal	NBG	Romeo Wharf Reparis	10-Sep-14										x	x																						A contingency plan will be in place for the removal and adequate securing of equipment in the event of approaching storms.
Section 7 informal	NBG	Romeo Wharf Reparis	10-Sep-14										x	x																						A plan will be developed and implemented to prevent construction debris from entering or remaining in the marine environment during the project.

Requirement	Location	Title	Project BO/BA/BE Date	Mariana fruit bat	Mariana swiftlet	Mariana common moorhen	Mariana crow	Micronesian kingfisher	Guam rail	Micronesian Megapode	Nightingale Reed-warbler	Serianthes nelsonii	Green sea turtle	Hawksbill sea turtle	Scalloped hammerhead	ESA Corals	EFH	Eugenia bryanii	Hedyotis megalantha	Heritiera longipetiolata	Phyllanthus saffordii	Psychotria malaspinae	Solanum guamense	Tinaspora homosepala	Bulbophyllum guamense	Cycas micronesica	Dendrobium guamense	Maesa walkeri	Nervilia jacksoniae	Tabernaemontana rotensis	Tuberolabium guamense	Mariana eight-spot butterfly	Guam tree snail	Humped tree snail	Fragile tree snail	Conservation Measure (One Per Row)
Section 7 informal	NBG	Romeo Wharf Reparis	10-Sep-14										x	x																						All project-related materials and equipment placed in the water will be free of pollutants. The project manager and the heavy equipment operator will perform daily pre-work equipment inspections for cleanliness and leaks. All heavy equipment operations will be postponed or halted should a leak be detected, and will not proceed until the leak is repaired and equipment cleaned.
Section 7 informal	NBG	Romeo Wharf Reparis	10-Sep-14										x	x																						Competent observers will be designated to visually survey the marine areas within and adjacent to the project footprint for protected species.
Section 7 informal	NBG	Romeo Wharf Reparis	10-Sep-14										x	x																						Construction activities that result in sediment/pollutant discharges (pile driving) will cease during the primary coral spawning events each year for scleractinian corals. NMFS PIRO HCD Guam Field Office will be consulted for information on spawning dates.
Section 7 informal	NBG	Romeo Wharf Reparis	10-Sep-14										x	x																						Construction related vessels will be operated at 10 knots or less in areas of known or suspected turtle activity. If practicable, speed of construction related vessel will be reduced to 5 knots or less.
Section 7 informal	NBG	Romeo Wharf Reparis	10-Sep-14										x	x																						Fueling of construction project related vehicles and equipment will take place at least 50 feet away from the water, preferably over an impervious surface. With respect to construction equipment that cannot be fueled out of the water, spill prevention booms will be employed to contain any potential spills. Any fuel spilled will be cleaned up immediately.
Section 7 informal	NBG	Romeo Wharf Reparis	10-Sep-14										x	x																						If approached by a sea turtle within Apra Harbor, construction related vessel operators will put the engine in neutral and allow the animal to pass.
Section 7 informal	NBG	Romeo Wharf Reparis	10-Sep-14										x	x																						No marine mammals or sea turtles may be within 81 yards of pile driving and dredging operations. All pile driving and dredging will be postponed or halted until the animals have voluntarily moved beyond 81 yards.
Section 7 informal	NBG	Romeo Wharf Reparis	10-Sep-14										x	x																						No one on site or associated with this project will attempt to feed, touch, ride, or otherwise intentionally interact with any protected species.
Section 7 informal	NBG	Romeo Wharf Reparis	10-Sep-14										x	x																						No pile driving or dredging will be conducted after dark unless that work has proceeded uninterrupted since at least 1 hour prior to sunset, and no protected species have been observed near the 81-yard safety range for that work.
Section 7 informal	NBG	Romeo Wharf Reparis	10-Sep-14										x	x																						Observers will remain continuously alert for protected species starting 60 minutes prior to commencement of pile driving and dredging through 30 minutes after shut-down. Resumption of work following a break of 30 minutes or more requires a 60 minute pre-work area visual search.
Section 7 informal	NBG	Romeo Wharf Reparis	10-Sep-14										x	x																						Pile driving and dredging will commence using a ramp-up technique at the start of each work day or following a break of more than 30 minutes or longer. Pile driving will employ a slow increase in hammering, whereas dredging will commence with slow and deliberate deployment of the bucket or chisel to the bottom for the first several cycles to alert protected species and allow them an opportunity to vacate the area prior to full-intensity operations.
Section 7 informal	NBG	Romeo Wharf Reparis	10-Sep-14										x	x																						Sea turtles should not be encircled or trapped between multiple vessels or between vessels and the shore.
Section 7 informal	NBG	Romeo Wharf Reparis	10-Sep-14										x	x																						Turbidity and siltation from project related work will be minimized and contained through the appropriate use of effective silt containment devices and the curtailment of work during adverse tidal and weather conditions. Silt curtains will completely enclose dredging and pile driving operations to the maximum extent practicable.
Section 7 informal	NBG	Romeo Wharf Reparis	10-Sep-14										x	x																						When piloting vessels, vessel operators shall alter course to remain at least 100 yards from whales, and at least 50 yards from other marine mammals and sea turtles.
Section 7 informal	NBG	Romeo Wharf Reparis	10-Sep-14										x	x																						With the exception of pile driving and dredging, all in-water work will be postponed or halted when protected species are within 50 feet of the proposed work, and will only begin/resume after the animals have voluntarily departed the area.

Requirement	Location	Title	Project BO/BA/BE Date	Mariana fruit bat	Mariana swiftlet	Mariana common moorhen	Mariana crow	Micronesian kingfisher	Guam rail	Micronesian Megapode	Nightingale Reed-warbler	Serianthes nelsonii	Green sea turtle	Hawksbill sea turtle	Scalloped hammerhead	ESA Corals	EFH	Eugenia bryanii	Hedyotis megalantha	Heritiera longipetiolata	Phyllanthus saffordii	Psychotria malaspinae	Solanum guamense	Tinaspora homosepala	Bulbophyllum guamense	Cycas micronesica	Dendrobium guamense	Maesa walkeri	Nervilia jacksoniae	Tabernaemontana rotensis	Tuberolabium guamense	Mariana eight-spot butterfly	Guam tree snail	Humped tree snail	Fragile tree snail	Conservation Measure (One Per Row)
Section 7 informal	NBG	Romeo Wharf Reparis	10-Sep-14										x	x																						With the exception of pile driving and dredging, observers will visually survey the project area each day beginning 30 minutes prior to the start of work, and repeated frequently throughout the day.
Section 7 formal	Marianas	MILITARY TRAINING ACTIVITIES IN THE MARIANA ISLANDS TRAINING AND TESTING STUDY AREA: TERRESTRIAL SPECIES AND HABITATS	20-Feb-15	x	x	x				x	x		x	x																						1. Upon completion of the MIRC Reinitiation BO and other pending consultations, Navy will update the COMNAVMARIANASINST 3500.4A to reflect the language contained in these Biological Opinions applicable to range users. Navy will also finalize a new Joint Region COMNAVMAR Brown Treesnake instruction which will contain the Brown Treesnake Control and Interdiction Requirements. These efforts shall be prepared in coordination with the Service and other stakeholder agencies.
Section 7 formal	Marianas	MILITARY TRAINING ACTIVITIES IN THE MARIANA ISLANDS TRAINING AND TESTING STUDY AREA: TERRESTRIAL SPECIES AND HABITATS	20-Feb-15	x	x	x				x	x		x	x																						2. Training activities will undergo a pathway risk analysis as a tool to improve programmatic efficiency while preventing the spread or introduction of BTS.
Section 7 formal	Marianas	MILITARY TRAINING ACTIVITIES IN THE MARIANA ISLANDS TRAINING AND TESTING STUDY AREA: TERRESTRIAL SPECIES AND HABITATS	20-Feb-15	x	x	x				x	x		x	x																						3. The Navy, in compliance with Public Law 110-417, [Division A], title III, Section 316, October 14, 2008, 122 Statute 4410 and per DoD Transportation Regulations, Chapter 505 protocols, is committed to implementing 100% inspection of all aircraft and all cargo/equipment leaving Guam via vessel or aircraft for an off-island destination with trained brown treesnake personnel and qualified canine detection teams. The skills and standards required to certify a canine inspection team as "qualified" will be agreed upon mutually by DoD and the Service. These teams may be supplemented with qualified personnel to meet 100 percent inspection goals for training activities.
Section 7 formal	Marianas	MILITARY TRAINING ACTIVITIES IN THE MARIANA ISLANDS TRAINING AND TESTING STUDY AREA: TERRESTRIAL SPECIES AND HABITATS	20-Feb-15	x	x	x				x	x		x	x																						3a. <u>Missed Brown Treesnake Inspections</u> - In the event military units, vehicles, or equipment accidentally leave Guam without inspection, as soon as possible, the Navy will notify the qualified brown treesnake interdiction program and the destination port or airport authorities. Navy will work with the destination authority(ies) to resolve the issue. Urgency of notification is a priority so that rapid response or other actions can be implemented to reduce risk, if warranted.
Section 7 formal	Marianas	MILITARY TRAINING ACTIVITIES IN THE MARIANA ISLANDS TRAINING AND TESTING STUDY AREA: TERRESTRIAL SPECIES AND HABITATS	20-Feb-15	x	x	x				x	x		x	x																						3b. <u>Tactical Approach Exercises/Events</u> - To the maximum extent practicable, the Navy will route inbound personnel and cargo for tactical approach exercises (that require an uninterrupted flow of events) directly to CNMI training locations to avoid Guam seaports and airfields to the extent possible. If Guam cannot be avoided for tactical approaches, the Navy will work with the U.S. Fish and Wildlife Service to identify and implement appropriate interdiction methods at the receiving port (Rota, Saipan or Tinian). Methods may include redundant inspections or other interdiction actions, such as multiple inspections or barrier use on Guam. In addition, tactical approach exercises will involve only cargo/equipment that has not originated from areas containing a brown treesnake population or will be 100 percent inspected by qualified brown treesnake canine detection programs.

Requirement	Location	Title	Project BO/BA/BE Date	Mariana fruit bat	Mariana swiftlet	Mariana common moorhen	Mariana crow	Micronesian kingfisher	Guam rail	Micronesian Megapode	Nightingale Reed-warbler	Serianthes nelsonii	Green sea turtle	Hawksbill sea turtle	Scalloped hammerhead	ESA Corals	EFH	Eugenia bryanii	Hedyotis megalantha	Heritiera longipetiolata	Phyllanthus saffordii	Psychotria malaspinae	Solanum guamense	Tinaspora homosepala	Bulbophyllum guamense	Cycas micronesica	Dendrobium guamense	Maesa walkeri	Nervilia jacksoniae	Tabernaemontana rotensis	Tuberolabium guamense	Mariana eight-spot butterfly	Guam tree snail	Humped tree snail	Fragile tree snail	Conservation Measure (One Per Row)
Section 7 formal	Marianas	MILITARY TRAINING ACTIVITIES IN THE MARIANA ISLANDS TRAINING AND TESTING STUDY AREA: TERRESTRIAL SPECIES AND HABITATS	20-Feb-15	x	x	x				x	x		x	x																					3c. Administrative/Logistic Movements - The Navy is committed to implementing redundant inspections after discussions with appropriate stakeholders. Redundant inspections include inspections on Guam and at the receiving ports (Rota, Saipan or Tinian) for administrative and logistical movements within the MITT action area that do not require a tactical approach to complete the training requirements. It is anticipated that redundant inspections would utilize existing quarantine and inspection protocols at receiving ports in the CNMI to the extent possible. However, should inspection coverage be inadequate, the Navy will provide inspection teams to fully implement quarantine and inspection protocols. Appropriate stakeholders include, but are not limited to the U.S. Fish and Wildlife Service to ensure the inspections are adequate to reduce risks to trust resources, receiving jurisdictions and their supporting agencies with expertise in invasive species control, and other inspection authorities as needed to ensure inspection methods are current and revised as new techniques, technology, or data become available.
Section 7 formal	Marianas	MILITARY TRAINING ACTIVITIES IN THE MARIANA ISLANDS TRAINING AND TESTING STUDY AREA: TERRESTRIAL SPECIES AND HABITATS	20-Feb-15	x	x	x				x	x		x	x																					3d. Movements Involving Farallon de Medinilla (FDM) - The Navy will consider all movements between Guam and FDM as tactical in nature and work with appropriate stakeholders to determine the appropriate interdiction methods required for aircraft, personnel, and equipment/gear movements. All aircraft and equipment/gear will be 100 percent inspected prior to departing Guam. Additional interdiction measures on Guam may be required after discussions with appropriate stakeholders. Training operations that go from Guam to Saipan and then FDM will require canine inspection on Saipan or other BTS inspection as mutually agreed upon by the DoD and the Service. For training that starts on Guam and goes directly to FDM, visual inspections for BTS will be conducted by military or UXO personnel upon arrival on FDM.
Section 7 formal	Marianas	MILITARY TRAINING ACTIVITIES IN THE MARIANA ISLANDS TRAINING AND TESTING STUDY AREA: TERRESTRIAL SPECIES AND HABITATS	20-Feb-15	x	x	x				x	x		x	x																					4. The Navy will establish snake-free quarantine areas (barriers) as deemed necessary by the Navy and U.S. Fish and Wildlife Service for cargo/equipment traveling from Guam to CNMI and locations outside of the MITT action area. Barriers will be used if the volume of cargo/equipment/vehicle movement out-paces the available canine inspection capacity or BTS quarantine capacity. The snake-free quarantine areas will be subject to: (1) multiple day and night searches with appropriately trained interdiction canine teams, (2) snake trapping, and (3) visual inspection for snakes. Standard operating procedures will be developed based on the barrier size needed for the training event(s). Temporary barriers will be constructed and maintained in a manner that assures the efficacy of the barrier and that staff maintaining and constructing the temporary barriers will receive training related to this activity prior to construction and operation. Barrier specifications as well as the qualifications of BTS barrier maintenance and management staff will be mutually agreed upon by DoD and the Service.

Requirement	Location	Title	Project BO/BA/BE Date	Mariana fruit bat	Mariana swiftlet	Mariana common moorhen	Mariana crow	Micronesian kingfisher	Guam rail	Micronesian Megapode	Nightingale Reed-warbler	Serianthes nelsonii	Green sea turtle	Hawksbill sea turtle	Scalloped hammerhead	ESA Corals	EFH	Eugenia bryanii	Hedyotis megalantha	Heritiera longipetiolata	Phyllanthus saffordii	Psychotria malaspinae	Solanum guamense	Tinaspora homosepala	Bulbophyllum guamense	Cycas micronesica	Dendrobium guamense	Maesa walkeri	Nervilia jacksoniae	Tabernaemontana rotensis	Tuberolabium guamense	Mariana eight-spot butterfly	Guam tree snail	Humped tree snail	Fragile tree snail	Conservation Measure (One Per Row)
Section 7 formal	Marianas	MILITARY TRAINING ACTIVITIES IN THE MARIANA ISLANDS TRAINING AND TESTING STUDY AREA: TERRESTRIAL SPECIES AND HABITATS	20-Feb-15	x	x	x				x	x		x	x																						5. Navy will (1) coordinate closely with the Service1 and the CNMI Department of Land and Natural Resources staff on planning for training activities in the CNMI; (2) coordinate with the other DoD action agencies implementing the MITT program and the Service to identify the inspection and interdiction requirements for MITT program-related training activities, including the number of trained quarantine officers and canine detection teams required to ensure that the inspection and interdiction requirements for MITT program-related training activities can be met; (3) coordinate with the Service on the inspection and interdiction requirements identified by the Navy prior to the implementation of the exercise or training activity; and (4) identify the support that the Navy will need to provide for the inspections and develop plans to ensure that inspection personnel are available and all requirements are met. 1 Currently, the Service point-of-contact (POC) for these planning activities in the CNMI Brown Tree Snake Program Coordinator (Coordinator). If the agency affiliation of the Coordinator changes, the Service shall formally designate a new Service POC and adivse the DON and other DoD action agencies associated withthe MITT Program within 10 working days.
Section 7 formal	Marianas	MILITARY TRAINING ACTIVITIES IN THE MARIANA ISLANDS TRAINING AND TESTING STUDY AREA: TERRESTRIAL SPECIES AND HABITATS	20-Feb-15	x	x	x				x	x		x	x																						6. Navy will utilize ongoing adaptive management to improve methods for BTS rapid response, including detection of low-density snake populations using all technologies as they become available. The Navy will annually review BTS rapid response needs with the Service to mutually determine if refined methods need to be implemented; the Navy will support such refinement based on that mutual agreement. Support for this adaptive management approach will include financial support subject to Congressional funding guidelines and restrictions. All parties acknowledge financial suppport is subject to the availability of funds, and no provision herein shall be interpreted to require obligation of payment of funds in violation of the Anti-Deficiency Act, 31 U.S.C Section 1341.
Section 7 formal	Marianas	MILITARY TRAINING ACTIVITIES IN THE MARIANA ISLANDS TRAINING AND TESTING STUDY AREA: TERRESTRIAL SPECIES AND HABITATS	20-Feb-15	x	x	x				x	x		x	x																						7. MITT action proponents will provide support for BTS rapid response associated with a BTS sighting with the JRM AOR related to MIRC training activities subject to this consultation.
Section 7 formal	Marianas	MILITARY TRAINING ACTIVITIES IN THE MARIANA ISLANDS TRAINING AND TESTING STUDY AREA: TERRESTRIAL SPECIES AND HABITATS	20-Feb-15	x	x	x				x	x		x	x																						8. The Navy will provide brown treesnake awareness briefings for all military and contractor personnel prior to all MITT training activities. Brown treesnake awareness briefings will be scaled to the type of training activity to take place. Awareness materials may consist of a brown treesnake educational video and distribution of brown treesnake information and personal inspection guidelines. Awareness briefs will emphasize that brown treesnake awareness must extend through the chain of command from the Commanding Officer to the individual military service member.
Section 7 formal	Marianas	MILITARY TRAINING ACTIVITIES IN THE MARIANA ISLANDS TRAINING AND TESTING STUDY AREA: TERRESTRIAL SPECIES AND HABITATS	20-Feb-15	x	x	x				x	x		x	x																						9. Joint Region Marianas (JRM) will assure that "Area Training" coordinates meetings for BTS interdiction on all training activities for the training execution phase and an after-action review phase. If a snake is found during training, the Navy policy is to kill the snake and is reported to Navy Environmental Staff.
Section 7 formal	Marianas	MILITARY TRAINING ACTIVITIES IN THE MARIANA ISLANDS TRAINING AND TESTING STUDY AREA: TERRESTRIAL SPECIES AND HABITATS	20-Feb-15	x	x	x				x	x		x	x																						10. The Navy will invite the Service to participate in the development of regional standard operating procedures and exercise planning to better meet BTS management needs associated with MITT training.

Requirement	Location	Title	Project BO/BA/BE Date	Mariana fruit bat	Mariana swiftlet	Mariana common moorhen	Mariana crow	Micronesian kingfisher	Guam rail	Micronesian Megapode	Nightingale Reed-warbler	Serianthes nelsonii	Green sea turtle	Hawksbill sea turtle	Scalloped hammerhead	ESA Corals	EFH	Eugenia bryanii	Hedyotis megalantha	Heritiera longipetiolata	Phyllanthus saffordii	Psychotria malaspinae	Solanum guamense	Tinaspora homosepala	Bulbophyllum guamense	Cycas micronesica	Dendrobium guamense	Maesa walkeri	Nervilia jacksoniae	Tabernaemontana rotensis	Tuberolabium guamense	Mariana eight-spot butterfly	Guam tree snail	Humped tree snail	Fragile tree snail	Conservation Measure (One Per Row)
Section 7 formal	Marianas	MILITARY TRAINING ACTIVITIES IN THE MARIANA ISLANDS TRAINING AND TESTING STUDY AREA: TERRESTRIAL SPECIES AND HABITATS	20-Feb-15	x	x	x				x	x		x	x																						11. Prior to each exercise that involves the movement of equipment and troops between islands, a pathway risk analysis will be conducted and biosecurity protocols confirmed by the DoD (JRM). Implementation of biosecurity protocols will be a requirement for training. An adaptive management review of risk analyses and biosecurity protocols will be conducted periodically with the Service. Initially, this adaptive management review will include the development of Standard Operating Protocols (SOPs) for biosecurity by the DoN in support of training activities covered under the MITT program. These DON biosecurity SOPs will be reviewed by the Service when initially developed. Once the MITT program is implemented, MITT program-related SOPs will be reviewed with the Service annually.
Section 7 formal	Marianas	MILITARY TRAINING ACTIVITIES IN THE MARIANA ISLANDS TRAINING AND TESTING STUDY AREA: TERRESTRIAL SPECIES AND HABITATS	20-Feb-15	x	x	x				x	x		x	x																						12. In coordination with the Service, the DoD action agencies implementing MITT activities will establish a contractual agreement for adequate rapid response capabilities with appropriate agencies having invasive species rapid response expertise and technology within three months of the Service's issuance of this Biological Opinion. The contracted services will focus on control and eradication of introduced non-established, non-native invasive species sighted in the vicinity of: (1) DoD MITT training areas, and (2) DoD areas and facilities used for the staging, storage and movement of MITT personnel, cargo, and MITT-associated vehicles (e.g., planes, trucks, and vessels). Priority should be given to non-native invasive species that pose a high risk of being transported elsewhere due to MITT-related training actions. This arrangement will be in place until superseded by a regional rapid response plan. Monitoring will consist of the established protocols for USDA inspections, personnel awareness during pre-event preparations, and self-inspections. As noted above, an adaptive management review of risk analyses and biosecurity protocols will be conducted periodically with the Service. The regional rapid response plan discussed refers to the full implementation of a comprehensive Emergency Response Plan for Guam and the CNMI in association with the Regional Biosecurity Plan (RBP) for Micronesia and Hawaii. The RBP is discussed further in the MIRC re-initiation / MITT Biological Opinion.
Section 7 formal	Marianas	MILITARY TRAINING ACTIVITIES IN THE MARIANA ISLANDS TRAINING AND TESTING STUDY AREA: TERRESTRIAL SPECIES AND HABITATS	2015	x	x	x				x	x		x	x																						13. All personnel involved in MIRC/MITT training will be responsible for conducting self-inspections to avoid potential introductions of invasive species to Guam and the CNMI. Troops will inspect all gear and clothing (e.g., boots, bags, weapons, and clothing) for soil accumulations, seeds, invertebrates, and vertebrates).
Section 7 formal	Marianas	MILITARY TRAINING ACTIVITIES IN THE MARIANA ISLANDS TRAINING AND TESTING STUDY AREA: TERRESTRIAL SPECIES AND HABITATS	2015	x	x	x				x	x		x	x																						14. Navy will adhere to AFPMB Technical Guide 31 protocols on vehicle/equipment washdown procedures and other APHIS PPQ inspection procedures for deployments and redeployments.
Section 7 formal	Marianas	MILITARY TRAINING ACTIVITIES IN THE MARIANA ISLANDS TRAINING AND TESTING STUDY AREA: TERRESTRIAL SPECIES AND HABITATS	20-Feb-15	x	x	x				x	x		x	x																						15. The Navy will locate ground-disturbing training activities on previously disturbed sites whenever possible.
Section 7 formal	Marianas	MILITARY TRAINING ACTIVITIES IN THE MARIANA ISLANDS TRAINING AND TESTING STUDY AREA: TERRESTRIAL SPECIES AND HABITATS	20-Feb-15	x	x	x				x	x		x	x																						16. The Navy will ensure that all training areas, including transit routes necessary to reach training areas, are clearly identified or marked. Vehicular activities will be restricted to designated and previously identified areas.
Section 7 formal	Marianas	MILITARY TRAINING ACTIVITIES IN THE MARIANA ISLANDS TRAINING AND TESTING STUDY AREA: TERRESTRIAL SPECIES AND HABITATS	20-Feb-15	x	x	x				x	x		x	x																						17. The Navy will continue to control erosion through the "Site Approval Process," whereby the Navy environmental program reviews each proposed project for its erosion potential and involves the designated installation Natural Resource Specialist in the process.
Section 7 formal	Marianas	MILITARY TRAINING ACTIVITIES IN THE MARIANA ISLANDS TRAINING AND TESTING STUDY AREA: TERRESTRIAL SPECIES AND HABITATS	20-Feb-15	x	x	x				x	x		x	x																						18. The Navy will continue to manage erosion in accordance with the applicable storm water pollution prevention plan at each training location.

Requirement	Location	Title	Project BO/BA/BE Date	Mariana fruit bat	Mariana swiftlet	Mariana common moorhen	Mariana crow	Micronesian kingfisher	Guam rail	Micronesian Megapode	Nightingale Reed-warbler	Serianthes nelsonii	Green sea turtle	Hawksbill sea turtle	Scalloped hammerhead	ESA Corals	EFH	Eugenia bryanii	Hedyotis megalantha	Heritiera longipetiolata	Phyllanthus saffordii	Psychotria malaspinae	Solanum guamense	Tinaspora homosepala	Bulbophyllum guamense	Cycas micronesica	Dendrobium guamense	Maesa walkeri	Nervilia jacksoniae	Tabernaemontana rotensis	Tuberolabium guamense	Mariana eight-spot butterfly	Guam tree snail	Humped tree snail	Fragile tree snail	Conservation Measure (One Per Row)
Section 7 formal	Marianas	MILITARY TRAINING ACTIVITIES IN THE MARIANA ISLANDS TRAINING AND TESTING STUDY AREA: TERRESTRIAL SPECIES AND HABITATS	20-Feb-15	x	x	x				x	x		x	x																						19. The Navy will prohibit off-road vehicle use except in designated off-road areas or on established trails.
Section 7 formal	Marianas	MILITARY TRAINING ACTIVITIES IN THE MARIANA ISLANDS TRAINING AND TESTING STUDY AREA: TERRESTRIAL SPECIES AND HABITATS	20-Feb-15	x	x	x				x	x		x	x																						20. The Navy will comply with existing policies and management activities to conserve soils, including requirements and restrictions outlined in the Marianas Training Handbook.
Section 7 formal	Marianas	MILITARY TRAINING ACTIVITIES IN THE MARIANA ISLANDS TRAINING AND TESTING STUDY AREA: TERRESTRIAL SPECIES AND HABITATS	20-Feb-15	x	x	x				x	x		x	x																						21. FDM: The Navy will continue to implement targeting and access restrictions, such as: (1) no targeting of the northern Special Use Area (north of the No Fire Line) and no targeting of the narrow land bridge, (2) only targeting Impact Areas 1, 2, and 3 during air-to-ground bombing exercises and air-to-ground missile and gunnery exercises; Impact Area 1 (closest to the northern Special Use Area) is for inert ordnance only, and (3) personnel are not authorized on FDM without approval from JRM Operations.
Section 7 formal	Marianas	MILITARY TRAINING ACTIVITIES IN THE MARIANA ISLANDS TRAINING AND TESTING STUDY AREA: TERRESTRIAL SPECIES AND HABITATS	20-Feb-15	x	x	x				x	x		x	x																						22. FDM: Live cluster weapons/scatterable munitions, fuel air explosives, incendiary munitions, depleted uranium rounds, or bombs greater than 2,000 pounds will be prohibited. It should be noted that some spotting charges use small amounts of phosphorous but are not main constituents of munitions dropped on FDM. In addition, smoke markers will be used during some direct action activities for targeting.
Section 7 formal	Marianas	MILITARY TRAINING ACTIVITIES IN THE MARIANA ISLANDS TRAINING AND TESTING STUDY AREA: TERRESTRIAL SPECIES AND HABITATS	20-Feb-15	x	x	x				x	x		x	x																						23. FDM: Nesting sea turtles are not expected; however, it is possible that a sea turtle may be basking on beaches or resting in holes or caves. If a sea turtle is seen on a beach by participating aircraft, training will be altered until the sea turtle leaves the beach and nearby waters.
Section 7 formal	Marianas	MILITARY TRAINING ACTIVITIES IN THE MARIANA ISLANDS TRAINING AND TESTING STUDY AREA: TERRESTRIAL SPECIES AND HABITATS	20-Feb-15	x	x	x				x	x		x	x																						24. Saipan: Training in the Marpi Maneuver Area is expected to be infrequent and limited to pedestrian land navigation training.
Section 7 formal	Marianas	MILITARY TRAINING ACTIVITIES IN THE MARIANA ISLANDS TRAINING AND TESTING STUDY AREA: TERRESTRIAL SPECIES AND HABITATS	20-Feb-15	x	x	x				x	x		x	x																						24a. Saipan: Training in the Marpi Maneuver Area - Training will be limited to open areas (i.e., grasslands; no forest or mixed shrub and scrub habitats) to minimize impacts to nightingale reed-warblers, Mariana fruit bat, and Micronesian megapodes.
Section 7 formal	Marianas	MILITARY TRAINING ACTIVITIES IN THE MARIANA ISLANDS TRAINING AND TESTING STUDY AREA: TERRESTRIAL SPECIES AND HABITATS	20-Feb-15	x	x	x				x	x		x	x																						24b. Saipan: Training in the Marpi Maneuver Area - There will be no digging in the soil or cutting of vegetation along the southern border of the Marpi Maneuver Area in the mixed limestone forest. No ground disturbance or vegetation removal of any kind is permitted in this area to avoid impacts to the Micronesian megapode and Mariana fruit bat. Vegetation removal would be limited to the maintenance of existing bivouac areas. No new bivouac areas are proposed. Maneuver units will remain tactical and not establish support camps. This measure is designed to minimize potential impacts associated with ground maneuvers on the Micronesian megapode. No habitat will be removed for any training activity on Saipan.
Section 7 formal	Marianas	MILITARY TRAINING ACTIVITIES IN THE MARIANA ISLANDS TRAINING AND TESTING STUDY AREA: TERRESTRIAL SPECIES AND HABITATS	20-Feb-15	x	x	x				x	x		x	x																						24c. Saipan: Training in the Marpi Maneuver Area - Smoking is not permitted during training activities and fire-safe-portable receptacles for cigarette butts are used during periods of rest between training activities. No fires are permitted during bivouac activities.
Section 7 formal	Marianas	MILITARY TRAINING ACTIVITIES IN THE MARIANA ISLANDS TRAINING AND TESTING STUDY AREA: TERRESTRIAL SPECIES AND HABITATS	20-Feb-15	x	x	x				x	x		x	x																						24d. Saipan: Training in the Marpi Maneuver Area - If other areas are needed for training, the Navy will contact the Service regarding the need for reinitiation of this biological opinion.
Section 7 formal	Marianas	MILITARY TRAINING ACTIVITIES IN THE MARIANA ISLANDS TRAINING AND TESTING STUDY AREA: TERRESTRIAL SPECIES AND HABITATS	20-Feb-15	x	x	x				x	x		x	x																						24e. Saipan: Training in the Marpi Maneuver Area - All training activities that involve ground maneuvers in the Saipan Marpi Maneuver Area will be consistent with the fire management plan included in COMNAVMARIANASINST 3500.4A.

Requirement	Location	Title	Project BO/BA/BE Date	Mariana fruit bat	Mariana swiftlet	Mariana common moorhen	Mariana crow	Micronesian kingfisher	Guam rail	Micronesian Megapode	Nightingale Reed-warbler	Serianthes nelsonii	Green sea turtle	Hawksbill sea turtle	Scalloped hammerhead	ESA Corals	EFH	Eugenia bryanii	Hedyotis megalantha	Heritiera longipetiolata	Phyllanthus saffordii	Psychotria malaspinae	Solanum guamense	Tinaspora homosepala	Bulbophyllum guamense	Cycas micronesica	Dendrobium guamense	Maesa walkeri	Nervilia jacksoniae	Tabernaemontana rotensis	Tuberolabium guamense	Mariana eight-spot butterfly	Guam tree snail	Humped tree snail	Fragile tree snail	Conservation Measure (One Per Row)
Section 7 formal	Marianas	MILITARY TRAINING ACTIVITIES IN THE MARIANA ISLANDS TRAINING AND TESTING STUDY AREA: TERRESTRIAL SPECIES AND HABITATS	20-Feb-15	x	x	x				x	x		x	x																						25. Saipan: JRM will coordinate with CNMI-DLNR to determine the latest species locations as necessary prior to training actions. If a training exercise cannot be modified to avoid impacts on listed ESA species, the Navy will contact the Service as required by Section 7 of the ESA prior to conducting the training exercise. If CNMI-DLNR is not able to assist with best available data or surveys, Joint Region Marianas will provide in-house or contracted subject matter experts to conduct surveys if necessary.
Section 7 formal	Marianas	MILITARY TRAINING ACTIVITIES IN THE MARIANA ISLANDS TRAINING AND TESTING STUDY AREA: TERRESTRIAL SPECIES AND HABITATS	20-Feb-15	x	x	x				x	x		x	x																						26. Tinian: All training activities that involve ground maneuvers on Tinian Military Lease Area will be consistent with the fire management plan included in COMNAVMARIANASINST 3500.4A.
Section 7 formal	Marianas	MILITARY TRAINING ACTIVITIES IN THE MARIANA ISLANDS TRAINING AND TESTING STUDY AREA: TERRESTRIAL SPECIES AND HABITATS	20-Feb-15	x	x	x				x	x		x	x																						27. Tinian: The Navy will locate ground-disturbing training activities on previously disturbed sites whenever possible. Training areas, including transit routes necessary to reach training areas will be clearly marked. On Tinian, vehicular activities will be restricted to designated and previously identified areas.
Section 7 formal	Marianas	MILITARY TRAINING ACTIVITIES IN THE MARIANA ISLANDS TRAINING AND TESTING STUDY AREA: TERRESTRIAL SPECIES AND HABITATS	20-Feb-15	x	x	x				x	x		x	x																						28. Tinian: The Navy will implement training restrictions at Unai Chulu, Unai Babui, and Unai Dankulo to avoid and minimize effects to sea turtles:
Section 7 formal	Marianas	MILITARY TRAINING ACTIVITIES IN THE MARIANA ISLANDS TRAINING AND TESTING STUDY AREA: TERRESTRIAL SPECIES AND HABITATS	20-Feb-15	x	x	x				x	x		x	x																						28a. Tinian: Training Restrictions - Unai Chulu, Unai Babui, and Unai Dankulo will not be designated as landing zones for mechanized amphibious vehicles at this time. Should mechanized amphibious vehicles (AAV and LCAC) landings on those beaches become necessary, Navy will reinitiate consultation for those activities.
Section 7 formal	Marianas	MILITARY TRAINING ACTIVITIES IN THE MARIANA ISLANDS TRAINING AND TESTING STUDY AREA: TERRESTRIAL SPECIES AND HABITATS	20-Feb-15	x	x	x				x	x		x	x																						28b. Tinian: Unai Chulu, Unai Babui, and Unai Dankulo - Biologists trained in identifying sea turtle nests will survey landing beaches no more than six hours prior to the first non-mechanized craft landing or use of other beach landing equipment that is part of a training event that requires use of the beach. Any potential sea turtle nests will be flagged and avoided by landing craft and personnel, vehicles (including non-mechanized water craft) and equipment. The buffer zone will have a radius of 6 meters (20 feet) from the edge of the nesting activity (area disturbed by the turtle) to ensure complete avoidance. Use of a beach monitor during the training event and turtle-friendly lighting will avoid impacts to nesting females.
Section 7 formal	Marianas	MILITARY TRAINING ACTIVITIES IN THE MARIANA ISLANDS TRAINING AND TESTING STUDY AREA: TERRESTRIAL SPECIES AND HABITATS	20-Feb-15	x	x	x				x	x		x	x																						28c. Tinian: Unai Chulu, Unai Babui, and Unai Dankulo - If an active nest has been discovered, night-training will not occur after 50 days of incubation until the nest has hatched OR a buffer (9 meters [30 feet] wide) from the active nest to the water will be in place to avoid any potential impacts to sea turtle hatchlings trying to reach the ocean. If an active nest has been discovered, night-training will not occur once a prehatch hole is detected. (A pre-hatch hole indicates that the nest will hatch that evening.) Evening training may resume five days after the pre-hatch hole is discovered.
Section 7 formal	Marianas	MILITARY TRAINING ACTIVITIES IN THE MARIANA ISLANDS TRAINING AND TESTING STUDY AREA: TERRESTRIAL SPECIES AND HABITATS	20-Feb-15	x	x	x				x	x		x	x																						28d. Tinian: Unai Chulu, Unai Babui, and Unai Dankulo - For any training on beaches at night during the sea turtle nesting season, only turtle-friendly lighting will be used. No lighting will be used in the vicinity of nests that are past 50 days of incubation.
Section 7 formal	Marianas	MILITARY TRAINING ACTIVITIES IN THE MARIANA ISLANDS TRAINING AND TESTING STUDY AREA: TERRESTRIAL SPECIES AND HABITATS	20-Feb-15	x	x	x				x	x		x	x																						29. Tinian: Improvements to any beaches to facilitate training will be coordinated with the Service if the action may affect listed species.
Section 7 formal	Marianas	MILITARY TRAINING ACTIVITIES IN THE MARIANA ISLANDS TRAINING AND TESTING STUDY AREA: TERRESTRIAL SPECIES AND HABITATS	20-Feb-15	x	x	x				x	x		x	x																						30. Tinian: On Tinian, Hagoi and adjacent areas are designated as a “No Training Area.” No ground disturbance or vegetation removal of any kind is permitted in this area. This measure is designed to avoid impacts associated with ground training activities on the Mariana common moorhen. Training also does not occur in the Bateha or Mahalang wetlands areas.

Requirement	Location	Title	Project BO/BA/BE Date	Mariana fruit bat	Mariana swiftlet	Mariana common moorhen	Mariana crow	Micronesian kingfisher	Guam rail	Micronesian Megapode	Nightingale Reed-warbler	Serianthes nelsonii	Green sea turtle	Hawksbill sea turtle	Scalloped hammerhead	ESA Corals	EFH	Eugenia bryanii	Hedyotis megalantha	Heritiera longipetiolata	Phyllanthus saffordii	Psychotria malaspinae	Solanum guamense	Tinaspora homosepala	Bulbophyllum guamense	Cycas micronesica	Dendrobium guamense	Maesa walkeri	Nervilia jacksoniae	Tabernaemontana rotensis	Tuberolabium guamense	Mariana eight-spot butterfly	Guam tree snail	Humped tree snail	Fragile tree snail	Conservation Measure (One Per Row)
Section 7 formal	Marianas	MILITARY TRAINING ACTIVITIES IN THE MARIANA ISLANDS TRAINING AND TESTING STUDY AREA: TERRESTRIAL SPECIES AND HABITATS	20-Feb-15	x	x	x				x	x		x	x																						31. Tinian: Aircraft overflights are restricted over Tinian wetland areas (Hagoi, Mahalang, and Bateha). If aircraft must fly over wetlands during training exercises, the aircraft must maintain a minimum altitude of 1,000 feet (305 meters) AGL. This measure is designed to minimize visual and noise disturbance for Mariana common moorhens, and to reduce the potential for aircraft strike.
Section 7 formal	Marianas	MILITARY TRAINING ACTIVITIES IN THE MARIANA ISLANDS TRAINING AND TESTING STUDY AREA: TERRESTRIAL SPECIES AND HABITATS	20-Feb-15	x	x	x				x	x		x	x																						32. Tinian: On Tinian, training does not occur in limestone forests, found within the Tinian MLA along ridgelines associated with Mount Lasso (see COMMNAVMARIANAS 3500.4A, Figure 5-2). This measure is designed to avoid impacts associated with ground training activities on the Micronesian megapode. Vegetation removal would be limited to the maintenance of existing bivouac areas. No new bivouac areas are proposed. Maneuver units will remain tactical and not establish support camps. This measure is designed to minimize potential impacts associated with ground maneuvers on the Micronesian megapode.
Section 7 formal	Marianas	MILITARY TRAINING ACTIVITIES IN THE MARIANA ISLANDS TRAINING AND TESTING STUDY AREA: TERRESTRIAL SPECIES AND HABITATS	20-Feb-15	x	x	x				x	x		x	x																						33. Tinian: Aircraft overflights are restricted over limestone forest areas of Tinian, which are found within the Tinian MLA along ridgelines in the Mount Lasso area. If aircraft must fly over limestone forests during training exercises, the aircraft must maintain a minimum altitude of 1,000 feet (305 meters) AGL. This measure is designed to minimize visual and noise disturbance of Micronesian megapodes and fruit bats and to reduce the potential for aircraft strike (see COMNAVMARIANASINST 3500.4A, Figure 5-2.
Section 7 formal	Marianas	MILITARY TRAINING ACTIVITIES IN THE MARIANA ISLANDS TRAINING AND TESTING STUDY AREA: TERRESTRIAL SPECIES AND HABITATS	20-Feb-15	x	x	x				x	x		x	x																						Tinian: Fire Prevention - No live-fire or tracer rounds will be used on Tinian except with the use of bullet traps. Use of pyrotechnics, flares, blank fire, and other potential fire-starting activities must be conducted on existing cleared runways and in accordance with the Fire Prevention Plan. The area authorized for open fires and pyrotechnics is restricted to the North Field and West Field on hardtop surfaces only (except for actual emergency signaling).
Section 7 formal	Marianas	MILITARY TRAINING ACTIVITIES IN THE MARIANA ISLANDS TRAINING AND TESTING STUDY AREA: TERRESTRIAL SPECIES AND HABITATS	20-Feb-15	x	x	x				x	x		x	x																						35. Tinian: Cooking by individuals is not authorized in outdoor training areas (except for heating tabs and mechanisms in "meals ready to eat"). Large scale training exercises may include field kitchens in North Field in areas authorized for open fire.
Section 7 formal	Marianas	MILITARY TRAINING ACTIVITIES IN THE MARIANA ISLANDS TRAINING AND TESTING STUDY AREA: TERRESTRIAL SPECIES AND HABITATS	20-Feb-15	x	x	x				x	x		x	x																						36. Tinian: North Field's existing runways and taxiways act as fire breaks and fire access roads, and the vegetation is primarily characterized by tangantangan (*Leucaena leucocephala*) thickets. Standard Operating Procedures for all exercises include fire response measures that must be implemented.
Section 7 formal	Marianas	MILITARY TRAINING ACTIVITIES IN THE MARIANA ISLANDS TRAINING AND TESTING STUDY AREA: TERRESTRIAL SPECIES AND HABITATS	20-Feb-15	x	x	x				x	x		x	x																						37. Tinian: To date, no wildland fire has been ignited from MIRC training activities on Tinian (or on other DoD lands in the Mariana Islands). However, to further minimize risk and augment military fire response efforts, the Tinian Fire Department maintains a 300-gallon pump truck and fire crew to respond to wildland fires. The Tinian Fire Department also maintains a 750-gallon pumper truck and crew in San Jose to respond to and provide fire service for the southern Tinian and backup Crash-Fire-Rescue support to West Field. The Navy will request the use of Tinian Fire Department assets for major exercises. The request will be made through the West Field command post. The Navy will maintain airfield crash-fire-rescue equipment and crews at North Field for the duration of the exercise. Any military related fires will be controlled prior to the loss of any wetland or native limestone forest habitat is burned. Any military related fires in tangantangan will be controlled prior to the loss of five acres tangantangan habitat.

Requirement	Location	Title	Project BO/BA/BE Date	Mariana fruit bat	Mariana swiftlet	Mariana common moorhen	Mariana crow	Micronesian kingfisher	Guam rail	Micronesian Megapode	Nightingale Reed-warbler	Serianthes nelsonii	Green sea turtle	Hawksbill sea turtle	Scalloped hammerhead	ESA Corals	EFH	Eugenia bryanii	Hedyotis megalantha	Heritiera longipetiolata	Phyllanthus saffordii	Psychotria malaspinae	Solanum guamense	Tinaspora homosepala	Bulbophyllum guamense	Cycas micronesica	Dendrobium guamense	Maesa walkeri	Nervilia jacksoniae	Tabernaemontana rotensis	Tuberolabium guamense	Mariana eight-spot butterfly	Guam tree snail	Humped tree snail	Fragile tree snail	Conservation Measure (One Per Row)
Section 7 formal	Marianas	MILITARY TRAINING ACTIVITIES IN THE MARIANA ISLANDS TRAINING AND TESTING STUDY AREA: TERRESTRIAL SPECIES AND HABITATS	20-Feb-15	x	x	x				x	x		x	x																						38. Rota: No training activities will occur near or within critical habitat, habitat occupied by listed species, or other habitats designed for conservation use. If such activities are planned in the future, the Navy will consult with the USFWS pursuant to section 7 of the ESA. Prior to planning exercises on Rota, MIRC Operations (OPS) will coordinate with appropriate local officials on Rota to determine the latest status of species (e.g., species locations). MITT training will be planned such that ESA species will be avoided in accordance with the "areas to be avoided" map provided by USFWS. In May 2014, USFWS provided a map that represents all areas to be avoided that could be occupied by ESA-listed species at any time throughout the year. This map was overlaid with proposed training locations, critical habitat, and other conservation areas resulting in MITT Biological Assessment Figure 3-1 (August 2014). Green shaded areas represent all areas that could be occupied by ESA-listed species at any time throughout the year. These areas are not proposed for training.
Section 7 formal	Marianas	MILITARY TRAINING ACTIVITIES IN THE MARIANA ISLANDS TRAINING AND TESTING STUDY AREA: TERRESTRIAL SPECIES AND HABITATS	20-Feb-15	x	x	x				x	x		x	x																						39. Rota: Aircraft overflights on Rota, with the exception of landings and takeoffs as part of training exercises (landings, takeoffs, and insertion events at the Rota International Airport), are prohibited below 1,000 feet (305 meters) AGL and within 1,000 feet of coastlines.
Section 7 formal	Marianas	MILITARY TRAINING ACTIVITIES IN THE MARIANA ISLANDS TRAINING AND TESTING STUDY AREA: TERRESTRIAL SPECIES AND HABITATS	20-Feb-15	x	x	x				x	x		x	x																						40. Rota: Activities that involve aircraft training primarily occur on Guam. Rota will only be used when other locations on Guam or the CNMI are not available, use of these locations is not practical, and/or the training mission requirements cannot be met without the use of Rota.
Section 7 formal	Marianas	MILITARY TRAINING ACTIVITIES IN THE MARIANA ISLANDS TRAINING AND TESTING STUDY AREA: TERRESTRIAL SPECIES AND HABITATS	20-Feb-15	x	x	x				x	x		x	x																						41. Guam: "No Wildlife Disturbance" and "No Training Areas" are designated on Naval Base Guam Orote Point, Naval Base Guam Munitions Site, and Andersen AFB Tarague Beach. Vegetation removal would be limited to maintaining existing bivouac areas. No new bivouac areas are proposed in the MITT BA. Maneuver units will remain tactical and not establish support camps.
Section 7 formal	Marianas	MILITARY TRAINING ACTIVITIES IN THE MARIANA ISLANDS TRAINING AND TESTING STUDY AREA: TERRESTRIAL SPECIES AND HABITATS	20-Feb-15	x	x	x				x	x		x	x																						42. Guam: All training activities that involve ground maneuvers on Guam will be consistent with the fire management plan included in COMNAVMARIANASINST 3500.4A. DoD will continue to implement the following restrictions at all action areas on Andersen Air Force Base:
Section 7 formal	Marianas	MILITARY TRAINING ACTIVITIES IN THE MARIANA ISLANDS TRAINING AND TESTING STUDY AREA: TERRESTRIAL SPECIES AND HABITATS	20-Feb-15	x	x	x				x	x		x	x																						42a. Guam: AAFB - No vegetation clearing except: maintenance required to keep paved surfaces, landing zones, and the drop zones in a safe and useable condition and for bivouac purposes in the bivouac area. Tree species greater than 4-inches in diameter used for foraging, roosting, or nesting of bats and crows will not be removed.
Section 7 formal	Marianas	MILITARY TRAINING ACTIVITIES IN THE MARIANA ISLANDS TRAINING AND TESTING STUDY AREA: TERRESTRIAL SPECIES AND HABITATS	20-Feb-15	x	x	x				x	x		x	x																						42b. Guam: AAFB - Motorized vehicles shall be driven only on prepared surfaces, in the drop zone and landing zones as required and only rubber-tired vehicles will be allowed; no digging is allowed except in the Northwest Field bivouac area; and no harassment or killing of native wildlife is allowed.
Section 7 formal	Marianas	MILITARY TRAINING ACTIVITIES IN THE MARIANA ISLANDS TRAINING AND TESTING STUDY AREA: TERRESTRIAL SPECIES AND HABITATS	20-Feb-15	x	x	x				x	x		x	x																						42c. Guam: AAFB - Use of pyrotechnics and other incendiary devices is limited to paved surfaces, ground pits, or ceramic-lined rooms.
Section 7 formal	Marianas	MILITARY TRAINING ACTIVITIES IN THE MARIANA ISLANDS TRAINING AND TESTING STUDY AREA: TERRESTRIAL SPECIES AND HABITATS	20-Feb-15	x	x	x				x	x		x	x																						43. Guam: AAFB - Helicopter overflights as part of training activities are prohibited below 1,000 feet (305 meters) above ground level (AGL) over Northwest Field north of the South Runway. This measure is designed to minimize visual disturbance and acoustic noise impacts on foraging or roosting Mariana fruit bats in the Northwest Field area. The satellite tracking station located at Northwest Field also has a flight restriction of 2,500 feet (760 meters) AGL within 1 nautical mile of the station.
Section 7 formal	Marianas	MILITARY TRAINING ACTIVITIES IN THE MARIANA ISLANDS TRAINING AND TESTING STUDY AREA: TERRESTRIAL SPECIES AND HABITATS	20-Feb-15	x	x	x				x	x		x	x																						44. Guam: AAFB - Overflights as part of training activities along all Andersen AFB clifflines are prohibited below 1,000 feet (305 meters) AGL.

Requirement	Location	Title	Project BO/BA/BE Date	Mariana fruit bat	Mariana swiftlet	Mariana common moorhen	Mariana crow	Micronesian kingfisher	Guam rail	Micronesian Megapode	Nightingale Reed-warbler	Serianthes nelsonii	Green sea turtle	Hawksbill sea turtle	Scalloped hammerhead	ESA Corals	EFH	Eugenia bryanii	Hedyotis megalantha	Heritiera longipetiolata	Phyllanthus saffordii	Psychotria malaspinae	Solanum guamense	Tinaspora homosepala	Bulbophyllum guamense	Cycas micronesica	Dendrobium guamense	Maesa walkeri	Nervilia jacksoniae	Tabernaemontana rotensis	Tuberolabium guamense	Mariana eight-spot butterfly	Guam tree snail	Humped tree snail	Fragile tree snail	Conservation Measure (One Per Row)
Section 7 formal	Marianas	MILITARY TRAINING ACTIVITIES IN THE MARIANA ISLANDS TRAINING AND TESTING STUDY AREA: TERRESTRIAL SPECIES AND HABITATS	20-Feb-15	x	x	x				x	x		x	x																						45. Guam: NBGMS - Helicopter overflights as part of training activities are restricted throughout the Naval Base Guam Munitions Site below 500 feet (150 meters) AGL. Fixed-wing aircraft are restricted below 1,000 feet (305 meters) AGL as part of training activities.
Section 7 formal	Marianas	MILITARY TRAINING ACTIVITIES IN THE MARIANA ISLANDS TRAINING AND TESTING STUDY AREA: TERRESTRIAL SPECIES AND HABITATS	20-Feb-15	x	x	x				x	x		x	x																						46. Guam: NBGMS - Riparian wetlands are dispersed throughout the Southern Land Navigation Area and recent surveys have detected moorhens in this area. No maneuver and navigation training will occur in riparian wetlands in this area, in accordance with COMNAVMARIANASINST 3500.4A (Table 3-4, pg. 38 and Fig 3-10, pg. 40).
Section 7 formal	Marianas	MILITARY TRAINING ACTIVITIES IN THE MARIANA ISLANDS TRAINING AND TESTING STUDY AREA: TERRESTRIAL SPECIES AND HABITATS	20-Feb-15	x	x	x				x	x		x	x																						47. Guam: NBG - Continuance of amphibious landing standard operating procedures; observation of normal harbor navigation rules, pre-exercise surveys for presence of sea turtles no more than six hours prior to an exercise, directing landing crafts to areas determined to be clear of sea turtles and sea turtle nests, restoration of beach topography using hand tools after exercises, monitoring of landing sites during night-time landing activities). These include:
Section 7 formal	Marianas	MILITARY TRAINING ACTIVITIES IN THE MARIANA ISLANDS TRAINING AND TESTING STUDY AREA: TERRESTRIAL SPECIES AND HABITATS	20-Feb-15	x	x	x				x	x		x	x																						47a. Guam: NBG - The Navy implements restrictions on landings and launches at beach and boat ramp locations to minimize impacts to sea turtles and their habitats.
Section 7 formal	Marianas	MILITARY TRAINING ACTIVITIES IN THE MARIANA ISLANDS TRAINING AND TESTING STUDY AREA: TERRESTRIAL SPECIES AND HABITATS	20-Feb-15	x	x	x				x	x		x	x																						47b. Guam: NBG - The Navy maintains restrictions on landings and launches, such as the use of the concrete boat ramp at Sumay Cove which is across from potential sea turtle nesting habitat.
Section 7 formal	Marianas	MILITARY TRAINING ACTIVITIES IN THE MARIANA ISLANDS TRAINING AND TESTING STUDY AREA: TERRESTRIAL SPECIES AND HABITATS	20-Feb-15	x	x	x				x	x		x	x																						47c. Guam: NBG - The Navy implements speed restrictions to avoid creating wakes; the use of the Sumay Cove ramp avoids and minimizes effects to sea turtle nesting sites.
Section 7 formal	Marianas	MILITARY TRAINING ACTIVITIES IN THE MARIANA ISLANDS TRAINING AND TESTING STUDY AREA: TERRESTRIAL SPECIES AND HABITATS	20-Feb-15	x	x	x				x	x		x	x																						47d. Guam: NBG - Currently, training does not occur on other Guam beaches that support sea turtles. Should the Navy decide to use other Guam beaches for amphibious landings, the Navy will implement appropriate measures.
Section 7 formal	Marianas	MILITARY TRAINING ACTIVITIES IN THE MARIANA ISLANDS TRAINING AND TESTING STUDY AREA: TERRESTRIAL SPECIES AND HABITATS	20-Feb-15	x	x	x				x	x		x	x																						48 Guam: Andersen AFB - The USAF implements training and operation restrictions at the Combat Arms Training and Marksmanship (CATM) range adjacent to Tarague Beach, Andersen AFB to minimize effects to sea turtles and Mariana fruit bat.
Section 7 formal	Marianas	MILITARY TRAINING ACTIVITIES IN THE MARIANA ISLANDS TRAINING AND TESTING STUDY AREA: TERRESTRIAL SPECIES AND HABITATS	20-Feb-15	x	x	x				x	x		x	x																						48a. Guam: Andersen AFB - Night-training occurs at the CATM range; therefore night-lighting is installed. The lighting configuration at this location is maintained with four flood lights, located below the tree canopy level that are directed inland and parallel to the coast. Lighting in this configuration will avoid impacts to nesting and hatching sea turtles and Mariana fruit bats.
Section 7 formal	Marianas	MILITARY TRAINING ACTIVITIES IN THE MARIANA ISLANDS TRAINING AND TESTING STUDY AREA: TERRESTRIAL SPECIES AND HABITATS	20-Feb-15	x	x	x				x	x		x	x																						48b. Guam: Andersen AFB - The CATM range allows for training with small arms, inert mortars to 60 millimeter, and 40 millimeter grenade launchers. These weapons do not produce percussive force and no weapons that produce percussive force can be used at this facility.
Section 7 formal	Marianas	MILITARY TRAINING ACTIVITIES IN THE MARIANA ISLANDS TRAINING AND TESTING STUDY AREA: TERRESTRIAL SPECIES AND HABITATS	28-Feb-16	x	x	x				x	x		x	x																						1.1 Terms & Conditions (Revised) - The DoD action agencies for the MITT program shall provide funding, not to exceed $1.77 million, for invasive vertebrate pest control to be implemented by the Service to minimize the effect of take on the Micronesian megapode. The Service will be responsible for identifying where invasive vertebrate pest control will be conducted; complying with all applicable legal requirements and obtaining required approvals; providing DoD with an implementation plan and associated budget; implementing the control action; and responding to related media inquiries. Except for providing the necessary funding, DoD is not responsible for project implementation or the results thereof, and failure to implement the control project or achieve the desired results will no be a cause for reinitiation.

Requirement	Location	Title	Project BO/BA/BE Date	Mariana fruit bat	Mariana swiftlet	Mariana common moorhen	Mariana crow	Micronesian kingfisher	Guam rail	Micronesian Megapode	Nightingale Reed-warbler	Serianthes nelsonii	Green sea turtle	Hawksbill sea turtle	Scalloped hammerhead	ESA Corals	EFH	Eugenia bryanii	Hedyotis megalantha	Heritiera longipetiolata	Phyllanthus saffordii	Psychotria malaspinae	Solanum guamense	Tinaspora homosepala	Bulbophyllum guamense	Cycas micronesica	Dendrobium guamense	Maesa walkeri	Nervilia jacksoniae	Tabernaemontana rotensis	Tuberolabium guamense	Mariana eight-spot butterfly	Guam tree snail	Humped tree snail	Fragile tree snail	Conservation Measure (One Per Row)
Section 7 formal	Marianas	MILITARY TRAINING ACTIVITIES IN THE MARIANA ISLANDS TRAINING AND TESTING STUDY AREA: TERRESTRIAL SPECIES AND HABITATS	20-Feb-15	x	x	x				x	x		x	x																						2.1 Terms & Conditions: FDM - The DoD action agencies for the MITT program shall establish a formal protocol for the timing and implementation of megapode surveys on FDM in coordination with and the approval of the Service within 180 days of issuance date of the accompanying Opinion.
Section 7 formal	Marianas	MILITARY TRAINING ACTIVITIES IN THE MARIANA ISLANDS TRAINING AND TESTING STUDY AREA: TERRESTRIAL SPECIES AND HABITATS	20-Feb-15	x	x	x				x	x		x	x																						2.2 Terms & Conditions - FDM: The DoD action agencies for the MITT program shall conduct surveys for the Micronesian megapode along trails or paths that have been established during target refurbishment and operational range clearance activities. The results of these surveys shall be used as an index of megapode population change over time due to take impacts on FDM caused by the proposed action. Mariana fruit bats observed during surveys shall be recorded.
Section 7 formal	Marianas	MILITARY TRAINING ACTIVITIES IN THE MARIANA ISLANDS TRAINING AND TESTING STUDY AREA: TERRESTRIAL SPECIES AND HABITATS	20-Feb-15	x	x	x				x	x		x	x																						2.3 Terms & Conditions - FDM: The DoD action agencies for the MITT program shall establish an appropriate monitoring protocol for ground surveys in conjunction with range maintenance activities on FDM to monitor megapode and bat habitat changes over time on FDM, and for reporting the results of this analysis in coordination with and the approval of the Service within 180 days of the issuance date of the accompanying Opinion.
Section 7 formal	Marianas	MILITARY TRAINING ACTIVITIES IN THE MARIANA ISLANDS TRAINING AND TESTING STUDY AREA: TERRESTRIAL SPECIES AND HABITATS	20-Feb-15	x	x	x				x	x		x	x																						2.4 Terms & Conditions - The DoD action agencies for the MITT program shall provide the results of surveys and the change in habitat on FDM and concisely discuss the successes and challenges of implementing all the avoidance, minimization and conservation measures and terms and conditions listed in the Biological Opinion in an annual report submitted to the Service. The report also shall include the changes to the no impact area as a result of the accidental bombing and destroyed targets entering this area. The report is due at the end of the calendar year, December 31st, for the life of the project.
Section 7 formal (consultation in progress - CMs are tentative)	Guam	Re-Initiation of Consultation regarding the Proposed Military Relocation to Guam	7-Jul-05	x	x		x	x	x			x	x	x																						Brown Treesnake Research and Suppression - The DON has initiated support for large-scale, long-term efforts to refine methods for BTS control that will reduce the snake population on a landscape level more cost-effectively and increase the efficacy of capturing snakes in low-density situations. In early FY12, the DON coordinated with the USFWS, USDA, and U.S. Geological Survey (USGS) on priority BTS research projects. The development of a bait formulation for BTS suppression was determined to be the highest priority research need. The USDA National Wildlife Research Center (NWRC) was funded for a multi-year project by the DON at the start of FY13 to implement the bait formulation research. The DON will continue to fund selected research/design projects identified as priorities in the Brown Treesnake Technical Working Group Strategic Plan that are compatible with the military mission on Guam for up to 10 years from the start of main cantonment construction. Dependent upon the success of current experimental suppression activities within the Habitat Management Unit (HMU) or identification of an effective alternate technology, the DON will install a BTS barrier to exclude BTS from approximately 160 acres (65 ha). If the DON is successful at eradicating BTS within the 160 acres, the DON will install a second BTS barrier to exclude BTS from approximately 300 acres (121 ha). In response to decreased BTS densities, the rodent and feral cat population is expected to increase. In order to address this anticipated increase the DON will implement rodent and feral cat control. Rodent control would benefit recovery habitat as rodents consume seeds. Feral cat control would benefit the recovery of endangered birds as cats predate on native birds. The BTS fence areas are also areas proposed for forest enhancement.
Section 7 informal	Marianas	Informal Consultation on Mariana Islands Training and Testing Program Affects to Eighteen Newly-Listed Species, Guam and Tinian	10-Jun-16															x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	Guam: Training areas, including transit routes necessary to reach training areas, are clearly identified and marked. Vehicular activities will be restricted to designated and previously identified areas.
Section 7 informal	Marianas	Informal Consultation on Mariana Islands Training and Testing Program Affects to Eighteen Newly-Listed Species, Guam and Tinian	10-Jun-16															x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	Guam: The Navy will continue to control erosion through the "Site Approval Process," whereby the Navy environmental program reviews each proposed project for its erosion potential and involves the designated installation Natural Resource Specialist in the process.

Implementation and Tracking Table for Biological Opinions and Associated Conservation Measures

Requirement	Location	Title	Project BO/BA/BE Date	Mariana fruit bat	Mariana swiftlet	Mariana common moorhen	Mariana crow	Micronesian kingfisher	Guam rail	Micronesian Megapode	Nightingale Reed-warbler	Serianthes nelsonii	Green sea turtle	Hawksbill sea turtle	Scalloped hammerhead	ESA Corals	EFH	Eugenia bryanii	Hedyotis megalantha	Heritiera longipetiolata	Phyllanthus saffordii	Psychotria malaspinae	Solanum guamense	Tinaspora homosepala	Bulbophyllum guamense	Cycas micronesica	Dendrobium guamense	Maesa walkeri	Nervilia jacksoniae	Tabernaemontana rotensis	Tuberolabium guamense	Mariana eight-spot butterfly	Guam tree snail	Humped tree snail	Fragile tree snail	Conservation Measure (One Per Row)
Section 7 informal	Marianas	Informal Consultation on Mariana Islands Training and Testing Program Affects to Eighteen Newly-Listed Species, Guam and Tinian	10-Jun-16															x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	Guam: The Navy will continue to manage erosion in accordance with applicable storm water pollution prevention plan at each training location.
Section 7 informal	Marianas	Informal Consultation on Mariana Islands Training and Testing Program Affects to Eighteen Newly-Listed Species, Guam and Tinian	10-Jun-16															x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	Guam: The Navy will prohibit off-road vehicle use except in designated off-road areas or on established trails.
Section 7 informal	Marianas	Informal Consultation on Mariana Islands Training and Testing Program Affects to Eighteen Newly-Listed Species, Guam and Tinian	10-Jun-16															x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	Guam: The Navy will comply with existing policies and management activities to conserve soils, including requirements and restrictions outlined in COMNAVMARIANASINT 3500.4A (U.S. Department of the Navy, 2013).
Section 7 informal	Marianas	Informal Consultation on Mariana Islands Training and Testing Program Affects to Eighteen Newly-Listed Species, Guam and Tinian	10-Jun-16															x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	Guam: "No Wildlife Disturbance" and "No Training Areas" are designated on NBG Munitions Site and AAFB Tarague Beach. Vegetation removal is limited to maintaining existing bivouac areas, and no support camps will be established.
Section 7 informal	Marianas	Informal Consultation on Mariana Islands Training and Testing Program Affects to Eighteen Newly-Listed Species, Guam and Tinian	10-Jun-16																								x								Tinian: The Navy will locate ground-disturbing training activities on previously disturbed sites whenever possible,. Training areas, including transit routes necessary to reach training areas, will be clearly marked, with vehicular activities restricted to designated and previously identified areas.
Section 7 informal	Marianas	Informal Consultation on Mariana Islands Training and Testing Program Affects to Eighteen Newly-Listed Species, Guam and Tinian	10-Jun-16																								x								Tinian: Training does not occur within Hagoi or adjacent areas designated as a "No Training Area," and no vegetation removal of any kind is permitted in this location. Training also does not occur in the Bateha or Mahalang wetland areas.
Section 7 informal	Marianas	Informal Consultation on Mariana Islands Training and Testing Program Affects to Eighteen Newly-Listed Species, Guam and Tinian	10-Jun-16																								x								Tinian: Training does not occur in limestone forests, found within the MLA along ridgelines associated with Mount Lasso. Vegetation removal would be limited to the maintenance of existing bivouac areas and maneuver units will remain tactical and not establish support camps.
Section 7 informal	Marianas	Informal Consultation on Mariana Islands Training and Testing Program Affects to Eighteen Newly-Listed Species, Guam and Tinian	10-Jun-16															x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	Guam: Riparian wetlands are dispersed through the Southern Land Navigation Area; no maneuver and navigation training occurs within riparian wetlands in this area, in accordance with U.S. Department of the Navy, 2013 (Table 3-4, page 38; and Figure 3-10, page 40).
Section 7 informal	Marianas	Informal Consultation on Mariana Islands Training and Testing Program Affects to Eighteen Newly-Listed Species, Guam and Tinian	10-Jun-16															x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	Guam: All training activities that involve ground maneuvers on Guam will be consistent with the fire management plan included in COMNAVMARIANAISNT 3500.4A (U.S. Department of the Navy, 2013 (Appendix B).
Section 7 informal	Marianas	Informal Consultation on Mariana Islands Training and Testing Program Affects to Eighteen Newly-Listed Species, Guam and Tinian	10-Jun-16																								x								Tinian: All training activities that involve ground maneuvers on the Tinian MLA will be consistent with the fire management plan included in COMNAVMARIANAISNT 3500.4A (U.S. Department of the Navy, 2013 (Appendix B).

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Appendix G
Guam Micronesian Kingfisher Memorandum of Agreement (June 2015) and Modification to Guam Micronesian Kingfisher Memorandum of Agreement (December 2015)

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MEMORANDUM OF AGREEMENT

Between

THE DEPARTMENT OF THE NAVY
And
THE U.S. FISH AND WILDLIFE SERVICE

Regarding

CONSERVATION OF GUAM MICRONESIAN KINGFISHER RECOVERY HABITAT
In
NORTHERN GUAM

I. PARTIES

This Memorandum of Agreement (MOA) is entered into by and between the Department of the Navy (DON) and the U.S. Fish and Wildlife Service (USFWS), hereinafter referred to as "the Parties."

II. PURPOSE AND SCOPE

A. The purpose of this MOA is to ensure that:

1. A sufficient amount of suitable survival and recovery habitat (hereinafter "habitat") is conserved and managed in accordance with federal agency obligations under section 7(a) of the Endangered Species Act, 16 U.S.C. § 1536(a) in northern Guam to support the reintroduction and recovery of the Guam Micronesian kingfisher (hereinafter "kingfisher"); and

2. The DON can meet the purpose and need for the proposed action to relocate U.S. Marines to Guam (hereinafter "Guam Military Relocation") in accordance with its responsibilities under Title 10 of the U.S.C.

B. The provisions of this MOA will inform the Parties' respective present and future mitigation actions and decisions under section 7(a) of the Endangered Species Act (16 U.S.C. § 1531 et seq.), including those mitigation actions and decisions under subsection 7(a)(2) currently pending regarding the DON's proposed relocation of U.S. Marines to Guam as discussed in paragraph.IV.E below.

III. AUTHORITY

A. Section 7(a) of the Endangered Species Act (ESA), 16 U.S.C. § 1536(a)

B. Section 101 of the Sikes Act, 16 U.S.C. § 670a (as amended)

C. Title 10 U.S.C. § 5063

D. This MOA neither modifies existing agency authorities nor reduces, expands, or transfers any of the respective statutory or regulatory authorities and responsibilities of the Parties.

IV. BACKGROUND

A. Private and public development on Guam has reduced the amount of potentially available habitat for the kingfisher to a point where it has created uncertainty regarding whether there will be a sufficient amount habitat preserved for the future reintroduction and ultimate recovery of the kingfisher on Guam which supports the entire native range of the species.

B. The endangered kingfisher is currently extirpated on Guam. The USFWS has depicted "survival and recovery habitat" for the kingfisher on Guam in Figure 1 (hereinafter "kingfisher habitat"). The Parties agree that conservation of habitat of sufficient quality and quantity to support the reintroduction and ultimate recovery of the endangered kingfisher is needed on Guam.

C. The Parties have a responsibility under the ESA to conserve and protect endangered species.

D. The USFWS currently estimates that approximately 11,512 acres of habitat for the kingfisher is needed across all of northern Guam to support its survival and recovery in the wild. The USFWS has identified approximately 14,997 acres of potential kingfisher habitat in northern Guam, of which approximately 10,742 acres are located on lands currently under the custody and control of the Department of Defense (DoD) (Figure 1). The USFWS estimates that 8,178 acres of these 10,742 acres need to be conserved in northern Guam to provide reasonable certainty that sufficient habitat for the species will remain available for reintroduction and recovery of the kingfisher. The Parties further agree that lands in northern Guam not currently under the custody and control of DoD are also required to support the reintroduction and ultimate survival of the kingfisher in the wild.

E. The DON is proposing to relocate approximately 5,000 Marines as part of the Guam Military Relocation. This proposal is central to the U.S. Government's rebalancing of forces in the Pacific. The purpose and need for the proposed action is to ensure that the relocated Marines are organized, trained, and equipped as mandated in section 5063 of Title 10 of the U.S.C., to satisfy individual live-fire training requirements, and to establish an operational U.S. Marine Corps (USMC) presence in Guam in

accordance with April 2012 adjustments to the May 2006 United States-Japan Roadmap for Realignment Implementation.

F. The Guam Military Relocation would result in the clearing of approximately 1,015 acres of kingfisher habitat in northern Guam on lands currently under the custody and control of DoD. In addition, the USFWS estimates that an additional 319 acres will be indirectly impacted by the proposed action thereby resulting in a total impact to kingfisher habitat of approximately 1,334 acres in northern Guam.

V. GENERAL PROVISIONS

A. The USFWS has determined that approximately 8,178 total acres are required on lands currently under the custody and control of DoD in northern Guam to provide sufficient habitat for the reintroduction and eventual recovery of the kingfisher (Figure 2). To facilitate kingfisher conservation goals, the DON agrees to designate approximately 5,234 acres under the custody and control of the DoD in northern Guam as identified on Figure 3, to a status that will provide durable habitat protection needed to support native habitat restoration and land management for the survival and recovery of the kingfisher. These 5,234 acres have been identified by the USFWS as habitat for the kingfisher and needed to offset impacts of the Guam Military Relocation. The Parties recognize that the designation of the 5,234 acres under this paragraph may also provide a conservation benefit to other Federally-listed species with similar habitat requirements (e.g. Mariana crow, Mariana fruit bat).

B. Consistent with the Joint Region Marianas (JRM) Integrated Natural Resources Management Plan (INRMP) developed in accordance with section 101 of the Sikes Act, the DON agrees to actively restore native habitat and manage, in collaboration with the USFWS, the 5,234 acres identified in Figure 3 consistent with DoD's obligations under the 7(a) of the ESA and the Sikes Act to benefit the survival and recovery of the kingfisher. The DON will work cooperatively with the USFWS to identify, develop and implement specific management activities and projects on these 5,234 acres to support the following: 1) brown treesnake (BTS) control and suppression to facilitate the larger goal of suppressing snake population levels that will ultimately support kingfisher survival and recovery; 2) support for BTS control and eradication methods development, focusing on tools and techniques needed for landscape level survival and recovery of the kingfisher, 3) ungulate fencing and eradication; 4) control of small mammalian predators; 5) invasive plant control and eradication; 6) native plant restoration; and, 7) localized control of introduced invertebrates that may negatively impact kingfisher nesting/fledging. The DON has funded and initiated a number of projects to support the seven focal activities identified above. The DON agrees to continue these activities with items (2) and (3) prioritized for continued funding.

C. The JRM INRMP will be completed by DON within 365 days of signing of the MOA. This timeline is contingent upon the USFWS providing its specific concerns with the 2013 draft INRMP to the DON within 45 days of the signing of this MOA. Any delay by the USFWS in providing comments to the DON will result in a corresponding

extension of this 365-day time period. In accordance with the Sikes Act, the DON will coordinate with the USFWS on specific INRMP projects and goals. Such coordination will include, but is not limited to, the annual INRMP review.

D. Recognizing the importance of DoD's mission in northern Guam, within 120 days of the signing of the Record of Decision (ROD) for the Guam Military Relocation, the DON may, in collaboration with the USFWS, identify an alternative configuration for the 5,234 acres of habitat identified in Figure 3 as necessary to enable the DoD to meet its national defense requirements. While the DON anticipates that the 5,234 acres identified in Figure 3 will enable DoD to meet its requirements, DoD must conduct a thorough assessment to ensure current and future military requirements are appropriately considered. The revised map (acreage) must total at least 5,234 acres and be derived from areas identified in Figure 2 and provide contiguous landscape and connected forested habitat corridors. If an alternative configuration is not defined within 120 days of the signing of the ROD, the Parties agree to default to the acreage identified in Figure 3.

E. DON will provide durable habitat protection for the 5,234 acres identified in Figure 3 or as modified in subparagraph V.D. However, should an emerging national defense requirement dictate that some of the aforementioned 5,234 acres be cleared or otherwise made unsuitable for kingfisher survival and recovery, in coordination with the USFWS, the DON will identify and substitute habitat of equal or greater quality, as determined by the USFWS, to replace the impacted habitat. If habitat of equal or greater quality cannot be identified, then additional acreage suitable for kingfisher survival and recovery will be placed in durable protection to offset the loss of higher quality habitat. The amount of habitat will be determined based on the kingfisher mitigation framework developed using the best available information at that time. The Parties recognize that any substituted habitat must provide contiguous landscape and connected forest habitat corridors. The DON commits to rigorously exploring other alternatives to support an emerging national defense requirement and will only use lands within the 5,234 acres to meet the requirement if absolutely necessary.

F. For the land identified on Figure 3 (or as amended via the process described in subparagraph V.D of this MOA), the USFWS requires enhanced management activity to ensure this habitat supports reintroduction of the kingfisher. Accordingly, starting in Fiscal Year (FY) 2016, the DON commits to provide an additional $2 million per year of funding above execution year INRMP funding levels (as adjusted for inflation) for the next ten years, subject to Congressional authorization and appropriation. This additional funding will be used to support projects that fall within one of the seven focal activities identified under subparagraph V.B of this MOA, according to priorities established jointly by DON and the USFWS. Upon expiration of this ten-year period (FY 2026), the Parties mutually agree to reassess progress of recovery efforts. If, following this assessment, the USFWS determines that it remains possible to recover the kingfisher on Guam, the DON commits to extend the additional $2 million per year in funding for another five years. Subsequently, the Parties will reassess the progress of recovery efforts every five years. So long as the USFWS determines that it remains

possible to recover the kingfisher on Guam, and until the kingfisher is delisted, every five years the DON and USFWS will identify activities and a schedule of implementation that the USFWS determines are sufficient to conserve and enhance the habitat needed to support the survival and recovery of the kingfisher on these 5,234 acres. The DON will implement these activities, dedicating $2 million annually in accordance with the JRM INRMP. The Parties recognize that the level of funding may vary depending on the activities to be implemented in a given year, but will not exceed $2 million annually. The Parties may also subsequently modify, as necessary, the focal activities identified in subparagraph V.B of this MOA to be implemented on the 5,234 acres.

G. If the provisions of subparagraphs V.A to F of this MOA are not implemented as described herein, barring mutual agreement by the Parties, the Guam Military Relocation section 7 ESA consultation will require re-initiation. In addition, nothing in this MOA is intended to affect the responsibility of the USFWS and DON to re-initiate consultations pursuant to 50 CFR § 402.16, or the re-initiation regulation then applicable.

H. If new scientific information indicates the amount or extent of habitat needed for the survival and recovery of the kingfisher is different than identified herein, as determined by the USFWS, the Parties will revise this MOA in accordance with paragraph VI of this MOA.

I. The DON will maintain management authority on kingfisher habitat on Guam under the custody and control of DoD unless DoD transfers management authority to another military service, in which case the responsibilities under this MOA that apply to DON shall transfer to the military service that assumes land management authority.

J. In accordance with established security procedures to grant access to military facilities, USFWS staff shall be provided reasonable access to kingfisher habitat identified on lands under the custody and control of the DoD. DON commits to working with the USFWS to help streamline the security approval process.

VI. MODIFICATIONS, INTERPRETATIONS, ENFORCEABILITY AND TERMINATION

A. Changes and/or modifications to this MOA may be made at any time upon mutual written consent of the Parties. With regard to both Parties, no oral statement by any person and no written statement by anyone other than the undersigned, or an authorized representative as designated in writing, shall be interpreted as modifying or otherwise affecting the terms of this MOA.

B. This MOA shall be deemed null and void in its entirety if any one of the following events occurs: 1) Both Parties revoke the agreement in writing; 2) the DON does not sign a ROD with the currently identified preferred alternative in the Final Biological Assessment regarding the DON's proposed Guam Military Relocation as discussed in

paragraph IV.E of this MOA; or 3) the USFWS determines that the kingfisher is no longer viable for reintroduction on Guam.

C. The Parties understand and agree that performance by the DON of any of the terms of this MOA is subject to the availability of appropriated funds. Nothing herein shall constitute nor be considered to constitute an obligation or expenditure of funds in advance of or in excess of a proper appropriation by the Congress of the United States or otherwise be in violation of the Anti-Deficiency Act, 31 U.S.C. § 1341 et seq.

D. This MOA shall not be construed to create any private right, privilege, remedy, claim or cause of action against the Parties for or by any person or entity.

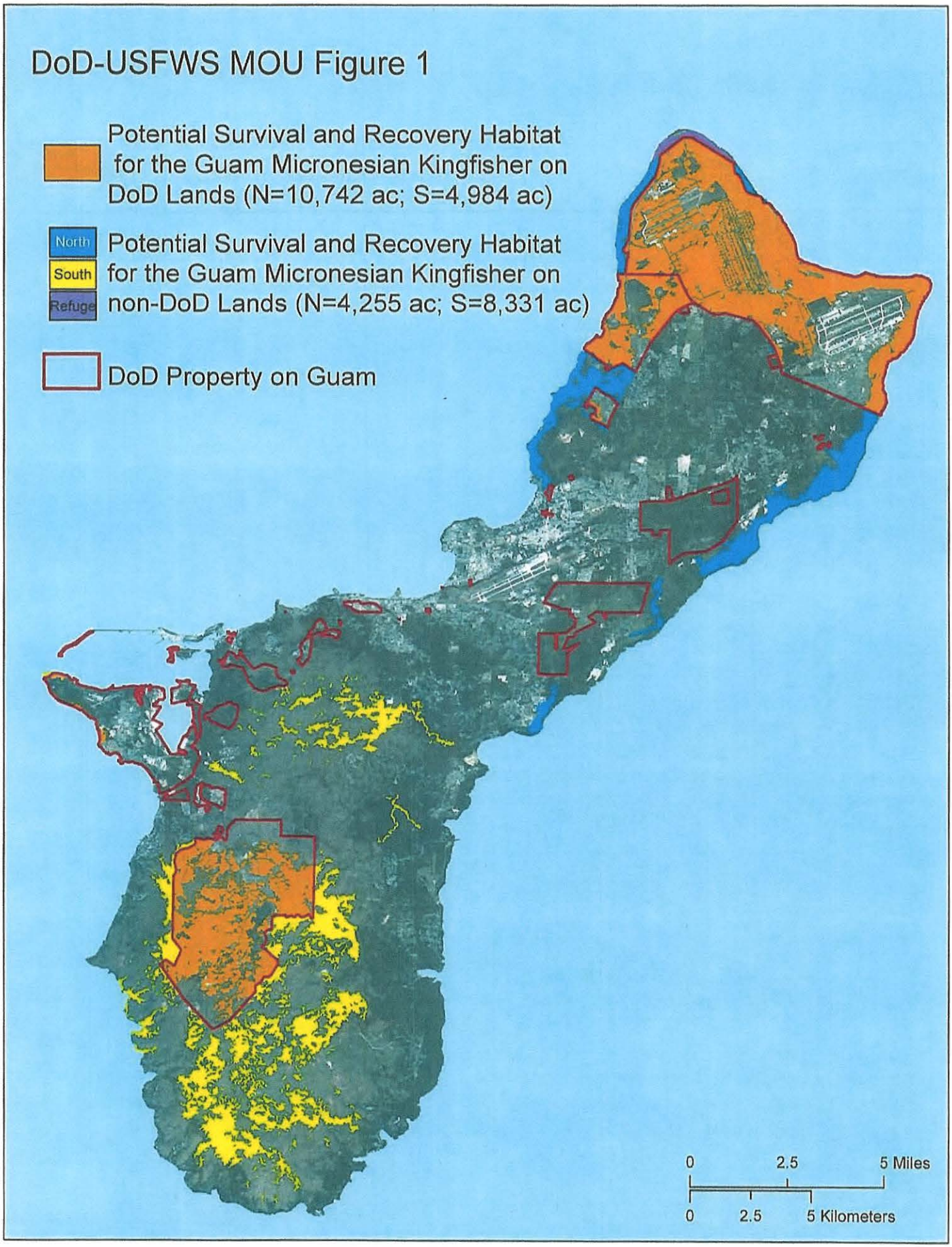
VII. RESOLUTION OF DISAGREEMENTS

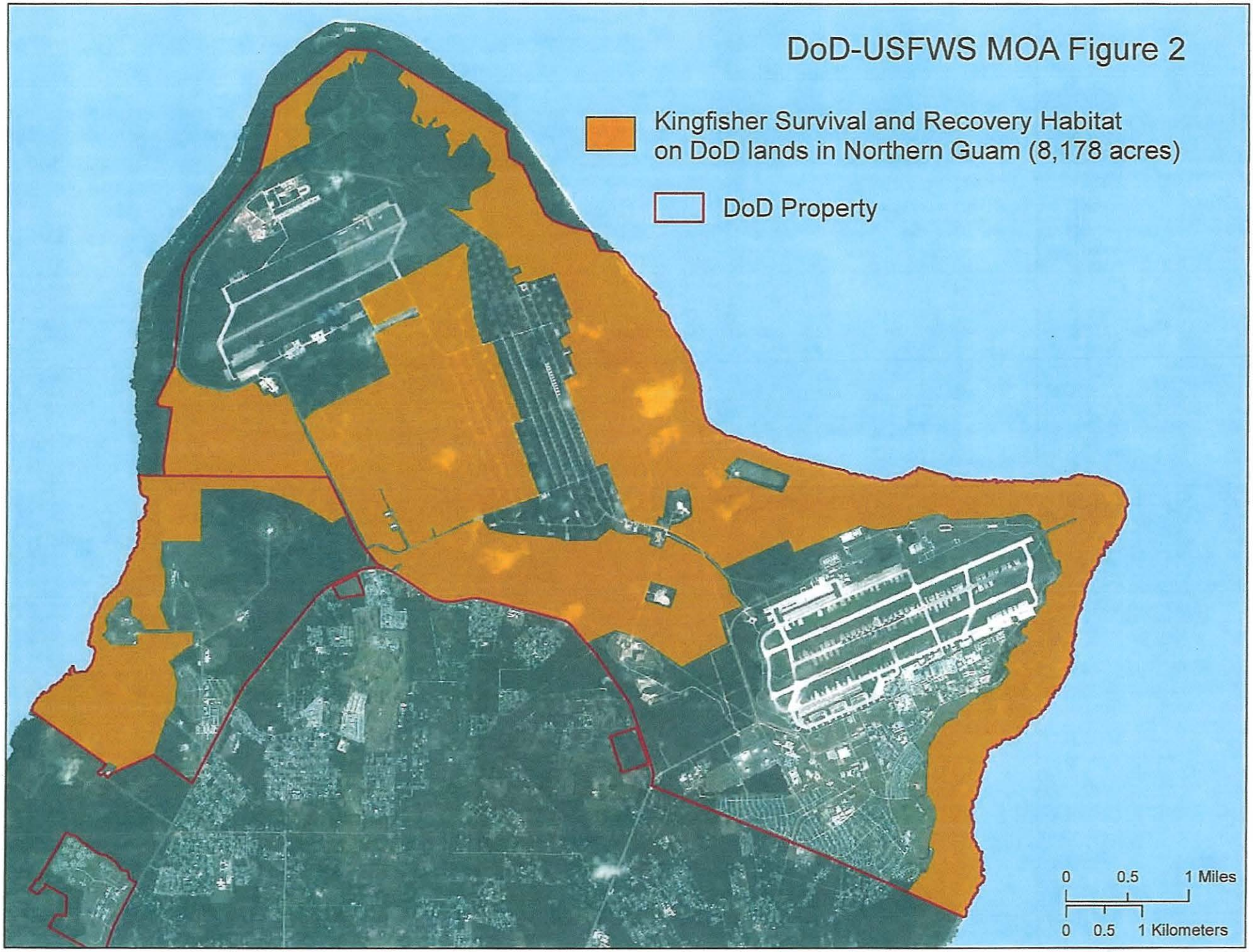
The Parties shall consult with one another to resolve issues at staff levels and elevate disputes through the respective organizational levels only if necessary. Notification of potential areas of disagreement by either agency should be in writing. If there is no resolution at the staff level, either agency may elevate the issue to the appropriate official within each agency or department.

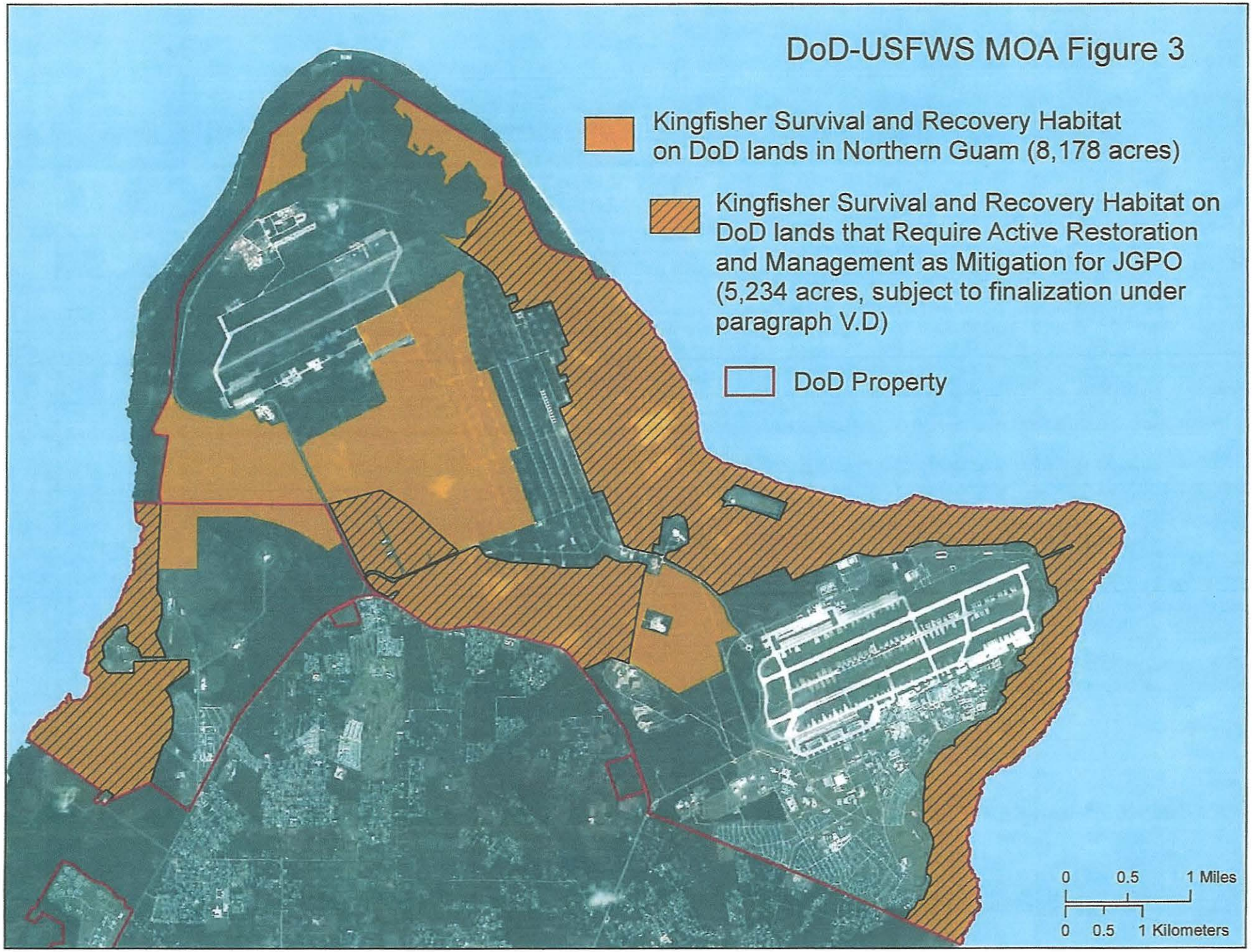
VIII. SIGNATURES

Donald R. Schregardus Date: June 11, 2015
Deputy Assistant Secretary of the Navy (Environment)

Date: June 11, 2015
Director, U.S. Fish and Wildlife Service


DoD-USFWS MOU Figure 1
Potential Survival and Recovery Habitat for the Guam Micronesian Kingfisher on DoD Lands (N=10,742 ac; S=4,984 ac)
North
South
Refuge
Potential Survival and Recovery Habitat for the Guam Micronesian Kingfisher on non-DoD Lands (N=4,255 ac; S=8,331 ac)
DoD Property on Guam
0
2.5
5 Miles
0
2.5
5 Kilometers


DoD-USFWS MOA Figure 2
Kingfisher Survival and Recovery Habitat on DoD lands in Northern Guam (8,178 acres)
DoD Property
0 0.5 1 Miles
0 0.5 1 Kilometers


DoD-USFWS MOA Figure 3
Kingfisher Survival and Recovery Habitat on DoD lands in Northern Guam (8,178 acres)
Kingfisher Survival and Recovery Habitat on DoD lands that Require Active Restoration and Management as Mitigation for JGPO (5,234 acres, subject to finalization under paragraph V.D)
DoD Property
0 0.5 1 Miles
0 0.5 1 Kilometers

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Department of the Navy
Office of the Assistant Secretary
Energy, Installations and Environment
1000 Navy Pentagon
Washington, DC 20350 – 1000
Date DEC 1 8 2015

U.S. Fish and Wildlife Service
1849 C Street, NW
Washington, DC 20240 – 0001
Date **DEC 22, 2015**

MODIFICATION TO MEMORANDUM OF AGREEMENT

BETWEEN

THE DEPARTMENT OF THE NAVY

AND

THE U.S. FISH AND WILDLIFE SERVICE

Subj: DESIGNATION OF ALTERNATIVE CONFIGURATION FOR GUAM MICRONESIAN KINGFISHER RECOVERY HABITAT IN NORTHERN GUAM

Ref: (a) Memorandum of Agreement (MOA) between the Department of the Navy (DON) and the U.S. Fish and Wildlife Service (USFWS) regarding Conservation of Guam Micronesian Kingfisher (GMK) Recovery Habitat in Northern Guam signed 11 June 2015

1. In accordance with subparagraph V.D. of reference (a) regarding identification of an alternative configuration for the 5,234 acres of habitat for the recovery and survival of the GMK in northern Guam, the DON and USFWS mutually agree to the revised map (acreage) provided as Figure 4.

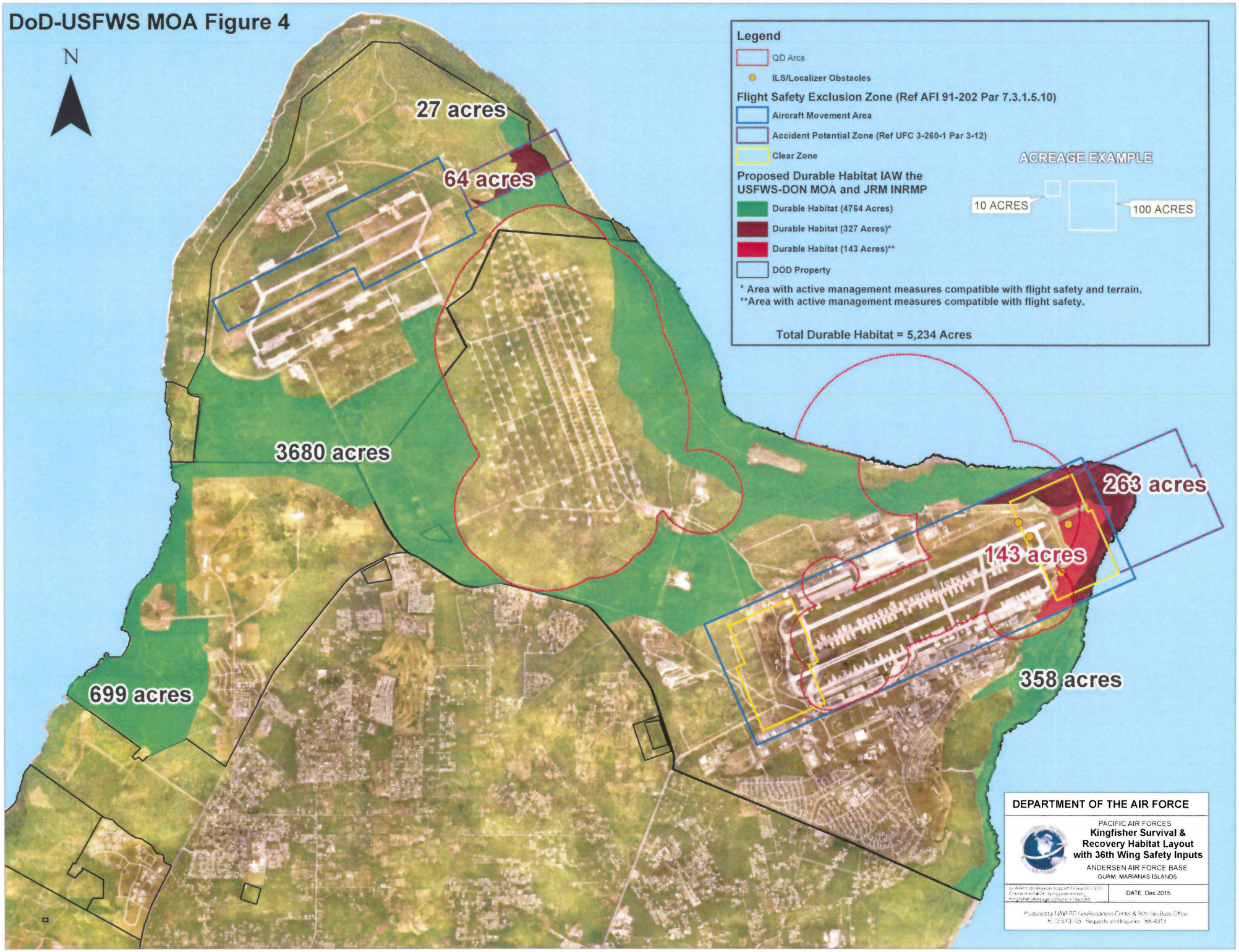
2. The alternative configuration designates 5,234 acres to a status that will provide durable habitat protection needed for the kingfisher and needed to offset impacts of the Guam Military Relocation.

3. This revised map (acreage) hereby replaces habitat designated in Figure 3 of reference (a).

Deputy Assistant Secretary of the Navy
(Environment)

Director, U.S. Fish and Wildlife Service

DoD-USFWS MOA Figure 4



Appendix H
Environmental Assessment for Joint Region Marianas Integrated Natural Resources Management Plan

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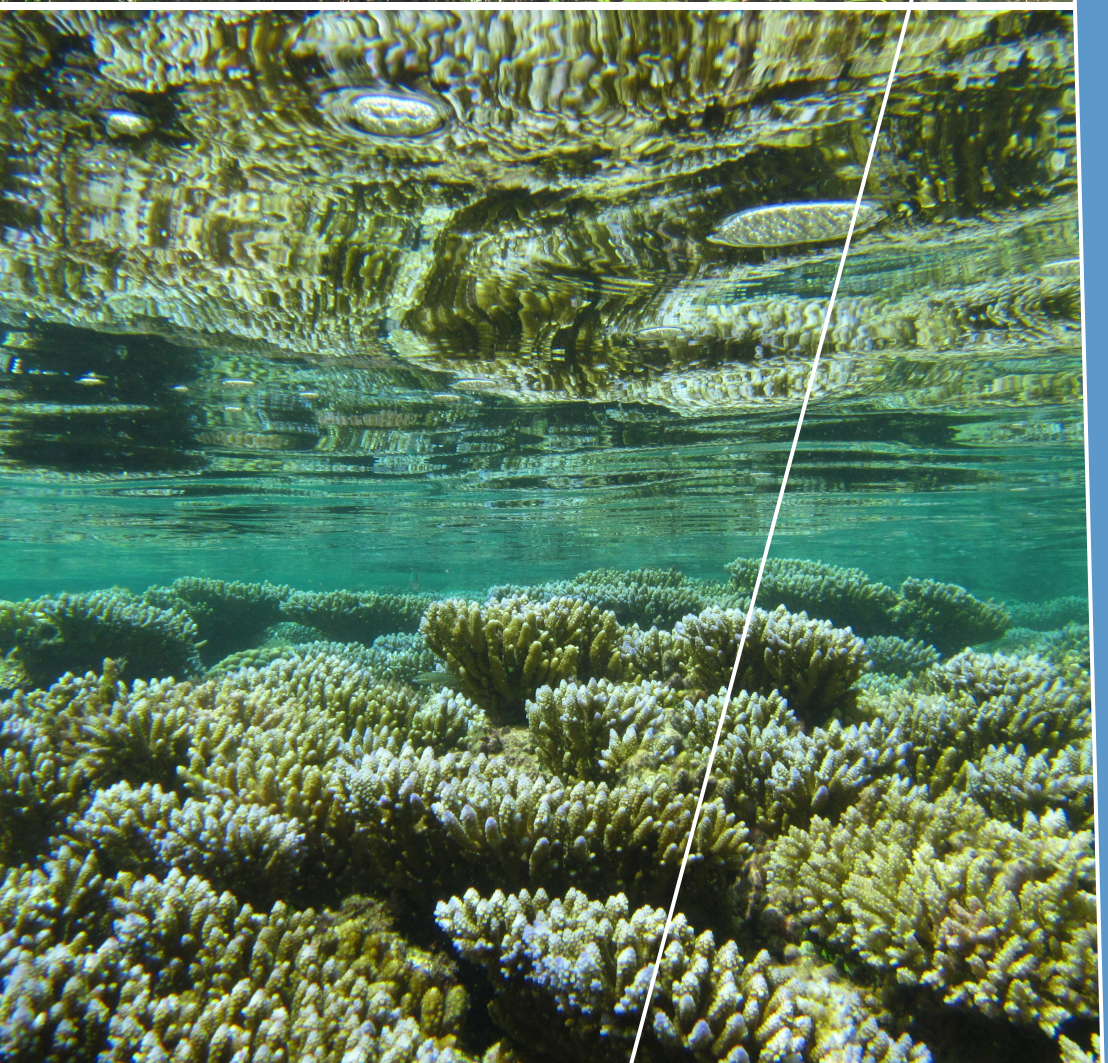

Final

Environmental Assessment

Joint Region Marianas Integrated Natural Resources Management Plan for

Joint Region Marianas-administered and Leased Lands On Guam, Tinian, and Farallon de Medinilla

June 2019

Prepared for:
Joint Region Marianas

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enhancement projects on Guam and Tinian that are aimed at protecting and restoring priority native habitats for the benefit of the Mariana fruit bat. Also planned are continued fruit bat population monitoring on AAFB to maintain and identify habitat relationships. No adverse effect to the Mariana fruit bat would occur under the Proposed Action.

Long-term, beneficial impacts would be expected for native bird populations as a result of implementation of the Proposed Action. There would be long-term, beneficial impacts especially on Guam where native bird populations were decimated by the introduction of the brown treesnake (*Bioga irregularis*) after World War II. Management activities associated with implementation of the 2019 JRM INRMP would contribute to survival and recovery of protected bird species, provide valuable information to inform management actions to facilitate population persistence and expansion, and help examine long-term population trends and changes in the wetland habitat. In addition to surveys for listed birds, surveys would be conducted every five years on Tinian to document long-term trends in density and abundance of native forest and Migratory Bird Treaty Act-listed bird populations. No adverse effects to native birds would occur under the Proposed Action.

Reptile populations would benefit from baseline monitoring and adaptive management that contributes to improved habitat conditions. Many of the terrestrial management projects would have indirect benefits for native reptiles, and a number of the management projects were developed particularly for native reptile conservation.

Long-term, beneficial impacts would be expected for native invertebrate populations as a result of implementation of the Proposed Action. Many of the terrestrial management projects would have indirect benefits for native invertebrates. A number of the management projects were developed particularly for native invertebrate conservation, including actions to conduct tree snail and butterfly surveys to identify the locations of unknown populations; locate, protect, and propagate native invertebrate host plants; conduct studies that assess the impacts of parasitoids, and develop methods for their control.

Therefore, implementation of the Proposed Action would not result in significant adverse impacts to terrestrial biological resources.

Marine Biological Resources. The 2019 JRM INRMP management projects would have indirect, long-term, beneficial impacts to marine flora and fauna through implementation of management strategies and actions aimed at protecting habitat diversity, maintaining healthy coral reefs, and enhancing habitat. The 2019 JRM INRMP aims at controlling populations of invasive marine species, controlling erosion, mapping benthic communities, restoring coral reefs, and monitoring and adaptively managing marine ecosystems on JRM-administered and leased submerged lands. As maintaining a high level of habitat diversity that does not conflict with the military mission is a priority of this INRMP, implementation of the 2019 JRM INRMP would result in improved marine habitat conditions.

The 2019 JRM INRMP management actions are consistent with the directives of EO 13089, *Coral Reef Protection*. ESA-listed coral species that may occur in the area include *Acropora globiceps*, *Acropora retusa*, and *Seriatopora aculeata*. To the extent that these species occur, they may benefit from survey data that better define their distributions and the habitat conditions that support them. In addition, surveys help to identify locations where (a) impacts can be avoided or reduced or (b) opportunities may exist to enhance the habitat of local populations. Insofar as only beneficial effects would occur, there would be no significant adverse impacts on corals.

Fish populations and essential fish habitat (EFH) would benefit from baseline monitoring and adaptive management that contributes to improved habitat conditions. No adverse effect to EFH would occur under the Proposed Action. One ESA-listed fish species, the scalloped hammerhead shark (*Sphyrna lewini*), may occur in waters of the study area, although documented occurrences are few. Beneficial impacts could affect scalloped hammerhead and other fish species of concern, including humphead wrasse (*Cheilinus undulatus*) and bumphead parrotfish (*Bolbometopon muricatum*), as a result of the new environmental deoxyribonucleic acid study to detect the occurrence and habitat use of these species in Apra Harbor. Given only beneficial, if

any, effects to this species, there would be no significant adverse impacts on the scalloped hammerhead shark.

All five species of sea turtles that may occur in the study area are ESA-listed but only two, the green turtle (*Chelonia mydas*) and hawksbill turtle (*Eretmochelys imbricata*), are reasonably likely to occur in areas affected by the Proposed Action. Under the 2019 JRM INRMP, extensive monitoring and protective management of nesting beaches within JRM-administered and leased lands and submerged lands would have potentially beneficial effects to sea turtles. An existing project on sea turtle distribution and habitat use on JRM-administered submerged lands around Guam, using satellite tags, has the potential to inform beneficial management actions for sea turtles in water.

The most common marine mammals that occur in the waters within 3 miles (4.8 kilometers) of the coastline are spinner dolphins (*Stenella longirostris*), bottlenose dolphins (*Tursiops truncatus*), and pantropical spotted dolphins (*Stenella attenuata*). Several other species, including ESA-listed sperm whales (*Physeter macrocephalus*) and humpback whales (*Megaptera novaeangliae*), have been infrequently encountered and/or usually occur farther offshore. The Proposed Action includes the continuation of annual marine mammal surveys off Guam and the CNMI. The 2016 surveys resulted in encounters with the aforementioned species as well as rough-toothed dolphins (*Steno bredanensis*), short-finned pilot whales (*Globicephala marcrorhynchus*), and dwarf sperm whales (*Kogia sima*). Satellite tags were deployed on sperm and short-finned pilot whales as well as a pantropical spotted dolphin (Hill et al. 2017). Data from these surveys indirectly benefits marine mammals by enabling more informed assessments of the potential effects of DoD training activities.

Therefore, implementation of the Proposed Action would not result in significant adverse impacts to marine biological resources.

Land Use. As required by the Sikes Act (as amended) and DoD Instruction 4715.03, the 2019 JRM INRMP was developed in a manner that ensures that there would be no net loss of the capability of installations to support military missions and future mission requirements. The 2019 JRM INRMP is consistent with current land use plans and policies of JRM-administered and

leased lands as well as for any planned military uses. Implementation of the 2019 JRM INRMP would not adversely affect the short-term or long-term use of land for military activities.

Ecosystem management is emphasized in the 2019 JRM INRMP (see Section 3.1) because the DoD recognizes that the mission of the JRM is inextricably linked to local, regional, and global ecological integrity and that sustaining ecosystem integrity is the best way to protect biodiversity, ensure sustainable use, and minimize the effort and cost of management. Thus, implementing the 2019 JRM INRMP would result in long-term, beneficial impacts on military use of JRM-administered and leased lands and public use of surrounding areas, by ensuring that healthy and self-sustaining natural resources such as clean water, stable soils and beaches, and naturally-vegetated areas continue to be available to support the use of JRM-administered and leased lands and future growth and development of JRM-administered and leased lands and surrounding areas.

Implementing some of the management projects identified in the 2019 JRM INRMP and associated management plans to conserve or restore habitat or other natural areas would occur in priority areas that are compatible with operational and training needs.

There are no planned activities associated with the 2019 JRM INRMP that would result in undue safety risks or otherwise threaten public health or safety, or conflict with planning criteria established to ensure the safety and protection of human life and property on and surrounding JRM-administered and leased lands. No impacts on coastal zone management would occur from implementation of the Proposed Action. Therefore, implementation of the Proposed Action would not result in significant impacts to land use.

Submerged Land Use. As required by the Sikes Act (as amended) and DoD Instruction 4715.03, the 2019 JRM INRMP was developed in a manner that ensures that there would be no net loss of the capability of installations to support military missions and future mission requirements. As such, the 2019 JRM INRMP is consistent with submerged land use plans and policies of JRM-administered and leased submerged lands and the ongoing and planned military uses of those sites, and implementation of the 2019 JRM INRMP would not adversely affect the short-term or long-term use of land for military activities.

Maintaining healthy marine communities for listed and native species on submerged lands would potentially relieve some of the restrictions of military training and in-water activities (e.g., military construction, routine maintenance/repair of in-water facilities) on submerged lands by minimizing costs and mitigation requirements, avoiding work-around solutions, and preventing delays in activities due to regulatory compliance processes.

Implementing some of the management projects identified in the 2019 JRM INRMP and associated management plans to conserve or restore habitat or other natural areas would occur in priority areas that are compatible with operational and training needs.

There are no planned activities associated with the 2019 JRM INRMP for submerged lands that would result in undue safety risks or otherwise threaten public health or safety or conflict with planning criteria established to ensure the safety and protection of human life and property on and surrounding JRM-administered and leased submerged lands.

Implementation of the Proposed Action would not result in significant impacts to submerged land use.

Socioeconomics. The Proposed Action primarily relates to resource management and includes no direct or indirect population attractors. Since no population increase would be induced by the Proposed Action, no housing or public services impacts would be expected. Similarly, while there may be some local expenditures related to resource management actions included in the Proposed Action, noticeable economic benefits would not be anticipated, and any economic or financial impacts would be less than significant.

No access restrictions to areas currently used for recreation are proposed. Therefore, no adverse impacts associated with recreation are anticipated. Management projects proposed in the 2019 JRM INRMP would likely have the effect of improving the sustainability of fishing on both Guam and Tinian, allowing for improved quality of this form of recreation over a longer period. Likewise, such management projects would also improve the long-term quality of fishing for purposes of subsistence. This improvement would tend to reduce the portion of incomes

required to be spent on food and allow for those with no financial means of better obtaining food to live off the land.

Therefore, implementation of the Proposed Action would not result in significant impacts to socioeconomics.

Environmental Justice. EO 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-income Populations* requires that "each Federal Agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health effects on its programs, policies, and activities on minority populations and low-income populations" (59 Federal Register 1994).

The Proposed Action would not substantially affect human health or the environment. No significant impacts were identified for resources relating to the human environment. Therefore, implementation of the Proposed Action would not cause disproportionately high and adverse human health or environmental effects on any minority or low-income populations. There may be beneficial effects on the long-term sustainability of subsistence activities, which would tend to primarily benefit those with low or no incomes.

Public Involvement: The Final 2019 JRM INRMP EA is an appendix (Appendix I) to the Final 2019 JRM INRMP. The Navy circulated the November 2018 Draft INRMP and Draft EA for a 30-day public review in Guam from November 14 to December 13, 2018. The documents were available for review by interested parties at the Nieves M. Flores Memorial Library, 254 Martyr Street, Hagatna, Guam; Dededo Public Library, West Santa Barbara Avenue, Dededo, Guam; and on the website at www.jrminrmp.com. In anticipation of the 30-day public review period in Guam, the Navy published Notices of Availability in printed journals and online websites of the Guam Daily Post and the Guam Pacific Daily News on November 9, 2018. The Notice of Availability remained advertised on the Guam Daily Post website from November 9 through December 9, 2018.

As a result of the damages experienced within the CNMI from Super Typhoon Yutu, the Navy postponed the public review within the CNMI to allow for recovery efforts. The Navy circulated the February 2019 Draft JRM INRMP and Draft EA for a 30-day public

review in the CNMI from February 15 to March 16, 2019. The documents were available for review by interested parties at the Joeten-Kiyu Public Library, Insatto Street, Saipan; Tinian Public Library, San Jose, Tinian; and on the website at www.jrminrmp.com. In anticipation of the 30-day public review period in the CNMI, the Navy published Notices of Availability in printed journals and online websites of the Saipan Tribune on February 12, 2019 and the Marianas Variety on February 13, 2019. The Notice of Availability remained advertised on the Saipan Tribune website from February 12 through March 11, 2019.

The Navy provided the public with an e-mail address, a physical address, and an online submission form to submit public comments. Comments on the Draft EA received by the Navy between November 14, 2018 and March 16, 2019 and responses to comments are provided in Appendix A of the EA.

Finding: Based on the information gathered during the preparation of this EA and the analysis presented; and coordination with U.S. Fish and Wildlife Service, National Marine Fisheries Service, Guam Department of Agriculture, CNMI Department of Lands and Natural Resources, Guam Bureau of Statistics and Plans, CNMI Bureau of Environmental and Coastal Quality; and completion of a public involvement process, the Commander, Joint Region Marianas has determined that the proposed action will have no significant impacts on the quality of the human environment or generate significant controversy.

The EA prepared by the Navy addressing this action is on file and interested parties may obtain a copy of the Final EA and Finding of No Significant Impact from Naval Facilities Engineering Command Marianas/Joint Region Marianas, PSC 455, Box 211, FPO AP 96540-1000, Attention ENV Conservation and Planning.

06SEP19
Date

J. V. MENONI
Rear Admiral, U.S. Navy
Commander, Joint Region Marianas

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Abstract

Designation:	Environmental Assessment
Title of Proposed Action:	Joint Region Marianas Integrated Natural Resources Management Plan
Project Location:	Joint Region Marianas-administered and Leased Lands on Guam, Tinian, and Farallon de Medinilla
Lead Agency for the EA:	Department of the Navy
Affected Region:	Territory of Guam and the Islands of Tinian and Farallon de Medinilla within the Commonwealth of the Northern Mariana Islands
Action Proponent:	Joint Region Marianas
Point of Contact:	Dana Lujan Naval Facilities Engineering Command Marianas/Joint Region Marianas PSC 455, Box 211, FPO AP 96540-1000
Date:	June 2019

The United States Department of the Navy has prepared this Environmental Assessment in accordance with the National Environmental Policy Act, as implemented by the Council on Environmental Quality regulations and the Department of the Navy regulations for implementing the National Environmental Policy Act. The Proposed Action would implement the 2019 Joint Region Marianas Integrated Natural Resources Management Plan on Joint Region Marianas-administered and leased lands on Guam, Tinian, and Farallon de Medinilla. This Environmental Assessment evaluates the potential environmental impacts associated with the Proposed Action and the No Action Alternative on the following resource areas: geology, topography, and soils; water resources; cultural resources; terrestrial biological resources; marine biological resources; land use; submerged land use; socioeconomics; and environmental justice. This Environmental Assessment appears as an appendix and refers frequently to resource descriptions in the main body of the Joint Region Marianas Integrated Natural Resources Management Plan.

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EXECUTIVE SUMMARY

ES.1 Proposed Action

The United States (U.S.) Department of the Navy (DON) is proposing to revise the 2013 Joint Region Marianas (JRM) Integrated Natural Resources Management Plan (INRMP). Both the 2013 JRM INRMP and the 2019 JRM INRMP provide natural resources management projects for JRM properties for all Naval and Air Force installations on Guam and JRM leased lands on Tinian and Farallon de Medinilla (FDM). The Proposed Action includes continuing some existing natural resources management projects conducted on JRM-administered lands under the current 2013 JRM INRMP, along with new management projects appropriate for managing the natural resources under current environmental conditions and challenges. All management projects would be integrated and implemented in the context of mission support needs in the region. Natural resources management on JRM-administered lands would also be integrated with other disciplines, programs, and planning beyond the scope of traditional fish and wildlife management on U.S. Navy and Air Force installations.

ES.2 Purpose of and Need for the Proposed Action

The purpose of an INRMP is to implement an ecosystem-based conservation program that provides for conservation and rehabilitation of natural resources in a manner that is consistent with the military mission, integrates and coordinates all natural resources management activities, provides for sustainable multipurpose uses of natural resources, and provides for public access for use of natural resources subject to public safety and military security considerations. The purpose of revising the JRM INRMP is to meet statutory requirements under the Sikes Act (as amended) to manage natural resources given the constant changing environmental challenges and changes in military mission.

The need for the Proposed Action is to provide a comprehensive, adaptive natural resources management approach for all properties under JRM. Both the INRMP and the natural resources management programs that it supports must meet the Department of Defense (DoD) and DON policy and guidance that collectively require a plan and management approach consistent with mission support (as defined in 10 U.S. Code [USC] Section 5062), multipurpose use, integration, ecosystem- or landscape-level management, and environmental compliance and stewardship objectives.

ES.3 Alternatives Considered

Proposed Action: The Proposed Action is to implement the 2019 JRM INRMP, consistent with the military use of the JRM-administered lands considered in this Environmental Assessment (EA) and the goals and objectives established in the Sikes Act (as amended). The goal of the 2019 JRM INRMP is to utilize adaptive management to maintain long-term ecosystem health and minimize impacts to natural resources consistent with the operational and training requirements of the DoD's mission. The 2019 JRM INRMP has been developed to ensure consistent management of resources on Guam and within the Commonwealth of the Northern Mariana Islands (CNMI) and to comply with federal, territory, commonwealth, and local standards, as applicable. The INRMP would be reviewed annually and no less than every 5-years for operation and effect as required by Section 670a of the Sikes Act.

No Action Alternative: The No Action Alternative to the Proposed Action would be to continue management as characterized in the 2013 JRM INRMP. This alternative represents the status quo.

ES.4 Summary of Environmental Resources Evaluated in the EA

This EA includes an analysis of potential environmental impacts associated with the Proposed Action and the No Action Alternative. The environmental resource areas analyzed in this EA include: geology, topography, and soils; water resources; cultural resources; terrestrial biological resources; marine biological resources; land use; submerged land use; and socioeconomics and environmental justice. The study area for each resource analyzed may differ due to how the Proposed Action interacts with or impacts the resource.

ES.5 Summary of Potential Environmental Consequences of the Action Alternatives and Major Mitigating Action

Table ES-1 provides a tabular summary of the potential impacts to the resources associated with each of the alternative actions analyzed.

ES.6 Public Involvement

The 2019 JRM INRMP Draft EA was an appendix (Appendix I) to the Draft 2019 JRM INRMP. The Navy circulated the November 2018 Draft INRMP and Draft EA for a 30-day public review in Guam from November 14 to December 13, 2018. The documents were available for review by interested parties at the Nieves M. Flores Memorial Library, 254 Martyr Street Hagatna, Guam; Dededo Public Library, West Santa Barbara Avenue, Dededo, Guam; and on the website at www.jrminrmp.com. In anticipation of the 30-day public review period in Guam, the Navy published Notices of Availability in printed journals and online websites of the Guam Daily Post and the Guam Pacific Daily News on November 9, 2018. The Notice of Availability remained advertised on the Guam Daily Post website from November 9 through December 9, 2018.

As a result of the damages experienced within the CNMI from Super Typhoon Yutu, the Navy postponed the public review within the CNMI to allow for recovery efforts. The Navy circulated the February 2019 Draft INRMP and Draft EA for a 30-day public review in the CNMI from February 15 to March 16, 2019. The documents were available for review by interested parties at the Joeten-Kiyu Public Library, Insatto Street, Saipan; Tinian Public Library, San Jose, Tinian; and on the website at www.jrminrmp.com. In anticipation of the 30-day public review period in the CNMI, the Navy published Notices of Availability in printed journals and online websites of the Saipan Tribune on February 12, 2019 and the Marianas Variety on February 13, 2019. The Notice of Availability remained advertised on the Saipan Tribune website from February 12 through March 11, 2019.

The Navy provided the public with an email address, a physical address, and an online submission form to submit public comments. Comments on the Draft EA received by the Navy between November 14, 2018 and March 16, 2019 and responses to comments are provided in Appendix A of this EA.

Table ES-1 Summary of Potential Impacts to Resource Areas

Resource Area	*No Action Alternative*	*Proposed Action*
Geology, Topography, and Soils	Continued implementation of the 2013 JRM INRMP would result in some beneficial impacts through the reduction in soil erosion, reduction in invasive vegetation, and an increase in native reforestation on JRM-administered lands; however, the 2013 JRM INRMP does not address soil conditions in their current state. Continued implementation of the 2013 JRM INRMP without updates to the comprehensive soil erosion and control plan and to the long-term, ecosystem-based plans for restoring and maintaining forests and other areas could result in continued erosion and minor to moderate adverse impacts on soils. In addition, the No Action Alternative does not address the current ungulate (i.e., hoofed mammals such as pigs, deer, and carabao [*Bubalus bubalis*]) populations found on JRM-administered lands; thus, ground disturbances and soil erosion caused by ungulates would continue which would have adverse impacts on soils and increased erosion.	Implementation of the 2019 JRM INRMP would have long-term, beneficial reduction in soil erosion from implementation of updated erosion control practices and ecosystem-based management plans for restoring and maintaining forests and other areas. Eroded areas would be identified and revegetated to reduce erosion. Control and eradication of ungulates would reduce digging and destruction of vegetation caused by those animals.
Water Resources	Continued implementation of the 2013 JRM INRMP would result in beneficial impacts to water resources by minimizing operational impacts on wetlands, maximizing native floral and faunal diversity of wetlands, and managing for no net loss of wetlands. These plans would include the restoration and maintenance of ecosystem processes, such as sustainable revegetation and soil production, which would improve water quality, promote the flow of surface waters into wetlands, and reduce flooding by increasing groundwater recharge and reducing surface water flow rates.	Implementation of the 2019 JRM INRMP would have long-term, beneficial impacts on surface water quality and aquatic habitats from rehabilitation of surface waters and from actions to reduce erosion, such as the control of ungulates and restoration of disturbed areas. There would be no direct, adverse impacts on wetlands and floodplains.
Cultural Resources	Continued implementation of the 2013 JRM INRMP would result in adverse impacts on cultural resources and culturally important medicinal plants since the No Action Alternative does not properly address the current ungulate populations on JRM-administered lands; thus, the high abundance of ungulates and degradation of forests and other areas could continue.	Implementation of the 2019 JRM INRMP would have no adverse impacts on cultural resources, including historic properties (as defined by Section 106 of the National Historic Preservation Act). Long-term, beneficial impacts on cultural resources could occur from implementation of updated actions such as those that seek to protect native forests (i.e., ungulate control). These actions would protect habitats in which culturally important plants are found and prevent or reduce degradation of historical landmarks.

Table ES-1 Summary of Potential Impacts to Resource Areas

Resource Area	*No Action Alternative*	*Proposed Action*
Terrestrial Biological Resources	Continued implementation of the 2013 JRM INRMP would result in some beneficial impacts on terrestrial biological resources on JRM-administered lands. However, because the 2013 JRM INRMP considered under this alternative does not address all current adverse conditions on JRM-administered lands, some natural habitats, such as native forests, would continue to decline in quality and complexity and some plant and animal species would continue to be adversely affected by those conditions. For example, the No Action Alternative does not include an updated plan to reduce ungulate populations on JRM sites; thus, degradation of native forest would continue and adversely affect recovery of threatened and endangered species. In addition, the 2013 JRM INRMP does not provide adequate management for the species listed under the federal Endangered Species Act in October 2015.	Implementation of the 2019 JRM INRMP would have beneficial impacts on terrestrial vegetation and wildlife, including newly protected species, from the implementation of updated long-term, ecosystem-based management plans to restore and enhance habitat for native species, control non-native species, and monitor native plant and animal populations.
Marine Biological Resources	Continued implementation of the 2013 JRM INRMP would result in some beneficial impacts on marine biological resources on JRM-administered submerged lands. However, because the 2013 JRM INRMP considered under this alternative does not address all current adverse conditions on JRM-administered submerged lands, some marine habitats would continue to decline in quality and complexity and some species would continue to be adversely affected by those conditions. For example, the No Action Alternative does not include a discussion on climate change and the effects of coral bleaching; thus, degradation of reef habitat would continue and adversely affect recovery of threatened and endangered species.	Implementation of the 2019 JRM INRMP would have beneficial impacts on marine flora and fauna, including protected species, from the implementation of long-term, ecosystem-based management plans to restore and enhance habitat for native species and control non-native species.
Land Use	Continued implementation of the 2013 JRM INRMP would be compatible with existing land uses. Therefore, no significant impacts would occur with implementation of the No Action Alternative.	Implementation of the 2019 JRM INRMP was developed in a manner that ensures no net loss of the capability of installations to support military missions and future mission requirements, and is therefore consistent with current land use plans and policies of JRM-administered and leased lands as well as for any planned military uses.

Table ES-1 Summary of Potential Impacts to Resource Areas

Resource Area	*No Action Alternative*	*Proposed Action*
Submerged Land Use	Continued implementation of the 2013 JRM INRMP would be compatible with existing submerged land uses. Therefore, no significant impacts would occur with implementation of the No Action Alternative.	There would be no adverse impacts to submerged land use with the implementation of the 2019 JRM INRMP. Potential beneficial impacts due to increased knowledge of marine resources could lead to lifting of restrictions on military operations.
Socioeconomics	No change in social or economic conditions or use of public services would occur with continued implementation of the 2013 JRM INRMP.	No change in social or economic conditions or use of public services would occur with the implementation of the 2019 JRM INRMP. There would be a significant positive impact to the sustainability of recreational fishing opportunities.
Environmental Justice	No adverse and disproportional impacts on minority or low-income populations would occur with continued implementation of the 2013 JRM INRMP.	No adverse and disproportional impacts on minority or low-income populations would occur with the implementation of the 2019 JRM INRMP.

Key: INRMP = Integrated Natural Resources Management Plan; JRM = Joint Region Marianas.

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Environmental Assessment
Joint Region Marianas
Integrated Natural Resources Management Plan
Joint Region Marianas-administered and Leased Lands on Guam, Tinian, and Farallon de Medinilla

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Appendix A Comments

Abbreviations and Acronyms

Acronym	Definition
%	percent
AFB	Air Force Base
BMP	best management practice
BTS	brown treesnake
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CJMT	CNMI Joint Military Training
CNMI	Commonwealth of the Northern Mariana Islands
COMPACFLT	Commander, U.S. Pacific Fleet
CWA	Clean Water Act
CZMA	Coastal Zone Management Act
DoD	Department of Defense
DON	Department of the Navy
DFW	Division of Fish and Wildlife
EA	Environmental Assessment
EFH	essential fish habitat
EIS	Environmental Impact Statement
EMUA	Exclusive Military Use Area
EO	Executive Order
EPP	Environmental Protection Plan
ESA	Endangered Species Act
ERA	Ecological Reserve Area
FDM	Farallon de Medinilla
Guam DAWR	Guam Division of Aquatic and Wildlife Resources
Guam EPA	Guam Environmental Protection Agency
GovGuam	Government of Guam
JRM	Joint Region Marianas
ICRMP	Integrated Cultural Resources Management Plan
INRMP	Integrated Natural Resources Management Plan
LBA	Lease Back Area
MBTA	Migratory Bird Treaty Act
MOA	Memorandum of Agreement
MIRC	Mariana Islands Range Complex
MITT	Mariana Islands Training and Testing
MLA	Military Lease Area
MMPA	Marine Mammal Protection Act
MOUT	Military Operations on Urban Terrain
NAVFAC	Naval Facilities Engineering Command
NBG	Naval Base Guam
NCTS	Naval Computer and Telecommunications Station
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NMS	Naval Munitions Site
NPDES	National Pollutant Discharge Elimination System
NRHP	National Register of Historic Places
OEIS	Overseas EIS
OPNAVINST	Office of the Chief of Naval Operations Instruction
POL	petroleum, oil and lubricants
ROD	Record of Decision
SDWA	Safe Drinking Water Act
THAAD	Terminal High-altitude Area Defense
TS	Telecommunications Site
U.S.	United States
USACE	U.S. Army Corps of Engineers
USAF	U.S. Air Force
USC	U.S. Code
USCG	U.S. Coast Guard
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service

1 Purpose of and Need for the Proposed Action

1.1 Introduction

The United States (U.S.) Department of the Navy (hereinafter, referred to as the DON) proposes to implement the Joint Region Marianas (JRM) Integrated Natural Resources Management Plan (INRMP) on JRM-administered and leased lands on Guam, Tinian, and Farallon de Medinilla (FDM). The purpose of an INRMP is to implement an ecosystem-based conservation program that provides for conservation and rehabilitation of natural resources in a manner that is consistent with the military mission, integrates and coordinates all natural resources management activities, provides for sustainable multipurpose uses of natural resources, and provides for public access for use of natural resources subject to public safety and military security considerations. As described in detail in Section 1.4 of this EA and Section 1.1 of the 2019 JRM INRMP, the purpose of the 2019 JRM INRMP is as follows:

- help natural resource managers on each installation to more effectively manage natural resources to ensure installation lands remain available and in good condition to support the military mission
- conserve and rehabilitate natural resources on lands managed by each installation
- support sustainable multipurpose use of the resources and public access, subject to safety requirements and military security, to military installations to facilitate the use of those natural resources
- participate, as appropriate, in regional ecosystem initiatives
- preclude designation of critical habitat

As discussed in Chapter 1, *Overview*, of the 2019 JRM INRMP, the goal of the INRMP is to utilize adaptive management to maintain long-term ecosystem health and minimize impacts to natural resources consistent with the operational requirements of the Department of Defense's (DoD's) mission. DON is required to ensure ecosystem management is the basis for all management of its lands (Sikes Act, as amended [16 U.S. Code {USC} 670a]; DoD Instruction 4715.03). It is also a goal of the 2019 JRM INRMP to provide a conservation benefit to federally listed species by providing adequate special management and protections.

The Navy has prepared this Environmental Assessment (EA) in accordance with the National Environmental Policy Act (NEPA), as implemented by the Council on Environmental Quality (CEQ) regulations (Title 40, Code of Federal Regulations [CFR], Parts 1500-1508) and DON regulations (32 CFR 775) for implementing NEPA.

All natural resources management projects listed in the 2019 JRM INRMP were reviewed and assessed for potential impact by subject matter experts; however, NEPA analysis was conducted on the collective effect of management projects relevant to each resource rather than at a management project-specific level. For example, non-invasive, pedestrian vegetation surveys were reviewed, assessed, and considered as part of the collective effect of the INRMP but are not specifically analyzed in this EA.

1.2 Background

The 2019 JRM INRMP considered in this EA is a revision of the 2013 JRM INRMP (JRM 2013), which had updated and combined the previous INRMPs for Naval Base Guam (NBG) (DON 2009), Andersen Air Force Base (AFB) (U.S. Air Force [USAF] 2009), Tinian, and FDM (DON 2010a). The 2019 JRM INRMP was developed based on a thorough review of the previously mentioned INRMPs, review of new data pertaining to these sites, and detailed discussions with Naval Facilities Engineering Command (NAVFAC) Marianas, JRM, installation personnel, partner agencies, and various INRMP stakeholders. Table 1-1 lists the major sections in the 2019 JRM INRMP along with page numbers for ease of reference. The 2019 JRM INRMP strives to allow for coordination of region-wide environmental management with the installation plans and activities and provides explicit goals and objectives to which natural resources management projects will contribute. Additional details are provided in Section 1.1 of the 2019 JRM INRMP.

Table 1-1 Major Sections in the 2019 JRM INRMP

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1.3 Location and Description of Joint Region Marianas Installations

As discussed in Chapter 2, *Military Mission and Overview of History and Land Use*, of the 2019 JRM INRMP, the Mariana Islands includes Guam and the Commonwealth of the Northern Mariana Islands (CNMI), both of which are sovereign (self-governing) U.S. territories. Fourteen islands (including Tinian and FDM) along with the territorial waters and submerged lands immediately north of Guam comprise the CNMI (Figure 1-1). DoD supports Naval and Air Force activities on Guam and in the CNMI to maintain operational readiness—maintaining the ability of units to respond to regional threats and to protect interests of the U.S. and its allies.

Guam is located in the Western Pacific Ocean and is situated approximately 3,700 miles (5,955 kilometers) west/southwest of Hawaii and 1,560 miles (2,511 kilometers) southeast of Japan. Guam is the southernmost and largest island of the Mariana Islands Archipelago (Figure 1-1). The island is approximately 30 miles (48 kilometers) long by 4 to 8 miles (6 to 13 kilometers) wide and has a total area of approximately 209 square miles (541 square kilometers). JRM sites are located throughout the island and include both NBG and Andersen AFB sites (Figure 1-2). NBG consists of a number of installations on Guam, but the primary properties are: Main Base, Naval Munitions Site (NMS), Telecommunications Site (TS), Tenjo Vista and Sasa Valley tank farms, and Naval Computer and Telecommunications Station (NCTS) Barrigada (Figure 1-2). Andersen AFB's primary properties include Main Base and Andersen South (Figure 1-2). Figure 1-3 depicts JRM-administered submerged lands around Guam that are addressed in the 2019 JRM INRMP.

Tinian is the fourth island, from south to north, in the Mariana archipelago (Figures 1-1 and 1-4). It is located 100 miles (161 kilometers) north-northeast of Guam and approximately 3 miles (8 kilometers) southwest of Saipan. Tinian is roughly 12 miles (20 kilometers) long and 6 miles (8 kilometers) wide at its widest point and has a total land area of 39 square miles (101 square kilometers).

FDM is the sixth island, from south to north, and is the northernmost island of the southern volcanic arc of the Mariana archipelago (Figures 1-1 and 1-5). It is located approximately 70 miles (113 kilometers) northeast of Tinian and 182 miles (293 kilometers) northeast of Guam. FDM is approximately 1.7 miles (2.8 kilometers) long and 0.3 miles (0.5 kilometers) wide at its widest point and covers approximately 221 acres (89 hectares). FDM is an uninhabited island and is difficult to access, except by helicopter.

The Overlay Refuge is a group of land areas that were established in 1994 and provide a commitment by DON and the U.S. Fish and Wildlife Service (USFWS) to engage in a coordinated program centered on the protection of threatened and endangered species and other native flora and fauna, the maintenance of native ecosystems, and the conservation of native biological diversity in cooperation with Guam Division of Aquatic and Wildlife Resources (Guam DAWR), recognizing that the primary purpose of lands within the Overlay Refuge is to support the national defense mission of DON. The Andersen AFB Overlay Unit in northern Guam covers approximately 10,159 acres (4,111 hectares), and the DON Overlay Unit in southern Guam covers approximately 11,534 acres (4,668 hectares). Coordination between the USFWS and the DON occurs as necessary to comply with NEPA and installation statutes and regulations.

The Haputo Ecological Reserve Area (ERA) and Orote Peninsula ERA were established in 1984 to preserve native terrestrial and marine habitats for the purpose of protecting genetic diversity and fostering scientific research and education (NAVFAC Marianas 2011) (Table 1-2 and Figure 1-2).

The 2019 JRM INRMP addresses natural resources management on those lands and nearshore areas that are owned by the U.S. and administered by JRM or used by JRM via license, permit, or lease for which JRM has been assigned management responsibility and that contain significant natural resources. Chapters 4 and 10 in the 2019 JRM INRMP provide overviews of the physical and biological environments on Guam and the CNMI, respectively. Detailed descriptions of current operations and land use and the physical and biological environments for each JRM installation or parcel are provided in Chapters 5 through 9, 11, and 12 of the 2019 JRM INRMP (*Note*: some NBG parcels are combined with other small parcels in Chapter 7 for simplicity). The JRM-administered lands and submerged lands addressed in the 2019 JRM INRMP are identified in Table 1-2 and are shown in Figures 1-1 through 1-5.

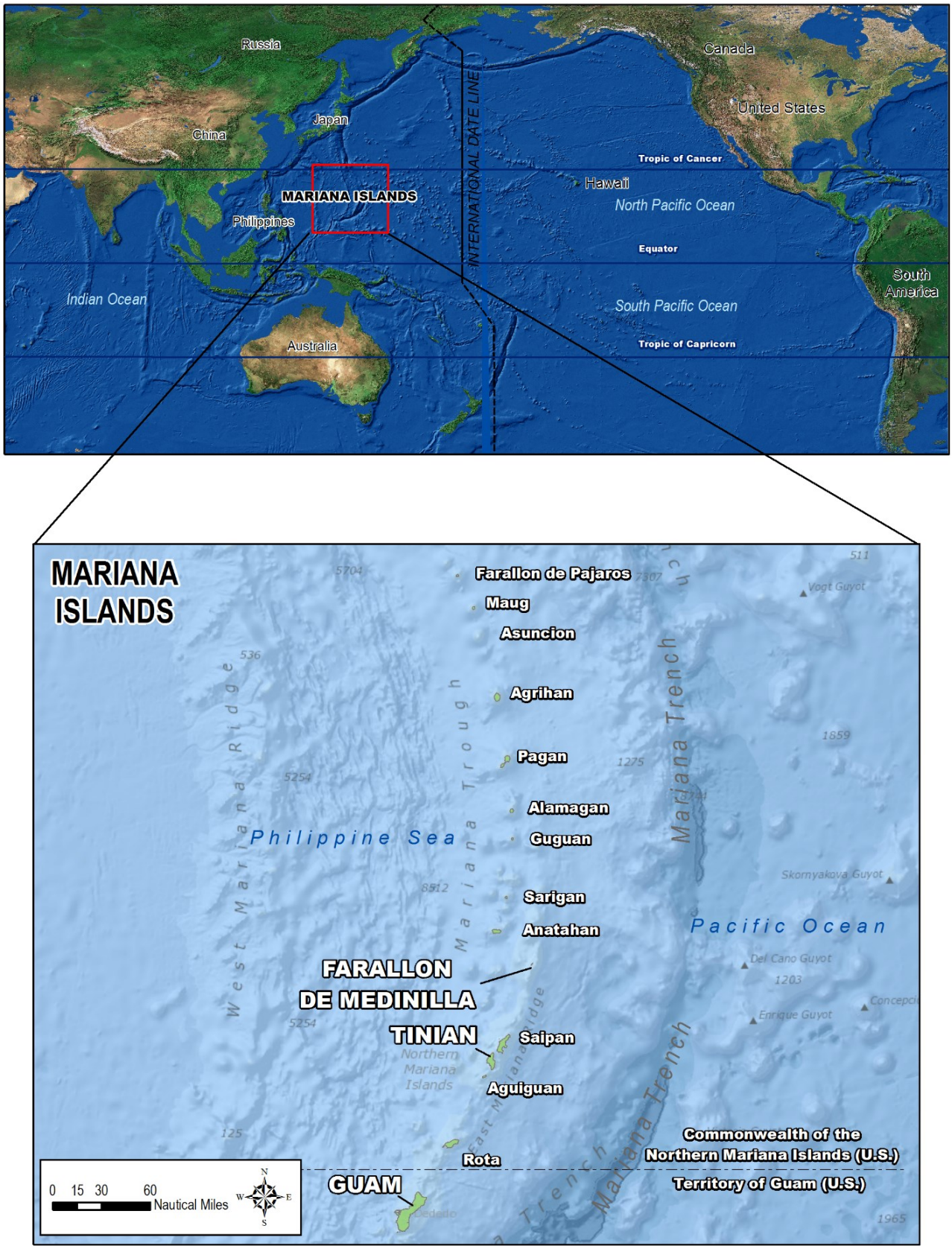

Figure 1-1 Location of Mariana Islands Archipelago, Guam, and the CNMI

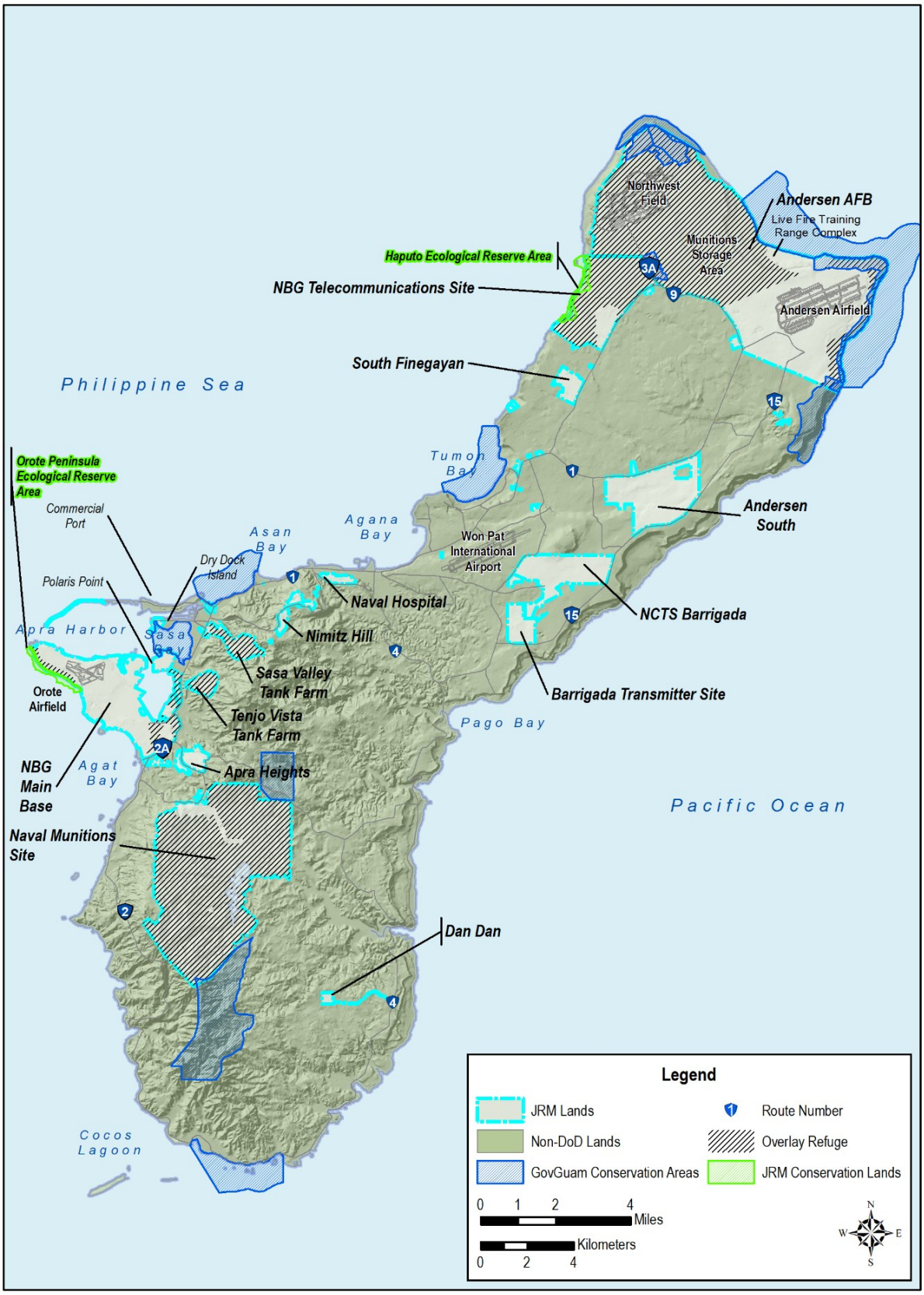

Figure 1-2 Location of JRM-administered Lands, ERA, and Overlay Refuge Lands on Guam

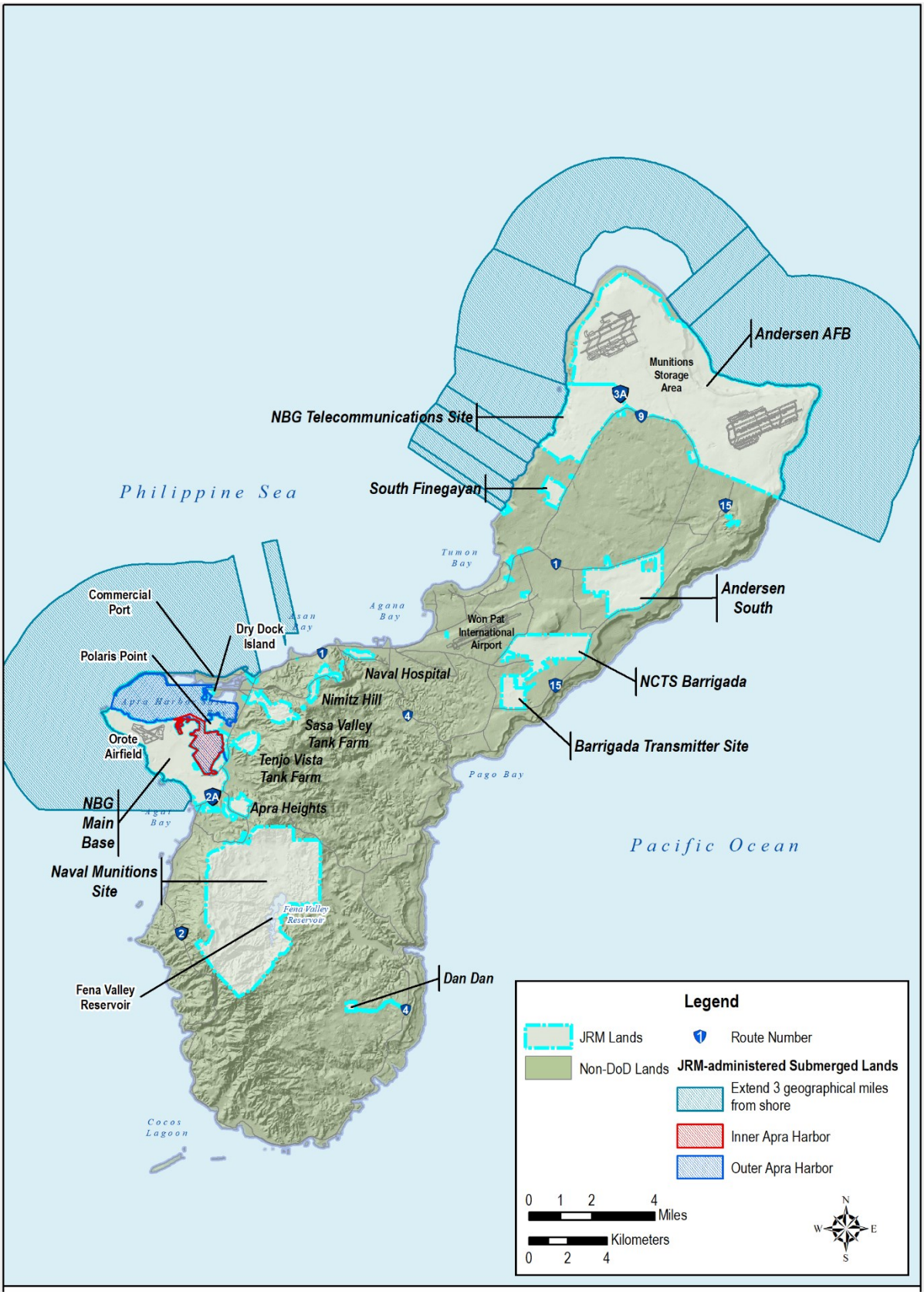

Figure 1-3 Location of JRM-administered Lands and Submerged Lands around Guam



Figure 1-4 Location of JRM Leased Lands and Submerged Lands on Tinian

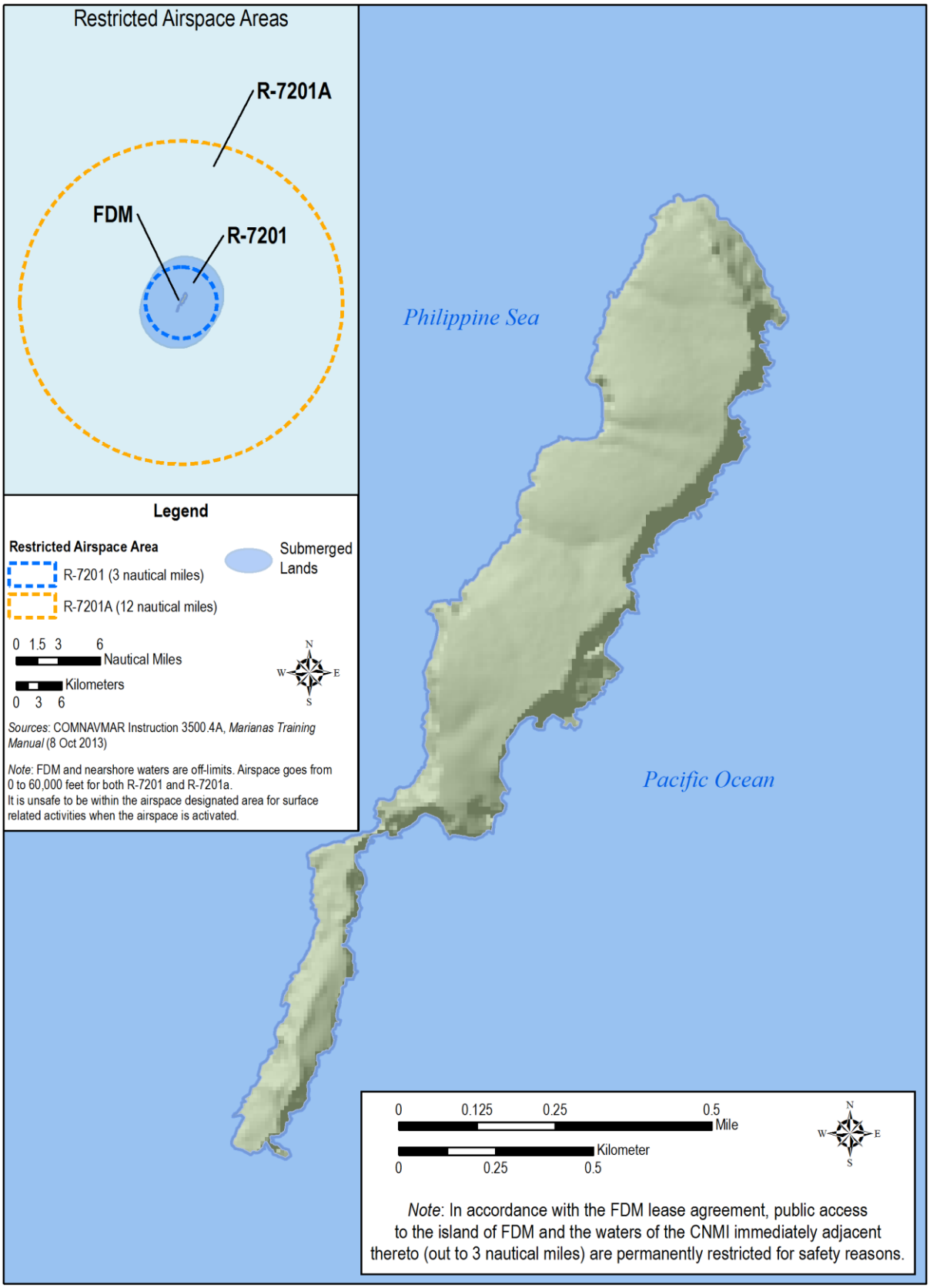

Figure 1-5 FDM, Associated Restricted Airspace Area, and Submerged Lands

Table 1-2 JRM-administered and Leased Terrestrial and Submerged Lands

Facility Name	*Chapters within the INRMP Where this Facility is Discussed*	*Other or Previous Name(s)*	*Terrestrial Lands (acres)*	*Submerged Lands (acres)*	*Ecological Reserve Area[1] (acres)*	*Overlay Refuge Lands[2] (acres)*
Naval Base Guam Main Base	4 and 5	Waterfront Annex	3,455	30,867	163[3]	506
Naval Munitions Site	4 and 6	Ordnance Annex, Naval Magazine	8,645	NA	NA	8,307
Naval Computer and Telecommunications Station Barrigada	4 and 7	Communications Annex Barrigada, Navy Barrigada	1,366	NA	NA	NA
Barrigada Transmitter Site	4 and 7	Air Force Barrigada	432	NA	NA	NA
Andersen South	4 and 7	MARBO Annex, Andersen South	1,980	NA	NA	NA
Sasa Valley Tank Farm	4 and 7		428	NA	NA	395
Tenjo Vista Tank Farm	4 and 7		231	NA	NA	230
Apra Heights/Palms/View	4 and 7		284	NA	NA	NA
Naval Base Guam Telecommunications Site	4 and 8	Naval Computer and Telecommunications Station Finegayan, Communications Annex Finegayan	2,412	11,241	252[4]	2,097
South Finegayan	4 and 8		290	5,388	NA	NA
Andersen Air Force Base	4 and 9	Naval Support Activity Andersen	15,400	37,869[5]	NA	10,158
Tinian Military Lease Area	10 and 11		15,347	47,418	NA	NA
Farallon de Medinilla	10 and 12		182	25,094	NA	NA
		Total Managed Acreage	**50,452**	**157,877**	**415**	**21,693**

Notes: [1]Terrestrial lands of ERAs are included in the Guam National Wildlife Refuge Overlay Refuge; submerged lands of the ERAs are not included in the Overlay Refuge.
[2]Guam National Wildlife Refuge.
[3]Includes Orote Peninsula ERA: 30 acres (12 hectares) of terrestrial lands; 133 acres (54 hectares) of submerged lands.
[4]Includes Haputo ERA: 180 acres (73 hectares) of terrestrial lands; 72 acres (29 hectares) of submerged lands.
[5]Includes Pati Point Marine Preserve: 4,819 acres (1,950 hectares) of submerged lands.

Key: INRMP = Integrated Natural Resource Management Plan; MARBO = Marianas/Bonins Command; NA = not applicable.

Source: JRM 2019, NAVFAC Marianas 2010a.

1.3.1 Naval Base Guam – Main Base

NBG Main Base is discussed in detail in Chapter 5, *Naval Base Guam Main Base*, of the 2019 JRM INRMP. This installation is the U.S. Navy's operations center and is located on the southwest coast of Guam around Apra Harbor, including the Orote Peninsula. The U.S. Navy shares Apra Harbor with the Port Authority of Guam. The commercial port is Guam's lifeline, serves as the regional transshipment hub for the Micronesian region, and functions as the shipping and receiving point for containers designated for DoD installations on Guam. The primary function of NBG Main Base is to support fleet units and operational forces of the Fifth and Seventh Fleets. It serves as the forward deployment base and logistics hub for operations in Asia and the Western Pacific; it is the main distribution center for material, personnel, and munitions that support sea, land, and air forces (Commander, Navy Installations Command 2016; NBG 2016).

The 3,455-acre (1,398-hectare) NBG Main Base consists of several sites controlled and administered by JRM, including the Main Base cantonment (3,114 acres [1,260 hectares]), Glass Breakwater (40 acres [17 hectares]), Polaris Point (253 acres [102 hectares]), and Drydock Island (48 acres [19 hectares]) (see Figure 1-2). NBG also includes 30,867 acres (12,491 hectares) of submerged lands, which are discussed in detail in Section 5.3 of the 2019 JRM INRMP. The U.S. Coast Guard (USCG) controls 14 acres (6 hectares) at Victor Wharf in Inner Apra Harbor as shown on Figure 5-1 of the 2019 JRM INRMP.

NBG hosts several key tenant commands such as the Commander, Submarine Squadron Fifteen, Coastal Riverine Group 1, Naval Special Warfare Unit One, and the USCG Sector Guam. It supports 28 other tenant commands and is the home base to dozens of Pacific Command, U.S. Pacific Fleet, and Seventh Fleet units. Camp Covington is also located within NBG Main Base and supports Naval Mobile Construction Battalions (SeaBees) (Commander, Navy Installations Command 2016; NBG 2016). Refer to Section 2.2.2 of the 2019 JRM INRMP for further details on NBG's mission and tenants.

Navy-controlled lands at Apra Harbor have land uses ranging from industrial to recreational. Shore-based support includes warehouses, power, water, sewage treatment, fuel transfer, and other facilities. NBG Main Base also supports military housing areas, schools, medical and dental facilities, recreational facilities, food services, and Navy commissaries and exchanges. In addition, Main Base provides facilities and infrastructure to support biosecurity inspection and interdiction requirements for cargo and personnel leaving NBG via ship, including an office and kennel for canine brown treesnake (BTS) (*Boiga irregularis*) detection teams.

Training activities at NBG Main Base include beach landings, riverine training, small unit maneuvers, rappelling, helicopter insertion and extraction, field exercises, small arms and pistol marksmanship, stress control training, and fire and maneuver training. Training activities within Apra Harbor include explosive ordnance disposal, deep water mine countermeasures, helicopter paradrops, helicopter cast and recovery, drown-proofing, heliborne firebucket (offload), helicopter search and rescue, and diving/swimming. Table 5-2 and Figure 5-1 in the 2019 JRM INRMP provide a summary of training areas associated with NBG Main Base and the offshore waters.

Approximately 506 acres (205 hectares) of Overlay Refuge lands are designated on NBG Main Base (see Table 1-2 and Figure 1-2) and were originally identified as providing important habitat for federal Endangered Species Act (ESA)-listed species (e.g., Mariana crow [*Corvus kubaryi*], Guam Micronesian kingfisher [*Todiramphus cinnamominus*], Mariana common moorhen [*Gallinula chloropus guami*]) as well as other Guam native species. Of this acreage, 159 acres (64 hectares) are located on the southern

portion of Orote Peninsula (including the Orote Peninsula ERA), with the remaining acreage associated with wetland areas to the east and south of Inner Apra Harbor (i.e., Atantano, Abo Cove, and Camp Covington wetlands). The Overlay Refuge lands on Orote Peninsula consist primarily of limestone native forest, limestone degraded forest, and limestone coastal scrub, which encompass 77 acres (31 hectares). The Overlay Refuge also contains an approximately 62 acres (25 hectares) of tangantangan (*Leucaena leucocephala*) vegetation. For more details on the Overlay Refuge lands located on NBG Main Base, refer to Section 5.1.6.1 of the 2019 JRM INRMP.

On the south side of Orote Peninsula is the Orote Peninsula ERA, which is discussed in detail in Section 5.1.6.2 of the 2019 JRM INRMP. The Orote Peninsula ERA protects two areas or land with a total of 163 acres (66 hectares) of habitat. The first unit consists of 30 acres (12 hectares) of remnant native limestone forest that provide habitat for native forest species. The second unit is a 133-acre (54-hectare) marine unit that provides nursery for marine species of commercial and recreational fishery value.

Refer to Section 5.1 of the 2019 JRM INRMP for further details on Apra Harbor assets and uses, Inner Apra Harbor assets and uses, training areas, explosive safety quantity distance arcs, and special conservation areas.

1.3.2 Naval Base Guam – Naval Munitions Site

NMS is discussed in detail in Chapter 6, *Naval Base Guam Naval Munitions Site*, of the 2019 JRM INRMP. It is located on mountainous terrain in south-central Guam and encompasses approximately 8,645 acres (3,499 hectares) (see Figures 1-2 and 1-3). NMS provides support through receiving, renovating, maintaining, storing, and issuing ammunition, explosives, and expendable ordnance materials to units of the Pacific Fleet operating in the Western Pacific. Managed by Navy Munitions Command, Pacific East Asia Division, Unit Guam, the installation has the primary responsibility of providing ordnance support for the Seventh and Fifth Fleets and is the lone transportation service for point-to-point ammunition hauling between military installations on Guam. Magazines at NMS provide more than 250,000 square feet (23,226 square meters) of storage space for ordnance materials (NAVFAC Marianas 2013).

Fena Valley Reservoir, a 2.3 billion gallon man-made lake, lies entirely within the boundaries of NMS and currently serves as the primary source of water for NBG. The reservoir provides 10 to 12 million gallons per day to DON and Guam Waterworks Authority (SWCA and Tom Nance Water Resource Engineering 2007). Excess water surplus to Navy requirements flows over the spillway into the Maagas River. NAVFAC Marianas operates the Fena Water Treatment Plant located just below the downstream toe of the dam. Detailed information about the reservoir is provided in Section 6.2.2.1 of the 2019 JRM INRMP.

NMS supports ground and air-ground training, primarily for Special Forces personnel, within the 3,357-acre (1,359-hectare) Southern Land Navigation Area and the 508-acre (206-hectare) Northern Land Navigation Area (see Figure 6-1 in the 2019 JRM INRMP). As outlined in the 2014 Mariana Islands Training and Testing (MITT) Biological Assessment, training activities that occur on NMS include the following:

- combat search and rescue
- urban warfare training, noncombatant evacuation operations/humanitarian assistance operations/disaster relief operations
- personnel insertion/extraction

- parachute insertion and embassy reinforcement
- direct action (combat close quarters)
- direct action (breaching)
- intelligence, surveillance, and reconnaissance
- urban warfare training, maneuver (convoy and land navigation)
- field exercise training and force protection
- anti-terrorism
- land demolitions (unexploded ordnance) discovery/disposal

Future training activities, as part of the Guam Military Relocation, include maneuver training (convoy and land navigation), combat search and rescue, and field training exercises. These training activities will occur in the Southern and Northern Land Navigation Areas (DON 2017). Additional details on duration and frequency of these activities appear in the 2010 Guam Military Relocation Environmental Impact Statement (EIS)/Overseas EIS (OEIS) and the 2015 MITT EIS/OEIS.

The majority of NMS is designated as Overlay Refuge (see Table 1-2 and Figure 1-2). The Government of Guam (GovGuam)-designated 2,854-acre (1,155-hectare) Bolanos Conservation Area and 662-acre (244-hectare) Cotal Conservation Area lie immediately adjacent to the southern and northern borders of NMS (see Figure 1-2).

Refer to Section 6.1 of the 2019 JRM INRMP for further details on assets and uses, training areas, explosive safety quantity distance arcs, and special conservation areas.

1.3.3 Naval Base Guam – Telecommunications Site

NBG TS, formerly known as the NCTS Finegayan and Communications Annex Finegayan, is discussed in detail in Chapter 8, *Naval Base Guam Telecommunications Site*, of the 2019 JRM INRMP. It is located on the northwestern coast of the island and provides multispectral connectivity, NetOps, and information assurance to Navy, Joint, and Coalition forces on Guam and the Western Pacific and Indian Oceans. The mission of NBG TS, a subordinate command of the Naval Computer and Telecommunications Area Master Station, Pacific, is to provide continuous global and universal communications services to fleet units, shore activities, and joint forces.

NBG TS totals 2,412 acres (976 hectares) of terrestrial lands and 11,241 acres (4,549 hectares) of submerged lands. The U.S. Navy owns lands within the boundaries of NBG TS and owns submerged lands off NBG TS out to a distance of 3 miles (4.8 kilometers) from the coast.

NBG TS operates communications systems including radio frequency systems and terrestrial-based fiber optic cables. This area is designated and maintained as a radio frequency quiet zone for a minimum of a 1-mile (1.6-kilometer) radius. NBG TS provides base level communications to all Navy and other authorized users at all Navy facilities on Guam. Base level communications include all facilities and services required to support electromagnetic dissemination; transmission or reception of voice, data, and video; and integrated telecommunications within the confines of a post, camp, station, base, installation, headquarters, or metropolitan area to include local interconnect trunks to the first serving commercial central office or military long-haul or tactical gateway.

Land uses on JRM-administered lands at NBG TS include telecommunications operations, community support, administrative functions, training, recreation, and conservation. Telecommunications antennas and related equipment require open areas to prevent interference. Shore-based support includes military housing, power distribution, food services, recreational and related facilities, as well as conservation of coastal limestone forests and fringing reefs within the Haputo ERA. NBG TS is also the primary site for the U.S. Marine Corps personnel associated with the relocation of the U.S. Marine Corps to Guam.

The lands and coastal waters of NBG TS are used for military training. Training within NBG TS includes urban warfare training, personnel insertion/extraction, humanitarian assistance/disaster relief operations, and embassy reinforcement exercises (USFWS 2015a). These activities may include the use of existing trails for inland maneuvers and Military Operation in Urban Terrain (MOUT) and the use of rifle and pistol ranges at the North Range. A Surface Danger Zone associated with these small arms ranges extends out over the submerged lands of Guam off Haputo Point (see Figure 8-1 in the 2019 JRM INRMP). Notices are sent out ahead of time to provide advance notice of when the ranges will be in use. Surface Danger Zone closures for the range on NBG TS are communicated in advance of the scheduled range closure through the issuance of Notices to Airmen and Notices to Mariners, as applicable.

The Haputo ERA protects a total of 252 acres (102 hectares) of habitat: 180 acres (73 hectares) of native forest with relatively few non-native species that extend from the water to the cliff line and 72 acres (29 hectares) of marine waters extending out from the mean lower water line, which includes the Double Reef area (see Table 1-2 and Figure 1-2). While the emphasis of the Haputo ERA is on conservation of natural resources, it also provides benefits to and protection of cultural resources. The terrestrial unit of the Haputo ERA is located within the 2,097-acre (849-hectares) Overlay Refuge lands (see Figure 1-2).

In 2015, 699 acres (283 hectares) of NBG TS lands were designated as recovery habitat for the endangered Guam Micronesian kingfisher under a Memorandum of Agreement (MOA) between the DON and the USFWS (DON and USFWS 2015a, 2015b). These lands encompass the forested cliffline of the entire western coastal portion of NBG TS and some forested areas in the northern and southern portions of the installation (see Figure 1-2).

Refer to Section 8.1 of the 2019 JRM INRMP for further details on NBG TS assets and uses, training areas, and special conservation areas.

1.3.4 Naval Base Guam – Sasa Valley and Tenjo Vista Tank Farms

Sasa Valley and Tenjo Vista Tank Farms are discussed in detail in Chapter 7, *Apra Heights, Sasa Valley and Tenjo Vista Tank Farms, Naval Computer and Telecommunications Station Barrigada, Barrigada Transmitter Site, and Andersen South*, of the 2019 JRM INRMP. Located east of Marine Corps Drive (Route 1) and south of the village of Piti, the Sasa Valley (428 acres [173 hectares]) and Tenjo Vista (231 acres [93 hectares]) tank farms provide storage, transfer, and pumping capability for petroleum, oil, and lubricants (POL) for both the DON and USAF (refer to Figure 7-6 of the 2019 JRM INRMP). Defense Fuel Support Point Guam operates both tank farms. Tenjo Vista Tank Farm houses thousands of gallons of F-76 military diesel fuel in seven underground storage tanks. The Sasa Valley Tank Farm is comprised of a lower and upper complex. The lower complex includes administration and security, a pump house, electrical substation, seven POL tanks, a truck fueling station, and supporting POL

processing equipment. The upper complex includes 20 underground storage tanks with a combined storage capacity of approximately 42 million gallons (159 million liters):

- six tanks store JP-8 jet fuel for Andersen AFB
- six tanks store JP-5 aircraft fuel for Navy aircraft carriers
- three tanks store F-76 diesel fuel for Navy vessels
- five tanks store marine fuel oil for Navy vessels

JP-8 fuel is pumped to Andersen AFB, while the other products are delivered via gravity flow to other Guam Defense Logistics Agency Defense Energy Support Center facilities/piers. The tank farms are directly connected to Delta and Echo piers, located on Drydock Island in Outer Apra Harbor, to support Navy fueling operations (NAVFAC Marianas 2015a, b; NBG 2016).

With the exception of the administration area at the main entrance to the Sasa Valley Tank Farm, all of the remaining lands within the Sasa Valley and Tenjo Vista Tank Farms are Overlay Refuge lands (see Table 1-2 and Figure 1-2).

1.3.5 Naval Base Guam – Naval Computer and Telecommunications Station Barrigada

NCTS Barrigada is discussed in detail in Chapter 7, *Apra Heights, Sasa Valley and Tenjo Vista Tank Farms, Naval Computer and Telecommunications Station Barrigada, Barrigada Transmitter Site, and Andersen South*, of the 2019 JRM INRMP. The 1,366-acre (553-hectare) site supports high-frequency transmitting activities for all DoD activities on Guam. A 1.2-mile (2-kilometer) radius electromagnetic radiation protection zone is designated around the transmitting antennas at NCTS Barrigada to preclude electromagnetic radiation problems. It is also the headquarters for the Space and Naval Warfare Systems Center Pacific Detachment Guam and the Army Reserve Center and supports military training operations. A MOUT area, the former Fleet Hospital warehouse, and the now closed Admiral Nimitz Golf Course are also located at NCTS Barrigada (refer to Figure 7-11 of the 2019 JRM INRMP) (NBG 2016). For the time being, the golf course is closed and is designated as an archaeological area while DON conducts cultural resource consultations with the Guam State Historic Preservation Officer in accordance with the National Historic Preservation Act (NHPA).

Military training activities that have occurred and currently occur on NCTS Barrigada are associated with previous Mariana Islands Range Complex (MIRC) operations (Commander, U.S. Pacific Fleet [COMPACFLT] 2010) and current MITT operations (COMPACFLT 2014, 2015a), which have replaced all MIRC activities. Military training activities that currently occur on NCTS Barrigada include the following (COMPACFLT 2014):

- urban warfare training
- noncombatant evacuation/humanitarian assistance/disaster relief operation
- personnel parachute insertion/extraction
- maneuver (convoy, land navigation)
- force protection

1.3.6 Apra Heights

Apra Heights is discussed in detail in Chapter 7, *Apra Heights, Sasa Valley and Tenjo Vista Tank Farms, Naval Computer and Telecommunications Station Barrigada, Barrigada Transmitter Site, and Andersen*

South, of the 2019 JRM INRMP. Located southeast of NBG Main Base and north of NMS on Route 5, this complex (243 acres [98 hectares]) comprises two family housing neighborhoods (Apra View and Apra Palms), community support facilities, and the Santa Rita Naval Administrative/Office Complex.

1.3.7 Andersen Air Force Base

Andersen AFB is discussed in detail in Chapter 9, *Andersen Air Force Base*, of the 2019 JRM INRMP. Andersen AFB was opened in 1944 as a B-29 staging base during World War II and served as a Strategic Air Command base until 1992, when it was realigned under Pacific Air Forces to support operations in the Asia and South Pacific regions. Since 2009, it has been jointly operated with NBG under the JRM military command. Andersen AFB is a strategically located forward main operating base and is vital to the security of the U.S. Its mission is expanding to support the defense strategy specified in the 2001 Quadrennial Defense Review and the 2003 Defense Planning Guidance. This defense strategy calls for the military to "deter forward" by stationing or deploying forces to five critical regions of the world: Europe, Middle East, Southwest Asia, Northeast Asia, and East Asian Littoral (e.g., region stretching from south of Japan through Australia and into the Bay of Bengal). Under this defense strategy, Andersen AFB serves as a main operating base to conduct and support operations in the East Asian Littoral region due to its long runways, vast ramp space, and large fuel storage capacity. The 36th Wing is the host unit to USAF, U.S. Army, DON (U.S. Navy and U.S. Marine Corps) active forces, along with USAF Reserve and Air National Guard. The Wing's mission is to provide the highest quality peacetime and wartime support from its strategic Pacific location. Guam serves as a stopping point for numerous aircraft enroute to Japan, Korea, and other Indo-Asia Pacific locations. Andersen AFB was chosen as the site for family housing as well as a Live-fire Training Range Complex as specified in the 2015 Record of Decision (ROD) for the Final Supplemental EIS for Guam and CNMI Military Relocation (DON 2015b). The U.S. Army maintains its Terminal High-altitude Area Defense (THAAD) ballistic missile defense battery on Guam on Northwest Field of Andersen AFB.

Andersen AFB is located in Yigo at the northern tip of Guam (see Figure 1-2). Andersen AFB totals 15,400 acres (6,232 hectares) of terrestrial lands and 37,869 acres (15,325 hectares) of submerged lands. The U.S. Navy owns lands within the boundaries of Andersen AFB and owns submerged lands off Andersen AFB out to a distance of 3 miles (4.8 kilometers) from the coast except for a portion of the water surrounding the Guam National Wildlife Refuge. The main operations area of Andersen AFB is in the eastern third of the installation at approximately 500 feet (152 meters) above sea level. This area includes the main active airfield and an array of operations, maintenance, and community support facilities. The central third of the installation is a Munitions Storage Area. The western third is Northwest Field, which was a World War II-era airfield used for fixed-wing aircraft and is currently used for helicopter training, various field exercises, and bivouacs. A potable water well field on Andersen AFB, south and southeast of the Munitions Storage Area, is proposed for development as a result of the Guam Military Relocation.

Approximately 10,158 acres (4,111 hectares) of Overlay Refuge lands are designated on Andersen AFB (see Figure 1-2), are currently managed by JRM, and have been identified as providing important habitat for federal ESA-listed threatened and endangered species (e.g., Mariana fruit bat [*Pteropus mariannus mariannus*], Mariana crow, Guam Micronesian kingfisher, Guam rail [*Gallirallus owstoni*], and the fire tree [*Serianthes nelsonii*]), as well as other Guam native species. The Overlay Refuge lands on Andersen AFB consist primarily of limestone native forest, limestone degraded forest, limestone coastal scrub

(77 acres [31 hectares] or 49 percent [%]), and approximately 62 acres (25 hectares) (or 39%) of tangantangan vegetation.

The Andersen AFB Marine Resources Preserve shown in Figure 1-2 was established in 1993 to protect the coastal resources surrounding the northeastern portion of the base (Andersen AFB 1995). Adjacent to the Marine Resources Preserve is the Pati Point Natural Area, which serves to protect the resources feeding into the marine environment (see Figure 1-2). The GovGuam established Pati Point Marine Preserve in 1999, citing 15 years of research that showed a decline in fish stocks in the area (National Oceanic and Atmospheric Administration 2009). Pati Point Marine Preserve covers nearly the same areas as the Andersen AFB Marine Preserve (4,819 acres [1,950 hectares]) and the Pati Point Natural Area (713 acres [288 hectares]).

Refer to Section 9.1 of the 2019 JRM INRMP for further details on Andersen AFB assets and uses, training areas, explosive safety quantity distance arcs, and other special conservation areas. The special conservation areas include the following:

- fenced ungulate (i.e., hoofed mammals such as pigs, deer, and carabao) exclosures, designed to enhance native habitat through the removal and exclusion of Philippine deer (*Rusa marianna*) and feral pigs (*Sus scrofa*)
- Habitat Management Unit, an enclosed 148-acre [60-hectares] parcel of land established to enhance native habitat based on the 2002 Area 50 Restoration Plan and used by various agencies as a test site for control and monitoring programs for removal of invasive species and habitat restoration
- recovery habitat for the Guam Micronesian kingfisher, 5,234 acres (2,118 hectares) of habitat that will be protected such that the land is suitable for the Guam Micronesian kingfisher on Andersen AFB and NBG TS

1.3.8 Andersen South

Andersen South is discussed in detail in Chapter 7, *Apra Heights, Sasa Valley and Tenjo Vista Tank Farms, Naval Computer and Telecommunications Station Barrigada, Barrigada Transmitter Site, and Andersen South*, of the 2019 JRM INRMP. Historically, Andersen South was used for family housing and barracks and includes a wastewater pump station and a water booster pump station, along with water tanks and an electrical substation that are not currently being used. There are installation restoration (clean-up) sites and water production wells with wellhead clearance buffers in the area. The vacant family housing and barracks areas in the southern portion of the parcel and north of Route 15 (refer to Figure 7-16 of the 2019 JRM INRMP) have been used for humanitarian operations, staging, bivouac, equipment inspection, and small unit tactics, including MOUT training.

Andersen South includes an 80-acre (32-hectare) parcel located in the northeastern area of the site that was deeded in 1992 from DoD to the GovGuam for development of a Guam Public School System High School (refer to Figure 7-16 of the 2019 JRM INRMP). There are conditions in the 30-year quit claim deed that limit the use to educational facilities, require no impact on the water lens or water wells in the vicinity, and provide that if conditions are not met, the land could revert to the federal government. The school was never developed; portions of the site were leased to civilians for crop production and one 10-acre (4-hectare) parcel is currently under lease in the western area of the property (DON 2010b). The lease can be terminated at USAF discretion when a military use for the area is identified.

As part of the ROD for the Guam and CNMI Military Relocation action (DON 2010c, 2015a, b), the construction of facilities and infrastructure to support military training operations at Andersen South will be implemented. Construction of proposed facilities is expected to begin in fiscal year 2019. Additional discussion, including a summary of the proposed facilities and military training operations within the new Andersen South Training Complex, is provided in Section 7.4.1 of the 2019 JRM INRMP.

1.3.9 Barrigada Transmitter Site

Barrigada Transmitter Site (previously known as Air Force Barrigada or Air Force Communications Annex Barrigada) is discussed in detail in Chapter 7, *Apra Heights, Sasa Valley and Tenjo Vista Tank Farms, Naval Computer and Telecommunications Station Barrigada, Barrigada Transmitter Site, and Andersen South*, of the 2019 JRM INRMP. The 432-acre (175-hectare) complex supports a next-generation, high-resolution weather radar system that is operated by Andersen AFB (see Figure 1-2).

1.3.10 Tinian Military Lease Area

JRM leased lands on Tinian are discussed in detail in Chapter 11, *Tinian Military Lease Area*, of the 2019 JRM INRMP. The northern two thirds of the island of Tinian is leased to the federal government and is excluded from the CNMI coastal zone by covenant. The area is designated the Military Lease Area (MLA) and is divided into the Exclusive Military Use Area (EMUA) and the Lease Back Area (LBA). Most existing military training activities are limited to lands within the EMUA. DoD training on Tinian is conducted in five general mission areas: Air Warfare, Sea Warfare, Undersea Warfare, Land Warfare, and Amphibious Warfare. Training conducted in these mission areas occurs to ensure the readiness of the U.S. Navy, U.S. Marine Corps, USAF, U.S. Army, USCG, and the U.S. military readiness partners.

The Tinian MLA is controlled and managed by DON and is approximately 15,347 contiguous acres (6,211 hectares) north of the Tinian International Airport (West Field) (see Figure 1-4). The EMUA is approximately 7,577 acres (3,066 hectares) in the northern section of the MLA and the LBA includes approximately 7,770 acres (3,145 hectares) in the central section of the island. There are no permanent military installations in the EMUA, and it is open to the public for recreational and other purposes when not being used for training. The International Broadcasting Bureau's Philippines Transmitting Station uses 777 acres (314 hectares) of the EMUA. The International Broadcasting Bureau is operated by the U.S. Information Agency (DON 2010b) and supports day-to-day operations of Voice of America and provides transmission and technical support to non-military U.S. broadcasting services. The LBA is jointly used for both military and non-military activities.

In 1999, the DON dedicated the Existing Tinian Military Retention Land for Wildlife Conservation – also known as Federal Aviation Administration Mitigation Area – as a conservation area for the Tinian monarch (*Monarcha takatsukasae*) to mitigate for past expansions of the Tinian International Airport (West Field) (Government of CNMI and U.S. of America 1999) (see Figure 1-4). This was done in cooperation with USFWS, CNMI Division of Fish and Wildlife (DFW), and the Federal Aviation Administration. The cooperative agreement allows the military to use the Federal Aviation Administration Mitigation Area for low-impact training that will not adversely modify habitat.

Refer to Section 11.1 of the 2019 JRM INRMP for further details on Tinian assets and uses, training areas, and special conservation areas.

1.3.11 Farallon de Medinilla

FDM is the Pacific Fleet's only U.S.-controlled range available for live-fire training. It is discussed in detail in Chapter 12, *Farallon de Medinilla*, of the 2019 JRM INRMP. The island has served as a bombing range since 1971, both for live- and inert-fire bombing. It supports activities such as surface-to-ground and air-to-ground Gunnery Exercise, Bombing Exercise, Missile Exercise, Fire Support, and Precision Weapons (U.S. Navy 2009).

FDM is under lease by the DoD from the CNMI. The lease agreement with the CNMI allows DoD use of the island until the year 2075. DON controls and manages access to and training on FDM. There are no designated special conservation areas for terrestrial resources on FDM; however, the No-fire Area at the northern tip of the island serves as a de-facto conservation area (see Figure 1-5). A limited archaeological reconnaissance survey of the island was conducted in 1996 and no archaeological sites or isolated non-modern artifacts were discovered.

Refer to Section 12.1 of the 2019 JRM INRMP for further details on FDM uses and training areas.

1.4 Purpose of and Need for the Proposed Action

The purpose of the Proposed Action is to implement the revised JRM INRMP to include species listed under the ESA since 2013 (Table 1-3) and to implement an approach for natural resources management on JRM-administered lands that is consistent with the Sikes Act (as amended) as well as the most recent DoD and DON policy and guidance regarding INRMPs.

The need for the Proposed Action is to provide a comprehensive, adaptive natural resources management approach for all properties under JRM. Both the INRMP and the natural resources management programs that it supports must meet DoD and DON policy and guidance that collectively require a plan and management approach consistent with mission support (as defined in 10 USC Section 5062), multipurpose use, integration, ecosystem- or landscape-level management, and environmental compliance and stewardship objectives.

> 10 USC Section 5062: "The Navy shall be organized, trained, and equipped primarily for prompt and sustained combat incident to operations at sea. It is responsible for the preparation of naval forces necessary for the effective prosecution of war except as otherwise assigned and, in accordance with integrated joint mobilization plans, for the expansion of the peacetime components of the Navy to meet the needs of war."

1.5 Scope of Environmental Analysis

This EA includes an analysis of potential environmental impacts associated with the Proposed Action and the No Action Alternative. The environmental resource areas analyzed in this EA include: geology, topography, and soils; water resources; cultural resources; terrestrial biological resources; marine biological resources; land use; submerged land use; and socioeconomics and environmental justice. The study area for each resource analyzed may differ due to how the Proposed Action interacts with or impacts the resource.

Table 1-3 Species Listed under the ESA since 2013

Common Name/ Chamorro Name[(1)]	*Scientific Name*	*Federal Status*
Reptiles		
Green turtle/Haggan betde	*Chelonia mydas*	E[(2)]
Slevin's skink/ Gualiek halom tano	*Emoia slevini*	E
Invertebrates		
Humped tree snail/Akaleha	*Partula gibba*	E
Guam tree snail/Akaleha	*Partula radiolata*	E
Fragile tree snail/Akaleha	*Samoana fragilis*	E
Mariana eight-spot butterfly/Ababbang	*Hypolimnas octocula marianensis*	E
Coral/Acho tasi	*Acropora globiceps*	T
Coral/Acho tasi	*Acropora retusa*	T
Coral/Acho tasi	*Seriatopora aculeata*	T
Fish		
Oceanic whitetip shark/Haluu	*Carcharhinus longimanus*	T
Giant manta ray/Afula or Hafula or Fanihen tasi	*Manta birostris*	T
Scalloped hammerhead shark/Haluun kiluus or Ulon matiyu na huluu	*Sphyrna lewini*	T[(3)]
Plants		
None/Siboyas halumtano	*Bulbophyllum guamense*	T
None/Fadang	*Cycas micronesica*	T
None/None	*Dendrobium guamense*	T
None/None	*Eugenia bryanii*	E
None/Pao dedu	*Hedyotis megalantha*	E
None/Ufa halumtano	*Heritiera longipetiolata*	E
None/None	*Maesa walkeri*	T
None/None	*Nervilia jacksoniae*	T
None/None	*Phyllanthus saffordii*	E
None/Aplokating-palaoan	*Psychotria malaspinae*	E
None/Biringenas halumtano	*Solanum guamense*	E
None/None	*Tabernaemontana rotensis*	T
None/None	*Tinospora homosepala*	E
None/None	*Tuberolabium guamense*	T

Notes: [(1)]Chamorro names from GovGuam (2009), USFWS (2015), and 85-30.1-CNMI Administrative Code.
[(2)]Central West Pacific Distinct Population Segment.
[(3)]Indo-West Pacific Distinct Population Segment.
Key: E = endangered; T = threatened.
Sources: NMFS 2018a, 2018b; NMFS and USFWS 2016; USFWS 2014, 2015.

1.6 Key Documents

Key documents are sources of information incorporated into this EA. Documents are considered key because they refer to similar actions, analyses, or impacts that may apply to this Proposed Action. CEQ guidance encourages incorporating documents by reference. Documents incorporated into this EA by reference in part or in whole include the following:

- *Mariana Islands Range Complex Final Environmental Impact Statement/Overseas Environmental Impact Statement* (COMPACFLT 2010). Published May 2010, the MIRC EIS/OEIS evaluated impacts associated with the military services conducting training in the Mariana Islands (inclusive of Guam and the CNMI). The ROD supports conducting current, emerging, and future military training and research, development, test, and evaluation activities in the MIRC, while enhancing training resources through investment in the MIRC (COMPACFLT 2010). Training, including non-live-fire, within the MIRC involves ranges, training areas, facilities, and Special Use Airspace over Tinian, Saipan, FDM, and Rota, as well as Guam.
- *Guam and Commonwealth of the Northern Mariana Islands Military Relocation Final Environmental Impact Statement*: Relocating Marines from Okinawa, Visiting Aircraft Carrier Berthing, and Army Air and Missile Defense Task Force (DON 2010b). The EIS was published in July 2010 and the ROD was signed in September 2010. The EIS addressed impacts of relocating Marines from Okinawa to Guam, the construction of four ranges (three small arms ranges and an infantry platoon battle course) on Tinian, and conducting training operations on Tinian.
- *Mariana Islands Range Complex Airspace Environmental Assessment/Overseas Environmental Assessment* (DON 2013a). Published in June 2013, the MIRC EA/Overseas EA analyzed potential environmental impacts relevant to the proposed modifications to training airspace and sea space in the MIRC. The proposed action is to maximize public awareness of hazardous military training activities and to optimize safety and training efficiency through the establishment of new Special Use Airspace throughout the MIRC and the modification of existing Special Use Airspace and the establishment of a new Surface Danger Zone at FDM.
- *Integrated Natural Resources Management Plan for Joint Region Marianas Environmental Assessment* (DON 2013b). Published in June 2013, the EA analyzed potential environmental impacts associated with implementation of the proposed 2013 JRM INRMP (JRM 2013). A Finding of No Significant Impact was signed in July 2013.
- *Mariana Islands Training and Testing Final Environmental Impact Statement/Overseas Environmental Impact Statement* (COMPACFLT 2015a). Published in May 2015, the EIS/OEIS evaluated impacts associated with supporting and conducting current, emerging, and future training and testing activities in the MITT study area, which is made up of the MIRC, additional areas on the high seas, and a transit corridor where training and testing activities may occur. The ROD supports meeting current and future DON and DoD training and testing requirements, including the use of active sonar and explosives within the study area (COMPACFLT 2015b).
- *Guam and Commonwealth of the Northern Mariana Islands Military Relocation (2012 Roadmap Adjustments) Supplemental Environmental Impact Statement* (DON 2015a). A Supplemental EIS to the Guam and CNMI Military Relocation Final EIS was published in July 2015 (DON 2015a) and a ROD was signed in August 2015 (DON 2015b). This Supplemental EIS modified many aspects of the previously approved 2010 Guam and CNMI Military Relocation Final EIS (DON 2010b), including the establishment on Guam of a Live-fire Training Range Complex, a cantonment area,

a family housing area, and associated infrastructure to support the relocation of a substantially reduced number of Marines and dependents; there were no changes addressed for the Tinian portion of the original proposed action.

- *Divert Activities and Exercises, Commonwealth of the Northern Mariana Islands Final Environmental Impact Statement* (USAF 2016). Published in September 2016, the Final EIS analyzed environmental impacts associated with improving an existing airport or airports and associated infrastructure in the Mariana Islands in support of expanding mission requirements and to achieve divert capabilities in the Western Pacific. The USAF signed the ROD for the Divert Exercises and Activities initiative on December 7, 2016, selecting the Tinian International Airport, Tinian alternative, and, specifically the North Option, as described in the Final EIS.
- *Environmental Assessment for Terminal High-Altitude Area Defense (THAAD) Permanent Stationing in Guam* (U.S. Army 2015). Published in 2015, the THAAD EA analyzed the impacts of the ballistic missile defense battery and an associated cargo drop zone training area permanently located at Northwest Field, Andersen 19 AFB, and Guam. The battery is under the direction of the U.S. Army Space and Missile Defense 20 Command/Army Forces Strategic Command.

1.7 Relevant Laws and Regulations

The DON has prepared this EA based upon federal and state laws, statutes, regulations, and policies pertinent to the implementation of the Proposed Action, including the following:

- NEPA (42 USC Sections 4321–4370h), which requires an environmental analysis for major federal actions that have the potential to significantly impact the quality of the human environment
- Sikes Act, as amended (16 USC 670a)
- Fish and Wildlife Coordination Act (16 USC 661-666c)
- Coast and Geodetic Survey Act of 1947 (33 USC Section 883 et seq.)
- CEQ Regulations for Implementing the Procedural Provisions of NEPA (40 CFR parts 1500–1508)
- Navy regulations for implementing NEPA (32 CFR part 775), which provides Navy policy for implementing CEQ regulations and NEPA
- Archaeological Resources Protection Act (16 USC Section 470aa-mm)
- Comprehensive Environmental Response, Compensation, and Liability Act (42 USC Section 9601 et seq.)
- Clean Air Act (42 USC Section 7401 et seq.)
- Clean Water Act (CWA) (33 USC Section 1251 et seq.)
- Rivers and Harbors Act (33 USC Sections 10 and 407)
- Coastal Zone Management Act (CZMA) (16 USC Section 1451 et seq.)
- NHPA (54 USC Section 306108 et seq.)
- ESA (16 USC Section 1531 et seq.)
- National Invasive Species Act (16 USC Section 4701)
- Magnuson-Stevens Fishery Conservation and Management Reauthorization Act (16 USC Section 1801 et seq.)
- Marine Mammal Protection Act (MMPA) (16 USC Section 1361 et seq.)

- Migratory Bird Treaty Act (MBTA) (16 USC Sections 703–712)
- Federal Insecticide, Fungicide, and Rodenticide Act (7 USC Section 136 et seq.)
- Resource Conservation and Recovery Act (42 USC Section 6901 et seq.)
- Toxic Substances Control Act (15 USC Sections 2601–2629)
- Executive Order (EO) 11988, *Floodplain Management*
- EO 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-income Populations*
- EO 13045, *Protection of Children from Environmental Health Risks and Safety Risks*
- EO 13089, *Coral Reef Protection*
- EO 13112, *Invasive Species*
- EO 13751, *Safeguarding the Nation from the Impacts of Invasive Species*
- Guam Pesticide Act (Guam Code Section 57120 et seq.)

A description of the Proposed Action's consistency with these laws, policies, and regulations, as well as the names of regulatory agencies responsible for their implementation, is presented in Chapter 6, *Other Considerations Required by National Environmental Policy Act* (Table 6-1).

1.8 Public and Agency Participation and Intergovernmental Coordination

Regulations from the CEQ direct agencies to involve the public in preparing and implementing their NEPA procedures.

The Navy prepared this Draft EA to inform the public of the Proposed Action and to allow the opportunity for public review and comment. The Draft EA review period for Guam and the CNMI was scheduled for November 14 to December 13, 2018. The Navy postponed the public review within the CNMI to allow for recovery efforts resulting from Super Typhoon Yutu but proceeded with the public review period in Guam. The Guam review period began with a public notice published in printed editions and online websites of the Guam Pacific Daily News and the Guam Daily Post on November 9, 2018 indicating the availability of the November 2018 Draft EA, the date by which comments must be received, the Navy point of contact, and the locations where public review copies were available for review by interested parties. An online public notice remained advertised on the Guam Daily Post website from November 9 through December 9, 2018. The November 2018 Draft EA along with the November 2018 Draft INRMP were available for review by interested parties from November 14 to December 13, 2018 at the Nieves M. Flores Memorial Library, 254 Martyr Street Hagatna, Guam; Dededo Public Library, West Santa Barbara Avenue, Dededo, Guam; and on the JRM INRMP website at www.jrminrmp.com.

The Navy then provided a 30-day public review period for the residents of the CNMI from February 15 to March 16, 2019. The CNMI review period began with a public notice published in printed editions and online websites of the Saipan Tribune on February 12, 2019 and the Marianas Variety on February 13, 2019 indicating the availability of the February 2019 Draft EA, the date by which comments must be received, the Navy point of contact, and the locations where public review copies were available for review by interested parties. An online public notice remained advertised on the Saipan Tribune website from February 12 through March 11, 2019. The February 2019 Draft EA along with the February 2019 Draft INRMP were available for review by interested parties from February 15 to March 16, 2019 at the

Joeten-Kiyu Public Library, Insatto Street, Saipan; Tinian Public Library, San Jose, Tinian; and on the JRM INRMP website at www.jrminrmp.com.

During the development of the Proposed Action, the Navy coordinated or consulted with the USFWS, including the Guam National Wildlife Refuge, the National Oceanic and Atmospheric Administration National Marine Fisheries Service (NMFS), other resource management agencies, and the territorial and commonwealth fish and wildlife agencies, which for Guam is Guam DAWR and for Tinian and FDM is the CNMI DFW. A Coastal Consistency Determination was prepared and submitted to the Guam Bureau of Statistics and Plans, Coastal Management Program. A CZMA determination will also be submitted to the CNMI Bureau of Environmental and Coastal Quality.

Section 7 of the ESA directs all federal agencies to work to conserve endangered and threatened species and to use their authorities to further the purposes of the ESA. Section 7 of the ESA is the mechanism by which federal agencies ensure the actions they take, including those they fund or authorize, do not jeopardize the existence of any federal ESA-listed species. If the Proposed Action is implemented, DON will coordinate with the USFWS and NMFS to engage in section 7 consultations for specific projects that may affect listed species.

The Navy will also perform project-specific consultations with the Guam State Historic Preservation Officer and CNMI Historic Preservation Officer as needed before implementing specific proposed natural resource management actions described in the 2019 JRM INRMP.

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2 Proposed Action and the No Action Alternative

2.1 Introduction

This chapter describes the alternatives that are evaluated in this Environmental Assessment (EA). The Proposed Action under consideration is to implement the 2019 Joint Region Marianas (JRM) Integrated Natural Resources Management Plan (INRMP), consistent with the military use of the JRM-administered lands and the goals and objectives established in the Sikes Act (as amended). As required by National Environmental Policy Act (NEPA) regulations, a No Action Alternative is also analyzed. The No Action Alternative under consideration would continue the implementation of the 2013 JRM INRMP (Department of the Navy [DON] 2013a). The No Action Alternative is evaluated to compare the outcomes of implementing the Proposed Action, versus continuing current practices.

2.2 Screening Factors

NEPA's implementing regulations provide guidance on the consideration of alternatives to a federally proposed action and require rigorous exploration and objective evaluation of reasonable alternatives. Only those alternatives determined to be reasonable and to meet the purpose and need require detailed analysis.

Potential alternatives that meet the purpose and need were evaluated against the following screening factors:

- be based on the principles of ecosystem management
- provide for sustainable multipurpose use of natural resources
- maintain compliance with relevant environmental regulations
- provide for public access for use of natural resources subject to safety and military security considerations
- establish specific natural resources management objectives and timeframes for the Proposed Action
- prevent loss in the capability of military lands to support the military mission of the installation

2.3 Alternatives Carried Forward for Analysis

Based on the reasonable alternative screening factors and meeting the purpose and need for the Proposed Action, only the No Action Alternative and the Proposed Action were carried forward and are analyzed in this EA. The Proposed Action in itself encompasses consideration of a wide variety of resource management projects (i.e., alternate actions) that can be implemented in the future, depending on environmental conditions and ecological considerations at the time. Many of these projects were addressed in the EA for the 2013 JRM INRMP, are currently being conducted, and will likely continue. Also, all resource management projects in the 2019 JRM INRMP would result in beneficial effects to area resources, as "good environmental stewardship" is the purpose of the INRMP.

In addition, early participation in the development of the Proposed Action by the United States (U.S.) Fish and Wildlife Service (USFWS); the National Oceanic and Atmospheric Administration National Marine Fisheries Service (NMFS); the Guam Department of Agriculture, Division of Aquatic and Wildlife Resources (Guam DAWR); and the Commonwealth of the Northern Mariana Islands (CNMI) Division of

Fish and Wildlife (DFW) ensured coordination among these parties on the natural resources management goals, objectives, and projects that are stated in the 2019 JRM INRMP. For these additional reasons, only the Proposed Action and the No Action Alternative were carried forward for detailed analysis in this EA.

2.3.1 No Action Alternative

Under the No Action Alternative, the Proposed Action would not occur and natural resources would continue to be managed as characterized in the 2013 JRM INRMP for Naval Base Guam (NBG), Andersen Air Force Base (AFB), and JRM leased lands on Tinian and Farallon de Medinilla (FDM); JRM would continue to implement applicable regulatory requirements. This alternative represents the status quo. The No Action Alternative would not meet the purpose and need for the Proposed Action since the management goals, objectives, projects, strategies, and actions from the 2013 JRM INRMP do not take into account current conditions. A key difference between the No Action Alternative and the Proposed Action is that the latter provides focused management of newly listed species under the Endangered Species Act (ESA). Other key differences include enhanced partner agency engagement and coordination, current state of the science, and improved terrestrial and marine resource management strategies that address changing environmental conditions. However, as required by NEPA, the No Action Alternative is carried forward for analysis in this EA. The No Action Alternative will be used to analyze the consequences of not undertaking the Proposed Action and will serve to establish a comparative baseline for analysis.

2.3.2 Proposed Action (Preferred Alternative)

The Proposed Action is to implement the 2019 JRM INRMP, consistent with the military use of the JRM-administered lands considered in this EA and (consistent with the requirements of) the Sikes Act (as amended). The 2019 JRM INRMP has been developed to ensure consistent management of resources on Guam and within the CNMI and to comply with applicable federal, territory, commonwealth, and local standards, as applicable. For an outline of the 2019 JRM INRMP, see Table 1-1 above.

As described in greater detail in Section 1.1 of the 2019 JRM INRMP, the goal of the 2019 JRM INRMP is to utilize adaptive management to maintain long-term ecosystem health and minimize impacts to natural resources consistent with the operational requirements of the Department of Defense's (DoD's) mission. The DON is required to ensure ecosystem management is the basis for all management of its lands (Sikes Act, as amended [16 U.S. Code {USC} 670a]; DoD Instruction 4715.03; DoD Manual 4715.03).

To achieve the goals and objectives of the 2019 JRM INRMP, resource-specific strategies and actions have been developed to guide natural resources management on JRM-administered lands and submerged lands (see Section 3.3 of the 2019 JRM INRMP for a list of goals and objectives). In addition, the 2019 JRM INRMP includes actions to address commitments with ESA section 7 consultations (informal and formal) including, but not limited to the following actions:

- JRM will ensure all military and contractor personnel receive brown treesnake (BTS) awareness briefings prior to all Mariana Islands Training and Testing (MITT) training activities.
- During training activities on NBG Main Base, NBG TS, and Andersen AFB, personnel will establish snake-free quarantine areas (barriers) as deemed necessary for cargo/equipment traveling from Guam to CNMI and locations outside of the MITT action area.

- On JRM-administered and leased lands on Guam and Tinian, vegetation removal shall be limited to the maintenance of existing bivouac areas that do not contain listed species or habitat. No new bivouac areas are proposed under MITT. Maneuver units will remain tactical and not establish support camps.
- JRM will maintain invasive species rapid response to control and eradicate introduced non-established, non-native, invasive species sighted in the vicinity of DoD training areas and facilities used for staging, storage, and movement of military personnel, cargo, and vehicles associated with training activities.
- Andersen AFB personnel will ensure flood lights at the Andersen AFB Combat Arms Training and Marksmanship range are maintained below the tree canopy level and directed inland and parallel to the coast. Lighting in this configuration will avoid impacts to nesting and hatching sea turtles and Mariana fruit bats.
- JRM natural resources staff will conduct baseline and long-term monitoring for invasive species in training areas and at locations used for staging and movement of military cargo and vehicles on Guam and Tinian to identify newly established and/or high-risk species.
- For tactical training exercises, to the maximum extent practicable, operations personnel will ensure inbound personnel and cargo are routed directly to the CNMI. If Guam cannot be avoided for tactical approaches, JRM will work with USFWS to identify and implement appropriate interdiction methods such as multiple, redundant inspections and barrier use on Guam. In addition, JRM will ensure tactical approach exercises will involve only cargo/equipment that has not originated from areas containing a BTS population or will be 100 percent (%) inspected by qualified BTS canine detection programs.
- Operations personnel will ensure training operations that go from Guam to Saipan and then FDM via aircraft will obtain required canine inspection on Saipan or other BTS inspection as mutually agreed upon by JRM and USFWS.

A summary of all proposed management projects for all JRM-administered lands and the conservation drivers for each can be found in Section 13.9 of the 2019 JRM INRMP.

It is also the intent of the 2019 JRM INRMP to provide a conservation benefit to federally listed species and their designated critical habitats under the ESA and preclude critical habitat designation on JRM-administered and leased lands by providing adequate special management and protections. Pursuant to section 4(a)(3)(B)(i) of the ESA, the Secretaries of the Departments of Interior and Commerce are prohibited from designating as critical habitat any lands or other geographical areas owned or controlled by the DoD, or designated for its use, that are subject to an INRMP prepared pursuant to section 670a of the Sikes Act (DoD Manual 4715.03). In accordance with USFWS Special Management Criteria, adequate special management may be provided by an INRMP that addresses the maintenance and improvement of habitat (and/or essential features) important to the species and manages for the long-term conservation of the species. Three criteria are used to determine if such special management or protections are provided: (1) there is a conservation benefit, (2) there are assurances that the management plans will be implemented, and (3) there are assurances that the conservation efforts will be effective (USFWS 2015b). Additional detail on how these three criteria would be met is provided in Chapter 3, *Environmental Management Strategy and Mission Sustainability*, of the 2019 JRM INRMP.

As described in greater detail in Section 1.2 of the 2019 JRM INRMP, the INRMP would be reviewed on an annual and a 5-year basis. If the 5-year INRMP review for operation and effect results in major revisions to INRMP, such as the addition of management projects to address newly listed species, JRM would solicit public review and comments through the NEPA process in the form of an EA to evaluate the new INRMP. Annual reviews would include discussions of the INRMP to ensure that necessary changes are made consistently, such as changes based on adaptive management with respect to ongoing projects or new data regarding species or habitats.

Finally, Table 2-1 summarizes the resources benefitted by strategies and actions described in the INRMP for each installation or parcel of land. Benefits of implementing the Proposed Action include but are not limited to the following:

- helping natural resource managers more effectively manage natural resources to ensure installation lands remain available and in good condition to support the military mission
- implementing projects designed with specific goals and objectives in mind for management of natural resources under the current environment
- implementing projects designed with the conservation of species listed under the ESA since 2013
- better integrating the INRMP with current JRM planning documents and regional conservation strategies and priorities
- improving integration of the natural resources program with current JRM activities
- improving the efficiency to managing natural resources and INRMP implementation
- precluding designation of critical habitat

Table 2-1 Resources Benefitted by the Strategies and Actions Described in the INRMP for Each Installation or Parcel of Land

Management Projects	*Geology, Topography, and Soils*	*Water Resources*	*Cultural Resources*	*Terrestrial Biological Resources*	*Marine Biological Resources*	*Land Use*	*Submerged Land Use*	*Socioeconomics*	*Environmental Justice*
Naval Base Guam Main Base									
THM-1: Forest Enhancement	X	X	X	X	X	X			
TIS-1: Brown Treesnake Interdiction	X	X	X	X	X	X			
TIS-2: Brown Treesnake Suppression	X	X	X	X	X	X			
TIS-3: Brown Treesnake Management for the Recovery of Protected Species	X	X	X	X	X	X			
TIS-4: Implementation of Regional Biosecurity Plan for Micronesia and Hawaii	X	X	X	X	X	X			
TIS-5: Invasive Species Management	X	X	X	X	X	X			
TIS-6: Mariana Islands Training and Testing Implementation of the Biological Opinion	X	X		X	X	X			
TIS-7: Control Feral Dogs and Cats				X					
TPS-1: ESA-listed Species Monitoring				X		X			
TPS-2: Sea Turtle Population Protection and Enhancement			X	X	X	X			
TPS-3: Mariana Common Moorhen Habitat Enhancement	X	X	X	X	X	X			
TPS-4: Mariana Islands Training and Testing Implementation of the Biological Opinion	X	X	X	X	X	X			
TPS-5: Mariana Fruit Bat Population Monitoring			X	X		X			
MIG-1: Monitoring and Analysis of MBTA-listed Bird Species				X		X			
MIG-2: Checklist of BMPs and Conservation Measures for Migratory Birds				X		X			

Table 2-1 Resources Benefitted by the Strategies and Actions Described in the INRMP for Each Installation or Parcel of Land

Management Projects	*Geology, Topography, and Soils*	*Water Resources*	*Cultural Resources*	*Terrestrial Biological Resources*	*Marine Biological Resources*	*Land Use*	*Submerged Land Use*	*Socioeconomics*	*Environmental Justice*
TEDU-1: ESA-listed Species and Terrestrial Resources Outreach				X		X		X	X
TEDU-2: JRM Natural Resources Stewardship Outreach and Public Engagement Program				X		X		X	X
TLAW-1: Conservation Law Enforcement	X	X	X	X		X		X	X
TGIS-1: Terrestrial Natural Resources GIS and Data Management	X	X	X	X		X		X	
MHM-1: Coral Habitat Enhancement		X	X		X		X		
MHM-2: Marine Flora Management					X		X		
MHM-3: Evaluate Mangrove Functionality in the Atantano Watershed		X			X		X		
MHM-4: Avoid and Minimize Adverse Effects of DON Activities on Marine Resources					X		X		
MHM-5: Marine Resources Data Analysis and Coordination					X		X		
MHM-6: Marine Habitat Mapping Efforts		X			X		X		
MHM-7: U.S. Navy Diver Training for Submerged Natural Resources Management					X		X		
MHM-8: Acoustic Telemetry Network					X		X		
MIS-1: Implementation of Regional Biosecurity Plan for Micronesia and Hawaii					X		X		
MIS-2: Federal and Territorial Coordination and Collaboration for Marine Invasive Species Prevention					X		X		

Table 2-1 Resources Benefitted by the Strategies and Actions Described in the INRMP for Each Installation or Parcel of Land

Management Projects	*Geology, Topography, and Soils*	*Water Resources*	*Cultural Resources*	*Terrestrial Biological Resources*	*Marine Biological Resources*	*Land Use*	*Submerged Land Use*	*Socioeconomics*	*Environmental Justice*
MPS-1: Scalloped Hammerhead Shark Study					X		X		
MPS-2: Sea Turtle Population Protection and Enhancement					X		X		
MPS-3: Mariana Islands Training and Testing Implementation of the Biological Opinion					X		X		
MEDU-1: ESA-listed Species and Marine Resources Outreach				X	X	X	X	X	X
MEDU-2: JRM Natural Resources Stewardship Outreach and Public Engagement Program				X	X	X	X	X	X
MLAW-1: Conservation Law Enforcement		X			X		X	X	X
MLAW-2: Recreational Access Tracking and Ecological Reserve Area Visitor Use Plan		X	X		X		X	X	X
MGIS-1: Marine Natural Resources GIS and Data Management		X			X		X		
Naval Munitions Site									
THM-1: Watershed Management	X	X		X	X	X			
THM-2: Forest Enhancement	X	X	X	X	X	X			
THM-3: Managing Wildland Fires	X			X		X			
TIS-1: Brown Treesnake Interdiction	X	X	X	X	X	X			
TIS-2: Brown Treesnake Suppression	X	X	X	X	X	X			
TIS-3: Brown Treesnake Management for the Recovery of Protected Species	X	X	X	X	X	X			
TIS-4: Control Feral Dogs and Cats				X					

Table 2-1 Resources Benefitted by the Strategies and Actions Described in the INRMP for Each Installation or Parcel of Land

Management Projects	*Geology, Topography, and Soils*	*Water Resources*	*Cultural Resources*	*Terrestrial Biological Resources*	*Marine Biological Resources*	*Land Use*	*Submerged Land Use*	*Socioeconomics*	*Environmental Justice*
TIS-5: Implementation of Regional Biosecurity Plan for Micronesia and Hawaii	X	X	X	X	X	X			
TIS-6: Invasive Species Management	X	X	X	X	X	X			
TIS-7: Mariana Islands Training and Testing Implementation of the Biological Opinion	X	X		X	X	X			
TPS-1: ESA-listed Species Monitoring				X		X			
TPS-2: Protection of Listed Invertebrates				X		X			
TPS-3: Perform Moth Skink and Pacific Slender-toed Gecko Surveys				X		X			
TPS-4: Monitor and Maintain Mariana Swiftlet Population				X		X			
TPS-5: Restoration of Mariana Common Moorhen Population	X	X	X	X	X	X			
TPS-6: Mariana Islands Training and Testing Implementation of the Biological Opinion	X	X	X	X	X	X			
TPS-7: Mariana Fruit Bat Population Monitoring			X	X		X			
MIG-1: Monitoring of MBTA-listed Bird Species				X		X			
TEDU-1: ESA-listed Species and Terrestrial Resources Outreach				X		X		X	X
TEDU-2: JRM Natural Resources Stewardship Outreach and Public Engagement Program				X		X		X	X
TLAW-1: Conservation Law Enforcement	X	X	X	X		X		X	X
TGIS-1: Terrestrial Natural Resources GIS and Data Management	X	X	X	X		X		X	

Table 2-1 Resources Benefitted by the Strategies and Actions Described in the INRMP for Each Installation or Parcel of Land

Management Projects	*Geology, Topography, and Soils*	*Water Resources*	*Cultural Resources*	*Terrestrial Biological Resources*	*Marine Biological Resources*	*Land Use*	*Submerged Land Use*	*Socioeconomics*	*Environmental Justice*
Apra Heights, Sasa Valley and Tenjo Vista Tank Farms, Naval Computer and Telecommunications Station Barrigada, Barrigada Transmitter Site, and Andersen South									
THM-1: Watershed Management	X	X		X	X	X			
THM-2: Fire Prevention and Management	X			X		X			
TIS-1: Brown Treesnake Interdiction	X	X	X	X	X	X			
TIS-2: Brown Treesnake Suppression	X	X	X	X	X	X			
TIS-3: Brown Treesnake Management for the Recovery of Protected Species	X	X	X	X	X	X			
TIS-4: Invasive Species Management	X	X	X	X	X	X			
TIS-5: Implementation of Regional Biosecurity Plan for Micronesia and Hawaii	X	X	X	X	X	X			
TIS-6: Mariana Islands Training and Testing Implementation of the Biological Opinion	X	X		X	X	X			
TIS-7: Control Feral Dogs and Cats				X					
TPS-1: ESA-listed Species Monitoring				X		X			
TPS-2: Mariana Islands Training and Testing Implementation of the Biological Opinion	X	X	X	X	X	X			
TPS-3: Mariana Fruit Bat Population Monitoring			X	X		X			
MIG-1: Monitoring of MBTA-listed Bird Species				X		X			
TEDU-1: ESA-listed Species and Terrestrial Resources Outreach				X		X		X	X
TEDU-2: JRM Natural Resources Stewardship Outreach and Public Engagement Program				X		X		X	X

Table 2-1 Resources Benefitted by the Strategies and Actions Described in the INRMP for Each Installation or Parcel of Land

Management Projects	*Geology, Topography, and Soils*	*Water Resources*	*Cultural Resources*	*Terrestrial Biological Resources*	*Marine Biological Resources*	*Land Use*	*Submerged Land Use*	*Socioeconomics*	*Environmental Justice*
TLAW-1: Conservation Law Enforcement	X	X	X	X		X		X	X
TGIS-1: Terrestrial Natural Resources GIS and Data Management	X	X	X	X		X		X	
Naval Base Guam Telecommunications Site									
THM-1: Watershed Management	X	X		X	X	X	X		
THM-2: Protection of Ecological Reserve Area	X			X		X			
THM-3: Forest Enhancement	X	X	X	X	X	X			
TIS-1: Brown Treesnake Interdiction	X	X	X	X	X	X			
TIS-2: Brown Treesnake Suppression	X	X	X	X	X	X			
TIS-3: Brown Treesnake Management for the Recovery of Protected Species	X	X	X	X	X	X			
TIS-4: Implementation of Regional Biosecurity Plan for Micronesia and Hawaii	X	X	X	X	X	X			
TIS-5: Mariana Islands Training and Testing Implementation of the Biological Opinion	X	X		X	X	X			
TIS-6: Invasive Species Management	X	X	X	X	X	X			
TIS-7: Control Feral Dogs and Cats				X					
TPS-1: ESA-listed Species Monitoring				X		X			
TPS-2: Conservation of Listed Species				X		X			
TPS-3: Mariana Islands Training and Testing Implementation of the Biological Opinion	X	X	X	X	X	X			
TPS-4: Mariana Fruit Bat Population Monitoring			X	X		X			

Table 2-1 Resources Benefitted by the Strategies and Actions Described in the INRMP for Each Installation or Parcel of Land

Management Projects	*Geology, Topography, and Soils*	*Water Resources*	*Cultural Resources*	*Terrestrial Biological Resources*	*Marine Biological Resources*	*Land Use*	*Submerged Land Use*	*Socioeconomics*	*Environmental Justice*
MIG-1: Monitoring of MBTA-listed Bird Species				X		X			
TEDU-1: ESA-listed Species and Terrestrial Resources Outreach				X		X		X	X
TEDU-2: JRM Natural Resources Stewardship Outreach and Public Engagement Program				X		X		X	X
TLAW-1: Conservation Law Enforcement	X	X	X	X		X		X	X
TGIS-1: Terrestrial Natural Resources GIS and Data Management	X	X	X	X		X		X	
MHM-1: Coral Habitat Enhancement		X	X		X		X		
MHM-2: Marine Resources Data Analysis and Coordination					X		X		
MHM-3: Marine Habitat Mapping Efforts		X			X		X		
MHM-4: U.S. Navy Diver Training for Submerged Natural Resources Management					X		X		
MIS-1: Implementation of Regional Biosecurity Plan for Micronesia and Hawaii					X		X		
MIS-2: Federal and Territorial Coordination and Collaboration for Marine Invasive Species Prevention					X		X		
MPS-1: Scalloped Hammerhead Shark Survey					X		X		
MPS-2: Sea Turtle Population Protection and Enhancement					X		X		
MEDU-1: ESA-listed Species and Marine Resources Outreach				X	X	X	X	X	X

Table 2-1 Resources Benefitted by the Strategies and Actions Described in the INRMP for Each Installation or Parcel of Land

Management Projects	*Geology, Topography, and Soils*	*Water Resources*	*Cultural Resources*	*Terrestrial Biological Resources*	*Marine Biological Resources*	*Land Use*	*Submerged Land Use*	*Socioeconomics*	*Environmental Justice*
MEDU-2: JRM Natural Resources Stewardship Outreach and Public Engagement Program				X	X	X	X	X	X
MLAW-1: Conservation Law Enforcement		X			X		X	X	X
MGIS-1: Marine Natural Resources GIS and Data Management		X			X		X		
Andersen Air Force Base									
THM-1: Forest Enhancement	X	X	X	X	X	X			
THM-2: Establish Forage Plots for ESA-listed Bats and Crows				X		X			
THM-3: Urban Forestry Data Base, Maintenance, and Replacement of Trees				X		X			
TIS-1: Brown Treesnake Interdiction	X	X	X	X	X	X			
TIS-2: Brown Treesnake Suppression	X	X	X	X	X	X			
TIS-3: Brown Treesnake Management for the Recovery of Protected Species	X	X	X	X	X	X			
TIS-4: Wildlife Management Biologist	X			X		X			
TIS-5: Invasive Species Management	X	X	X	X	X	X			
TIS-6: Implementation of Regional Biosecurity Plan for Micronesia and Hawaii	X	X	X	X	X	X			
TIS-7: Mariana Islands Training and Testing Implementation of the Biological Opinion	X	X		X	X	X			
TIS-8: Control Feral Dogs and Cats				X					
TPS-1: Sea Turtle Population Protection and Enhancement			X	X	X	X			

Table 2-1 Resources Benefitted by the Strategies and Actions Described in the INRMP for Each Installation or Parcel of Land

Management Projects	*Geology, Topography, and Soils*	*Water Resources*	*Cultural Resources*	*Terrestrial Biological Resources*	*Marine Biological Resources*	*Land Use*	*Submerged Land Use*	*Socioeconomics*	*Environmental Justice*
TPS-2: Mariana Fruit Bat Population Protection and Enhancement			X	X		X			
TPS-3: Moth Skink and Pacific Slender-toed Gecko Surveys				X		X			
TPS-4: Protection of Listed Invertebrates				X		X			
TPS-5: Conservation of Listed Plant Species				X		X			
TPS-6: Support Recovery Planning Using Surrogate Native Species			X	X		X			
TPS-7: Mariana Islands Training and Testing Implementation of the Biological Opinion	X	X	X	X	X	X			
MIG-1: Conservation Measures for Migratory Birds				X		X			
TEDU-1: ESA-listed Species and Terrestrial Resources Outreach				X		X		X	X
TEDU-2: JRM Natural Resources Stewardship Outreach and Public Engagement Program				X		X		X	X
TLAW-1: Conservation Law Enforcement	X	X	X	X		X		X	X
TGIS-1: Terrestrial Natural Resources GIS and Data Management	X	X	X	X		X		X	
MHM-1: Coral Habitat Enhancement		X	X		X		X		
MHM-2: Marine Resources Data Analysis and Coordination					X		X		
MHM-3: Marine Habitat Mapping Efforts		X			X		X		
MIS-1: Implementation of Regional Biosecurity Plan for Micronesia and Hawaii					X		X		

Table 2-1 Resources Benefitted by the Strategies and Actions Described in the INRMP for Each Installation or Parcel of Land

Management Projects	*Geology, Topography, and Soils*	*Water Resources*	*Cultural Resources*	*Terrestrial Biological Resources*	*Marine Biological Resources*	*Land Use*	*Submerged Land Use*	*Socioeconomics*	*Environmental Justice*
MIS-2: Federal and Territorial Coordination and Collaboration for Marine Invasive Species Prevention					X		X		
MPS-1: Scalloped Hammerhead Shark Study					X		X		
MPS-2: Sea Turtle Population Protection and Enhancement					X		X		
MEDU-1: ESA-listed Species and Marine Resources Outreach				X	X	X	X	X	X
MEDU-2: JRM Natural Resources Stewardship Outreach and Public Engagement Program				X	X	X	X	X	X
MLAW-1: Conservation Law Enforcement		X			X		X	X	X
MGIS-1: Marine Natural Resources GIS and Data Management		X			X		X		
Tinian Military Lease Area									
THM-1: Forest Enhancement	X	X	X	X	X	X			
TIS-1: Implementation of Regional Biosecurity Plan for Micronesia and Hawaii	X	X	X	X	X	X			
TIS-2: Mariana Islands Training and Testing Implementation of the Biological Opinion	X	X		X	X	X			
TPS-1: Conservation Management of Tinian *Cycas micronesica* Plantings			X	X		X			
TPS-2: Sea Turtle Population Protection and Enhancement			X	X	X	X			
TPS-3: Conservation of Mariana Common Moorhen	X	X	X	X	X	X			
TPS-4: Conservation of Forest Birds				X		X			

Table 2-1 Resources Benefitted by the Strategies and Actions Described in the INRMP for Each Installation or Parcel of Land

Management Projects	*Geology, Topography, and Soils*	*Water Resources*	*Cultural Resources*	*Terrestrial Biological Resources*	*Marine Biological Resources*	*Land Use*	*Submerged Land Use*	*Socioeconomics*	*Environmental Justice*
TPS-5: Protection of Listed Invertebrates				X		X			
TPS-6: Mariana Islands Training and Testing Implementation of the Biological Opinion	X	X	X	X	X	X			
TPS-7: Mariana Fruit Bat Population Monitoring			X	X		X			
MIG-1: Management of MBTA-listed Bird Species				X		X			
TEDU-1: JRM Natural Resources Stewardship Outreach and Public Engagement Program				X		X		X	X
TLAW-1: Conservation Law Enforcement	X	X	X	X		X		X	X
TGIS-1: Terrestrial Natural Resources GIS and Data Management	X	X	X	X		X		X	
MHM-1: Coral Habitat Enhancement		X	X		X		X		
MHM-2: Marine Resources Data Analysis and Coordination					X		X		
MHM-3: Marine Flora Management					X		X		
MIS-1: Implementation of Regional Biosecurity Plan for Micronesia and Hawaii					X		X		
MIS-2: Federal and Territorial Coordination and Collaboration for Marine Invasive Species Prevention					X		X		
MPS-1: Sea Turtle Population Protection and Enhancement					X		X		
MPS-2: Recreational Use Survey					X		X	X	X
MPS-3: Mariana Islands Training and Testing Implementation of the Biological Opinion					X		X		

Table 2-1 Resources Benefitted by the Strategies and Actions Described in the INRMP for Each Installation or Parcel of Land

Management Projects	*Geology, Topography, and Soils*	*Water Resources*	*Cultural Resources*	*Terrestrial Biological Resources*	*Marine Biological Resources*	*Land Use*	*Submerged Land Use*	*Socioeconomics*	*Environmental Justice*
MEDU-1: JRM Natural Resources Stewardship Outreach and Public Engagement Program				X	X	X	X	X	X
MLAW-1: Conservation Law Enforcement		X			X		X	X	X
MGIS-1: Marine Natural Resources GIS and Data Management		X			X		X		
Farallon de Medinilla									
TIS-1: Implementation of Regional Biosecurity Plan for Micronesia and Hawaii	X	X	X	X	X	X			
TIS-2: Mariana Islands Training and Testing Implementation of the Biological Opinion	X	X		X	X	X			
TPS-1: Monitoring for Micronesian Megapodes and Mariana Fruit Bats				X		X			
TPS-2: Mariana Islands Training and Testing Implementation of the Biological Opinion	X	X	X	X	X	X			
MIG-1: Monitoring of MBTA-listed Bird Species				X		X			
TEDU-1: JRM Natural Resources Stewardship Outreach and Public Engagement Program				X		X		X	X
TGIS-1: Terrestrial Natural Resources GIS and Data Management	X	X	X	X		X		X	
MHM-1: Fish, Coral, and Marine Flora Surveys					X		X		
MHM-2: Marine Habitat Mapping Efforts		X			X		X		
MPS-1: Sea Turtle Population Protection and Enhancement					X		X		

Table 2-1 Resources Benefitted by the Strategies and Actions Described in the INRMP for Each Installation or Parcel of Land

Management Projects	*Geology, Topography, and Soils*	*Water Resources*	*Cultural Resources*	*Terrestrial Biological Resources*	*Marine Biological Resources*	*Land Use*	*Submerged Land Use*	*Socioeconomics*	*Environmental Justice*
MPS-2: Assess ESA-listed Scleractinian Corals					X		X		
MEDU-1: CNMI Fishing Community Outreach				X	X	X	X	X	X
MLAW-1: Monitoring, Control, and Surveillance Plan		X			X		X	X	X
MGIS-1: Marine Natural Resources GIS and Data Management		X			X		X		

Note: Details of the strategies and actions for the management projects are listed in Chapters 5 through 9, 11, and 12 in the 2019 JRM INRMP. Details of the goals and objectives are found in Chapter 3, *Environmental Management Strategy and Mission Sustainability*, of the 2019 JRM INRMP.

Key: BMP = best management practice; CNMI = Commonwealth of the Northern Mariana Islands; DON = Department of the Navy; ESA = Endangered Species Act; GIS = Geographic Information Systems; JRM = Joint Region Marianas; MBTA = Migratory Bird Treaty Act; MEDU = Marine Natural Resources Educational Outreach; MGIS = Marine Natural Resources Geographic Information System and Data Management; MHM = Marine Habitat Management; MIG = Migratory Bird Management; MIS = Marine Invasive Species Management; MLAW = Marine Natural Resources Law Enforcement; MPS = Marine Protected Species Management; TEDU = Terrestrial Natural Resources Educational Outreach; TGIS = Terrestrial Natural Resources Geographic Information System and Data Management; THM = Terrestrial Habitat Management; TIS = Terrestrial Exotic and Invasive Species Management; TLAW = Terrestrial Natural Resources Law Enforcement; TPS = Terrestrial Protected Species Management; U.S. = United States.

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3 Affected Environment

This chapter presents a description of the environmental resources and baseline conditions that could be affected by the implementation of any of the alternatives. These resources include: geology, topography, and soils; water resources; cultural resources; terrestrial biological resources; marine biological resources; land use; submerged land use; socioeconomics; and environmental justice.

Other potentially relevant environmental resource areas were initially considered for analysis, but in compliance with the National Environmental Policy Act (NEPA), the Council on Environmental Quality (CEQ), and Department of the Navy (DON) guidelines, the potential impacts to the following resource areas were considered negligible or non-existent so they were not analyzed in detail in this EA:

- Air Quality: The Proposed Action Alternative and No Action Alternative do not include burning of vegetation, substantially increased use of fossil fuels, or other actions that would cause an increase in harmful air emissions.
- Visual Resources: The Proposed Action Alternative and No Action Alternative would not adversely change views of or from Joint Region Marianas (JRM)-administered lands, and improving ecosystem health on those lands could result in a long-term improvement in the views of natural areas in the region.
- Airspace: The Proposed Action Alternative and No Action Alternative would not affect, or be affected by, the use of DON military airspace or adjacent civilian airspace.
- Noise: The Proposed Action Alternative and No Action Alternative would have no impact on the current noise levels that would occur on or adjacent to JRM-administered lands. Any noise emissions from the Proposed Action Alternative or No Action Alternative would be temporary and transient, limited to the duration of the action.
- Infrastructure: Infrastructure and utilities would not be modified or affected during implementation of the Proposed Action Alternative or No Action Alternative.
- Transportation: The Proposed Action Alternative and No Action Alternative would not change traffic volume or traffic patterns on or in the vicinity of JRM-administered lands.
- Public Health and Safety: No safety risks are expected during implementation of the Proposed Action Alternative or No Action Alternative. Risks associated with ungulate control and other management projects would be minimized by following protocols in required Health and Safety Plans.
- Hazardous Materials and Wastes: Hazardous materials and wastes are regulated on JRM-administered and leased lands on Guam and the Commonwealth of the Northern Mariana Islands (CNMI) by a combination of mandated laws and regulations promulgated by the United States (U.S.) Environmental Protection Agency (USEPA), Guam Environmental Protection Agency (Guam EPA), and the CNMI Bureau of Environmental and Coastal Quality, Division of Environmental Quality, Hazardous and Solid Waste Management Branch, and the Department of Defense (DoD) itself. Implementation of the Proposed Action Alternative or No Action Alternative would not change this.

3.1 Geology, Topography, and Soils

This discussion includes geology, topography, and soils. The geology of an area may include bedrock materials, mineral deposits, and fossil remains. The principal geological factors influencing the stability of structures are soil stability and seismic (i.e., earthquake) properties. Topography, the arrangement of the natural and artificial physical features of an area, is typically described with respect to the elevation, slope, and surface features found within a given area. Soil refers to unconsolidated earthen materials overlying bedrock or other parent material. Soil structure, elasticity, strength, shrink-swell potential, and potential for soil erosion determine the ability for the ground to support structures and facilities. Soils are typically described in terms of their type, slope, physical characteristics, and relative compatibility or limitations with regard to particular construction activities and types of land use.

3.1.1 Regulatory Setting

The USEPA Region 9 gives the Guam EPA the authority to enforce portions of federal statutes via a Memorandum of Agreement (MOA). Under this MOA, an Environmental Protection Plan (EPP) is required for projects at the discretion of the Guam EPA Administrator. EPPs are specifically identified in 22 Guam Annotated Regulations, Division II, Chapter 10, Section 10103.C.5(d). EPPs would include management measures, such as erosion and sedimentation control, vegetation, wildlife resource protection measures, dust control, solid and hazardous waste management and disposal procedures, a nutrient management plan, an integrated pest management strategy/plan, a confined animal facilities management plan, an irrigation water management plan, personnel safety procedures, work site maintenance, and typhoon contingency plans, as necessary, depending on the work, project, activity and facility function.

Military construction projects are required to follow Unified Facilities Criteria 3-310-04 Seismic Design for Buildings, which contains specifications for limiting seismic liquefaction, which occurs when unconsolidated soil or sand is converted into a suspension during an earthquake, and ground shaking effects (U.S. Army Corps of Engineers [USACE] 2007).

Government of Guam (GovGuam) has established a Soils and Water Conservation Program as defined in Chapter 26 of Title 17 of the Guam Code Annotated, as authorized by Public Law 28-179. The program is administered by the University of Guam. This regulation promotes the Territory of Guam's soil and water conservation policy in an effort to prevent erosion and water management problems; conserves and improves the use of the Territory's land and water resources; establishes Soil and Water Conservation Districts; and affirms the University of Guam's role as the Territory's lead soil conservation agency. Conservation programs are also administered by the Guam Waterworks Authority and Guam EPA. Chapter 10 of Title 22 of the Guam Administrative Rules and Regulations requires appropriate permitting for activities that concern the control of operations that may bring about erosion, sedimentation, and soil degradation; the obtaining of permits; and the approval of Erosion and Sediment Control Plans. The regulations also provide rules relative to methods of soil-related activities to prevent erosion or other degradation of the soil.

The CNMI Earthmoving and Erosion Control program is responsible for establishing certain minimum standards and requirements as determined by the Division necessary for controlling nonpoint source runoff from human related activities, such as land clearing. The Northern Mariana Islands Administrative Code Chapter 65-30, Sections 65-30-101; Permit Requirements state, "No person shall commence or

continue any earthmoving activity including grading, filling, or clearing of vegetation without a Department of Environmental Quality Earthmoving and Erosion Control Permit issued in accordance with the regulation."

3.1.2 Affected Environment

Overview descriptions of the geology, topography, and soils found on Guam and the CNMI are included in Chapters 4 and 10, respectively, and detailed descriptions of the geology, topography, and soils found on each JRM installation are included in Chapters 5 through 9, 11, and 12 of the 2019 JRM Integrated Natural Resources Management Plan (INRMP). For the descriptions of the geology, topography, and soils associated with the Proposed Action refer to the following INRMP sections by area:

- 4.2 - Guam
- 5.2.1 - NBG Main Base
- 6.2.1 - Naval Munitions Site (NMS)
- 7.1.2 - Apra Heights
- 7.2.2 - Sasa Valley and Tenjo Vista Tank Farms
- 7.3.2 - NCTS Barrigada and Barrigada Transmitter Site
- 7.4.2 - Andersen South
- 8.2.1 - NBG Telecommunications Site (TS)
- 9.2.1 - Andersen Air Force Base (AFB)
- 10.2 - CNMI
- 11.2.1 - Tinian Military Lease Area (MLA)
- 12.2.1 - Farallon de Medinilla (FDM)

3.2 Water Resources

This discussion of water resources includes groundwater, surface water, marine waters, wetlands, and floodplains.

Groundwater is water that flows or seeps downward and saturates soil or rock, supplying springs and wells. Groundwater is used for water consumption, agricultural irrigation, and industrial applications. Groundwater properties are often described in terms of depth to aquifer, aquifer or well capacity, water quality, and surrounding geologic composition. Sole source aquifer designation provides limited protection of groundwater resources that serve as drinking water supplies.

Surface water resources generally consist of wetlands, lakes, rivers, and streams. Surface water is important for its contributions to the economic, ecological, recreational, and human health of a community or area. The total maximum daily load is a regulatory term in the federal Clean Water Act (CWA) that describes the maximum amount of a substance, such as a pollutant, that can be assimilated by a water body without causing damage to that body of water. A water body can be deemed impaired if it fails to meet water quality standards.

Marine waters typically include estuaries, waters seaward of the historic height of tidal influence, and offshore waters with high salt content. Marine water quality would be described as the chemical and physical composition of the water as affected by natural conditions and human activities. Additionally, marine waters may include an area within a National Marine Sanctuary requiring an action proponent to avoid adverse water quality impacts in order to prevent damage to resources within the sanctuary.

Wetlands are jointly defined by USEPA and USACE as "those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions." Wetlands generally include "swamps, marshes, bogs, and similar areas."

Floodplains are areas of low-level ground present along rivers, stream channels, large wetlands, or coastal waters. Floodplain ecosystem functions include natural moderation of floods, flood storage and transport, groundwater recharge, and nutrient cycling. Floodplains also help to maintain water quality and are often home to a diverse array of plants and animals. In their natural vegetated state, floodplains slow the rate at which the incoming movement of water over the land reaches the main water body. Floodplain boundaries are most often defined in terms of frequency of inundation, that is, the 100-year and 500-year flood. Maps that outline floodplains are produced by the Federal Emergency Management Agency and provide a basis for comparing the area of the Proposed Action to the floodplains.

3.2.1 Regulatory Setting

The Safe Drinking Water Act (SDWA) is the federal law that protects public drinking water supplies throughout the nation and U.S. territories. Under the SDWA, the USEPA sets standards for drinking water quality. Groundwater quality and quantity are regulated under several statutes and regulations, including the SDWA.

The CWA establishes federal limits, through the National Pollutant Discharge Elimination System (NPDES) program, on the amounts of specific pollutants that can be released into surface waters to restore and maintain the chemical, physical, and biological integrity of the water. The NPDES program regulates the discharge of point (e.g., end of pipe) and nonpoint sources (e.g., stormwater) of water pollution.

The Guam and CNMI NPDES stormwater programs require construction site operators engaged in clearing, grading, and excavating activities that disturb one acre or more to obtain coverage under an NPDES Construction General Permit for stormwater discharges. Construction or demolition that necessitates an individual permit also requires preparation of a Notice of Intent to discharge stormwater and a Stormwater Pollution Prevention Plan that is implemented during construction. As part of the 2010 Final Rule for the CWA, titled *Effluent Limitations Guidelines and Standards for the Construction and Development Point Source Category*, activities covered by this permit must implement non-numeric erosion and sediment controls and pollution prevention measures.

Wetlands are currently regulated by USACE under Section 404 of the CWA as a subset of all "Waters of the U.S." Waters of the U.S. are defined as (1) traditional navigable waters, (2) wetlands adjacent to navigable waters, (3) non-navigable tributaries of traditional navigable waters that are relatively permanent where the tributaries typically flow perennially or have continuous flow at least seasonally (e.g., typically 3 months), and (4) wetlands that directly border on such tributaries under Section 404 of the CWA, as amended, and are regulated by USEPA and USACE. The CWA requires that Guam and the CNMI establish a Section 303(d) list to identify impaired waters and establish total maximum daily loads for the sources causing the impairment.

Section 404 of the CWA authorizes the Secretary of the Army, acting through the Chief of Engineers, to issue permits for the discharge of dredge or fill into wetlands and other waters of the U.S. Any discharge of dredge or fill into waters of the U.S. requires a permit from the USACE.

Section 438 of the Energy Independence and Security Act establishes stormwater design requirements for development and redevelopment projects. Under these requirements, federal facility projects larger than 5,000 square feet must "maintain or restore, to the maximum extent technically feasible, the predevelopment hydrology of the property with regard to the temperature, rate, volume, and duration of flow."

Section 10 of the Rivers and Harbors Act provides for USACE permit requirements for any in-water construction. USACE and some states require a permit for any in-water construction including construction of piers, wharfs, bulkheads, pilings, marinas, docks, ramps, floats, moorings, and like structures; construction of wires and cables over the water, and pipes, cables, or tunnels under the water; dredging and excavation; any obstruction or alteration of navigable waters; construction of riprap, revetments, groins, breakwaters, and levees; and transportation of dredged material for dumping into ocean waters.

The Coastal Zone Management Act (CZMA) of 1972 provides assistance to states, in cooperation with federal and local agencies, for the development of land and water use programs in coastal zones. Actions occurring within the coastal zone commonly have several resource areas that may be relevant to the CZMA. The CZMA regulatory setting discussion is presented in Section 3.6.1.

Executive Order (EO) 11990, *Protection of Wetlands,* requires that federal agencies adopt a policy to avoid, to the extent possible, long- and short-term adverse impacts associated with destruction and modification of wetlands and to avoid the direct and indirect support of new construction in wetlands whenever there is a practicable alternative.

EO 11988, *Floodplain Management*, requires federal agencies to avoid to the extent possible the long- and short-term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct and indirect support of floodplain development unless it is the only practicable alternative. Flood potential of a site is usually determined by the 100-year floodplain, which is defined as the area that has a one percent (%) chance of inundation by a flood event in a given year.

3.2.2 Affected Environment

Overview descriptions of the water resources (surface water and groundwater) found on Guam and the CNMI are included in Chapters 4 and 10, respectively, and detailed descriptions of the water resources found on each JRM installation or parcel of land are included in the "Hydrology" sections of Chapters 5 through 9, 11, and 12 of the 2019 JRM INRMP. For the descriptions of the water resources associated with the Proposed Action refer to the following INRMP sections:

- 4.3 - Guam
- 5.2.2 - NBG Main Base
- 6.2.2 - NBG NMS
- 7.1.3 - Apra Heights
- 7.2.3 - Sasa Valley and Tenjo Vista Tank Farms
- 7.3.3 - NCTS Barrigada and Barrigada Transmitter Site

- 7.4.3 - Andersen South
- 8.2.2 - NBG TS
- 9.2.2 - Andersen AFB
- 10.3 - CNMI
- 11.2.2 - Tinian MLA
- 12.2.2 - FDM

3.3 Cultural Resources

This discussion of cultural resources includes prehistoric and historic archaeological sites; historic buildings, structures, and districts; and physical entities and human-made or natural features important to a culture, a subculture, or a community for traditional, religious, or other reasons. Cultural resources on Guam and the CNMI can be divided into three major categories:

- Archaeological resources (prehistoric and historic) are locations where human activity measurably altered the earth or left deposits of physical remains.
- Architectural resources include standing buildings, structures, landscapes, and other built-environment resources of historic or aesthetic significance.
- Traditional cultural properties may include archaeological resources, structures, neighborhoods, prominent topographic features, habitat, plants, animals, and minerals that Native Chamorro or other groups consider essential for the preservation of traditional culture.

3.3.1 Regulatory Setting

Cultural resources are governed by other federal laws and regulations, including the National Historic Preservation Act (NHPA), Archeological and Historic Preservation Act, and the Archaeological Resources Protection Act of 1979. Federal agencies' responsibility for protecting historic properties is defined primarily by Sections 106 and 110 of the NHPA. Section 106 requires federal agencies to take into account the effects of their undertakings on historic properties. Section 110 of the NHPA requires federal agencies to establish—in conjunction with the Secretary of the Interior—historic preservation programs for the identification, evaluation, and protection of historic properties. Cultural resources also may be covered by state, local, and territorial laws.

3.3.2 Affected Environment

Cultural resources listed in the National Register of Historic Places (NRHP) or eligible for listing in the NRHP are "historic properties" as defined by the NHPA. The list was established under the NHPA and is administered by the National Park Service on behalf of the Secretary of the Interior. The NRHP includes properties on public and private land. Properties can be determined eligible for listing in the NRHP by the Secretary of the Interior or by a federal agency official with concurrence from the applicable State Historic Preservation Office. A NRHP-eligible property has the same protections as a property listed in the NRHP. The historical properties include archaeological and architectural resources.

Descriptions of cultural resources on JRM-administered lands can be found in the following:

- Final Supplemental Environmental Impact Statement (EIS) Guam and CNMI Military Relocation (2012 Roadmap Adjustments)

- Final EIS Guam and CNMI Military Relocation: Relocating Marines from Okinawa; Visiting Aircraft Carrier Berthing
- Army Air and Missile Defense Task Force Volume 2: Marine Corps Relocation – Guam, Chapter 12 – Cultural Resources (Joint Guam Program Office 2010a)
- Army Air and Missile Defense Task Force Volume 3: Marine Corps Relocation – Training on Tinian, Chapter 12 – Cultural Resources (Joint Guam Program Office 2010b)
- 2015 Final Integrated Cultural Resources Management Plan (ICRMP) Andersen AFB, Guam
- 2015 Final ICRMP CNMI
- 2015 Final ICRMP Naval Base Guam (NBG) (Naval Facilities Engineering Command [NAVFAC] Marianas 2015a, b, c)

Cultural management projects listed in the 2015 ICRMP for JRM-administered lands that include digging require an analysis to evaluate if any other resources, including biological resources, are affected by the management project. Cultural dig permits require staff working on the management projects to complete an Endangered Species Act (ESA) training and conduct monitoring for listed species during the dig.

3.4 Terrestrial Biological Resources

Terrestrial biological resources include living, native, or naturalized plant and animal species and the habitats within which they occur. Plant associations are referred to generally as vegetation, and animal species are referred to generally as wildlife. Habitat can be defined as the resources and conditions present in an area that support a plant or animal.

Within this EA, terrestrial biological resources are divided into two major categories: (1) terrestrial vegetation and (2) terrestrial wildlife. Threatened, endangered, and other special status species are discussed in their respective categories.

3.4.1 Regulatory Setting

Special status species for the purposes of this assessment are those species listed as threatened or endangered under the federal ESA and avian species afforded federal protection under the Migratory Bird Treaty Act (MBTA).

The purpose of the ESA is to conserve the ecosystems upon which threatened and endangered species depend and to conserve and recover listed species. Section 7 of the ESA requires action proponents to consult with the U.S. Fish and Wildlife Service (USFWS) to ensure that their actions are not likely to jeopardize the continued existence of federal ESA-listed threatened and endangered terrestrial species or result in the destruction or adverse modification of designated critical habitat. Critical habitat cannot be designated on any areas owned, controlled, or designated for use by the DoD where an INRMP has been developed that, as determined by the Department of Interior Secretary, provides a benefit to the species subject to critical habitat designation.

The National Invasive Species Act of 1996 was primarily developed to regulate the release of ballast water carried by ships to prevent invasive species from entering inland waters. It also requires a Task Force to develop and implement a comprehensive program to control the invasive brown treesnake

(BTS) on Guam, which was introduced to the island during World War II and has directly devastated the native fauna.

Migratory and most native-resident bird species are protected under the MBTA, and their conservation by federal agencies is mandated by EO 13186, *Migratory Bird Conservation*. Under the MBTA, it is unlawful by any means or in any manner to pursue, hunt, take, capture, kill; attempt to take, capture, or kill; or possess migratory birds or their nests or eggs at any time, unless permitted by regulation. The 2003 National Defense Authorization Act gave the Secretary of the Interior authority to prescribe regulations to exempt the Armed Forces from the incidental taking of migratory birds during authorized military readiness activities. The final rule authorizing the DoD to take migratory birds in such cases includes a requirement that the Armed Forces must confer with the USFWS to develop and implement appropriate conservation measures to minimize or mitigate adverse effects of a Proposed Action if the action will have a significant negative effect on the sustainability of a population of a migratory bird species.

EO 13112, *Invasive Species*, was signed in 1999 to prevent the introduction and spread of invasive species and to support efforts to control and eradicate invasive species already established. In particular, it established the National Invasive Species Council. EO 13751, *Safeguarding the Nation from the Impacts of Invasive Species*, amended EO 13112 to clarify operations of the Council; expand its membership; incorporate considerations of human and environmental health, climate change, and technological advancements; and to continue coordinated federal prevention and control efforts related to invasive species.

3.4.2 Affected Environment

Forty-six terrestrial species that occur on Guam, Tinian, and FDM are listed as either threatened or endangered by the USFWS, GovGuam, or CNMI Division of Fish and Wildlife (DFW) (Table 3-1). Overview descriptions of the terrestrial biological resources found on Guam and the CNMI are included in Chapters 4 and 10, respectively, and detailed descriptions of the terrestrial biological resources found on each JRM installation are included in Chapters 5 through 9, 11, and 12 of the 2019 JRM INRMP. For the descriptions of the terrestrial biological resources associated with the Proposed Action, refer to the following INRMP sections:

- 4.4 - Guam
- 5.2.3 through 5.2.5 - NBG Main Base
- 6.2.3 through 6.2.5 - NBG NMS
- 7.1.4 through 7.1.6 - Apra Heights
- 7.2.4 through 7.2.6 - Sasa Valley and Tenjo Vista Tank Farms
- 7.3.4 through 7.3.6 - NCTS Barrigada and Barrigada Transmitter Site
- 7.4.4 through 7.4.6 - Andersen South
- 8.2.3 through 8.2.5 - NBG TS
- 9.2.3 through 9.2.5 - Andersen AFB
- 10.4 - CNMI
- 11.2.3 through 11.2.5 - Tinian MLA
- 12.2.3 through 12.2.5 – FDM

Table 3-1 Occurrence of Federal, GovGuam, and CNMI ESA-listed Threatened and Endangered and MBTA-listed Terrestrial Species on JRM-administered and Leased Lands on Guam and the CNMI

Common Name/ Chamorro Name[1]	*Scientific Name*	*Federal Status*	*GovGuam Status*	*CNMI Status*	*Habitat*	*Island*	*Occurrence*
Mammals							
Mariana fruit bat/Fanihi	*Pteropus mariannus mariannus*	T	E	T-E	Native limestone forest	Guam Tinian FDM	Y
Birds							
Mariana swiftlet/Yayaguak/ Chachaguak	*Aerodramus bartschi*	E, MBTA	E	T-E	Mahlac Cave, Fachi Cave, and Maemong Cave	Guam Tinian	Y Ex
Micronesian megapode/Sasangat	*Megapodius laperouse laperouse*	E	--	T-E	Native limestone forests and edges	Guam Tinian FDM	Ex P P
Micronesian starling/Sali	*Aplonis opaca*	--	E	--	Native limestone forest	Guam Tinian	Y
White-throated ground dove/Paluman apaka	*Alopecoenas xanthonurusa*	MBTA	E	--	Native limestone forest	Guam Tinian FDM	PU Y Y
Mariana common moorhen/Pulattat	*Gallinula chloropus guami*	E, MBTA	E	T-E	Fresh and brackish wetlands	Guam Tinian	Y
Mariana crow/Aga	*Corvus kubaryi*	E, MBTA	E	T-E	All forests – preference for native limestone forest	Guam Tinian	Ex Y
Guam rail/Koko	*Gallirallus owstoni*	E	E	--	Edge and secondary growth	Guam	N[3]
Guam Micronesian kingfisher/Sihek	*Todiramphus cinnamominus*	E, MBTA	E	--	Native limestone forest	Guam	Ex[4]
Reptiles							
Green turtle/Haggan betde	*Chelonia mydas*	E[5]	T	T-E	Offshore waters and nesting beaches	Guam Tinian FDM	Y
Hawksbill turtle/Haggan karai	*Eretmochelys imbricata*	E	E	T-E	Offshore waters and nesting beaches	Guam Tinian FDM	Y
Snake-eyed skink/Gualiek halom tano	*Cryptoblepharus poecilopleurus*	--	E	--	Coastal strand in rocky beach areas in loose sandy soils	Guam Tinian FDM	Y[2]
Tide-pool skink/Gualiek kanton tasi	*Emoia atrocostata*	--	E	--	Intertidal zone in rock crevices, mangroves, and tree holes	Guam Tinian	Y[2]
Azure-tailed skink/Gualiek halom tano	*Emoia cyanura*	--	E	--	Forest edge in loose ground cover	Guam	Ex
Slevin's skink/ Gualiek halom tano	*Emoia slevini*	E	E	--	Native limestone forest	Guam Tinian	Ex[6]

Table 3-1 Occurrence of Federal, GovGuam, and CNMI ESA-listed Threatened and Endangered and MBTA-listed Terrestrial Species on JRM-administered and Leased Lands on Guam and the CNMI

Common Name/ Chamorro Name[(1)]	*Scientific Name*	*Federal Status*	*GovGuam Status*	*CNMI Status*	*Habitat*	*Island*	*Occurrence*
Moth skink/Gualiek halom tano	*Lipinia noctua*	--	E	--	Native limestone forest	Guam	Y
Pacific slender-toed gecko/Gualiek	*Nactus pelagicus*	--	E	--	Native limestone forest	Guam Tinian FDM	Y
Micronesian gecko/Gualiek	*Perochirus ateles*	--	E	T-E	Native limestone forest	Guam Tinian	Y
Invertebrates							
Humped tree snail/Akaleha	*Partula gibba*	E	E	--	Native limestone and ravine forests	Guam Tinian	Y
Guam tree snail/Akaleha	*Partula radiolata*	E	E	--	Native limestone and ravine forests	Guam	Y
Fragile tree snail/Akaleha	*Samoana fragilis*	E	E	--	Native limestone and ravine forests	Guam	Y
Mariana eight-spot butterfly/Ababbang	*Hypolimnas octocula marianensis*	E	--	--	Native limestone forest	Guam	Y
Plants							
None/Siboyas halumtano	*Bulbophyllum guamense*	T	--	--	Lowland/limestone forests	Guam	Y
Tree fern/Satsa	*Cyathea lunulata*	--	E	--	Ravine forest and savanna	Guam	Y
None/Fadang	*Cycas micronesica*	T	--	--	Limestone forest, ravine forest, and savanna summits	Guam Tinian	Y
None/None	*Dendrobium guamense*	T	--	--	Lowland/ limestone forests	Guam Tinian	Y
None/None	*Eugenia bryanii*	E	--	--	Windy exposed coastal clifflines in lowland/ limestone forests	Guam	Y
None/Pao dedu	*Hedyotis megalantha*	E	--	--	Savanna	Guam	Y
None/Ufa halumtano	*Heritiera longipetiolata*	E	E	--	Native limestone forest	Guam Tinian	Y
Cat's tail/Disciplina	*Lycopodium phlegmaria var. longifolium*	--	--	T-E		Guam	Y
None/None	*Maesa walkeri*	T	--	--	Lowland/ limestone forests	Guam	Y
None/None	*Nervilia jacksoniae*	T	--	--	Lowland/ limestone forests	Guam	Y
None/None	*Phyllanthus saffordii*	E	--	--	Savanna	Guam	Y
None/Aplokating-palaoan	*Psychotria malaspinae*	E	--	--	Lowland/ limestone forests	Guam	P

Table 3-1 Occurrence of Federal, GovGuam, and CNMI ESA-listed Threatened and Endangered and MBTA-listed Terrestrial Species on JRM-administered and Leased Lands on Guam and the CNMI

Common Name/ Chamorro Name[(1)]	*Scientific Name*	*Federal Status*	*GovGuam Status*	*CNMI Status*	*Habitat*	*Island*	*Occurrence*
Fire tree/Hayun lago	*Serianthes nelsonii*	E	E	T-E	Native limestone forest	Guam	Y
None/Biringenas halumtano	*Solanum guamense*	E	--	--		Guam Tinian	PU
None/None	*Tabernaemontana rotensis*	T	--	--	Limestone forest	Guam	Y
None/None	*Tinospora homosepala*	E	--	--	Lowland/ limestone forests	Guam	Y
None/None	*Tuberolabium guamense*	T	--	--	Lowland/ limestone forests	Guam	Y

Notes: [(1)]Chamorro names from GovGuam (2009), USFWS (2015), and 85-30.1-CNMI Administrative Code.
[(2)]Historical occurrence.
[(3)]Experimental population on Cocos Island and Rota.
[(4)]Occurs only in captivity.
[(5)]Central West Pacific Distinct Population Segment.
[(6)]With known occurrence on Cocos Island.

Key: -- = not listed; CNMI = Commonwealth of the Northern Mariana Islands; E = endangered; GovGuam = Government of Guam; MBTA = Migratory Bird Treaty Act; N = No; Ex = No, extirpated; PU = potential for occurrence, but unlikely; T = threatened; T-E = listed as threatened/endangered by CNMI government; Y = yes, known to occur.

Sources: GovGuam 2009; Guam Division of Aquatic Wildlife Resources (Guam DAWR) 2006; USFWS 2011, 2015.

3.5 Marine Biological Resources

Marine biological resources include the flora (vegetation) and fauna (invertebrates, fish, turtles, and marine mammals) that live all or a significant part of their lifecycle within the marine environment, as well as the habitat resources and conditions that support these organisms. Table 3-2 lists all special status marine species in the study area; all are animals and are discussed under the faunal group that includes ESA-listed species.

3.5.1 Regulatory Setting

Special status marine species include ESA-listed species and marine mammals, all of which are protected under the ESA and/or Marine Mammal Protection Act (MMPA).

The purpose of the ESA is to conserve the ecosystems upon which threatened and endangered species depend and to conserve and recover listed species. Section 7 of the ESA requires action proponents to consult with the National Oceanic and Atmospheric Administration National Marine Fisheries Service (NMFS) to ensure that their actions are not likely to jeopardize the continued existence of federal ESA-listed threatened and endangered marine species or result in the destruction or adverse modification of designated critical habitat. According to ESA 4(a)(3)(b), critical habitat cannot be designated on any areas owned, controlled, or designated for use by the DoD where an INRMP has been developed that, as determined by the Department of Commerce Secretary, provides a benefit to the species subject to critical habitat designation.

All marine mammals are protected under the provisions of the MMPA. The MMPA prohibits any person or vessel from "taking" marine mammals in the U.S. or the high seas without authorization. The MMPA defines "take" to mean, "to harass, hunt, capture, or kill or attempt to harass, hunt, capture, or kill any marine mammal."

Table 3-2 Occurrence of Federal, GovGuam, and CNMI ESA-listed Threatened and Endangered Marine Species within JRM-administered Submerged Lands around Guam and the CNMI

Common Name/ Chamorro Name[1]	*Scientific Name*	*Federal Status*	*GovGuam Status*	*CNMI Status*	*Habitat*	*Island*	*Occurrence*
Reptiles							
Green turtle/Haggan betde	*Chelonia mydas*	E[2]	T	T-E	Offshore waters and nesting beaches	Guam Tinian FDM	Y
Hawksbill turtle/Haggan karai	*Eretmochelys imbricata*	E	E	T-E	Offshore waters and nesting beaches	Guam Tinian FDM	Y
Loggerhead turtle/Haggan	*Caretta caretta*	E[3]	--	--	Offshore waters	Guam Tinian	Y PU
Leatherback turtle/Haggan	*Dermochelys coriacea*	E	E	--	Offshore waters	Guam Tinian	PU
Olive ridley	*Lepidochelys olivacea*	T	--	--	Offshore waters	Guam Tinian	PU
Fish							
Oceanic whitetip shark/Haluu	*Carcharhinus longimanus*	T	--	--	Open ocean, usually well offshore	Guam Tinian FDM	PU
Giant manta ray/Afula or Hafula or Fanihen Tasi	*Manta birostris*	T	--	--	Coastlines, oceanic island groups, and offshore pinnacles and seamounts	Guam Tinian FDM	Y P P
Scalloped hammerhead shark/ Haluun kiluus or Ulon matiyu na huluu	*Sphyrna lewini*	T[4]	--	--	Coastal seas from intertidal to depths of 1,640 feet (500 meters); nearshore nursery habitat includes bays and estuaries	Guam Tinian FDM	Y Y P
Invertebrates (Corals)							
Coral/Acho tasi	*Acropora globiceps*	T	--	--	Intertidal zone, upper reef slopes, and reef flats at depths <26 feet (8 meters)	Guam Tinian FDM	Y
Coral/Acho tasi	*Acropora retusa*	T	--	--	Shallow reef slope and back-reef areas at depths of 3-16 feet (1-5 meters)	Guam Tinian FDM	Y Y P
Coral/Acho tasi	*Seriatopora aculeata*	T	--	--	Shallow reef slopes at depths of 10-131 feet (3-40 meters)	Guam Tinian FDM	Y P P

Notes: [1]Chamorro names from GovGuam (2009) and Kerr (2012).
[2]Central West Pacific DPS.
[3]North Pacific Ocean DPS.
[4]Indo-West Pacific DPS.

Key: -- = not listed; C = candidate; CNMI = Commonwealth of the Northern Mariana Islands; E = endangered; GovGuam = Government of Guam; N = no; P = potential for occurrence; PU = potential for occurrence, but unlikely; T = threatened; T-E = listed as threatened/endangered by CNMI government; Y = yes, known to occur.

Sources: GovGuam 2009; Guam DAWR 2006; Lybolt 2015; NMFS 2011, 2014a, 2014b, 2015; NMFS and USFWS 2007; USFWS 2011; USFWS and NMFS 2016.

The Magnuson-Stevens Fishery Conservation and Management Act provides for the conservation and management of fisheries. Under the Act, essential fish habitat (EFH) consists of the waters and substrate needed by fish to spawn, breed, feed, or grow to maturity. Lead federal agencies are required to evaluate the effects of proposed actions on EFH and to consult with NMFS if there would be an adverse effect to EFH.

In addition to preventing the introduction of invasive species into inland waters from the release of ballast water, the National Invasive Species Act of 1996 is also intended to protect marine waters from invasive species introductions.

EO 13112, *Invasive Species*, and EO 13751, *Safeguarding the Nation from the Impacts of Invasive Species,* provide not only for efforts against terrestrial invasive species, but for marine invasive species as well.

EO 13089, *Coral Reef Protection*, requires federal agencies whose actions affect U.S. coral reef ecosystems to provide for the implementation of measures needed to research, monitor, manage, and restore affected ecosystems, including, but not limited to, measures reducing impacts from pollution, sedimentation, and fishing.

3.5.2 Affected Environment

Overview descriptions of the marine biological resources found surrounding Guam and the CNMI are included in Chapters 4 and 10, respectively, and detailed descriptions of the marine biological resources found surrounding each JRM installation are included in Chapters 5, 8, 9, 11, and 12 of the 2019 JRM INRMP in the following INRMP sections:

- 4.5 - Guam
- 5.3.3.4 through 5.3.8 - NBG Main Base
- 8.3.4 through 8.3.7 - NBG TS
- 9.3.4 through 9.3.7 - Andersen AFB
- 10.5 - CNMI
- 11.3.4 through 11.3.7 - Tinian MLA
- 12.3.4 through 12.3.7 - FDM

3.6 Land Use

This discussion of land use includes current and planned uses and the regulations, policies, or zoning that may control the proposed land use. The term land use refers to real property classifications that indicate either natural conditions or the types of human activity occurring on a parcel. Two main objectives of land use planning are to ensure orderly growth and compatible uses among adjacent property parcels or areas. However, there is no nationally recognized convention or uniform terminology for describing land use categories. As a result, the meanings of various land use descriptions, labels, and definitions vary among jurisdictions. Natural conditions of property can be described or categorized as unimproved, undeveloped, conservation or preservation area, and natural or scenic area. There is a wide variety of land use categories resulting from human activity. Descriptive terms often used include residential, commercial, industrial, agricultural, institutional, and recreational.

3.6.1 Regulatory Setting

In many cases, land use descriptions are classified in installation master planning and local zoning laws. Office of the Chief of Naval Operations Instruction (OPNAVINST) 11010.40 establishes an encroachment management program to ensure operational sustainment that has direct bearing on land use planning on installations. Additionally, the joint instruction OPNAVINST 11010.36C and Marine Corps Order 11010.16 provides guidance for administering the Air Installation Compatible Use Zone program, which recommends land uses that are compatible with noise levels, accident potential, and obstruction clearance criteria for military airfield operations. OPNAVINST 3550.1A and Marine Corps Order 3550.11 provide guidance for a similar program, Range Air Installation Compatible Use Zone. This program includes range safety and noise analyses and provides land use recommendations that will be compatible with Range Compatibility Zones and noise levels associated with military range operations.

Through the CZMA of 1972, Congress established national policy to preserve, protect, develop, restore, or enhance resources in the coastal zone. This Act encourages coastal states and territories to properly manage use of their coasts and coastal resources, prepare and implement coastal management programs, and provide for public and governmental participation in decisions affecting the coastal zone. To this end, CZMA imparts an obligation upon federal agencies whose actions or activities affect any land or water use or natural resource of the coastal zone to be carried out in a manner consistent to the maximum extent practicable with the enforceable policies of federally approved state coastal management programs. However, federal lands, which are "lands the use of which is by law subject solely to the discretion of the federal government, its officers, or agents," are statutorily excluded from the State's "coastal uses or resources." If, however, the proposed federal activity affects coastal uses or resources beyond the boundaries of the federal property (i.e., has spillover effects), the CZMA Section 307 federal consistency requirement applies. As a federal agency, DON is required to determine whether its proposed activities would affect the coastal zone. This takes the form of a consistency determination, a negative determination, or a determination that no further action is necessary.

3.6.2 Affected Environment

Detailed descriptions of the land use found on each JRM installation are included in Chapters 5 through 9, 11, and 12 of the 2019 JRM INRMP. For the descriptions of land uses associated with the Proposed Action refer to the following INRMP sections:

- 5.1 - NBG Main Base
- 6.1 - NMS
- 7.1.1 - Apra Heights
- 7.2.1 - Sasa Valley and Tenjo Vista Tank Farms
- 7.3.1 - NCTS Barrigada and Barrigada Transmitter Site
- 7.4.1 - Andersen South
- 8.1 - NBG TS
- 9.1 - Andersen AFB
- 11.1 - Tinian MLA
- 12.1 - FDM

3.7 Submerged Land Use

Submerged land(s) refers to a special condition of jurisdictional control that is related to the "land beneath navigable waters." Generally, this is considered those lands between the low and high-tide line and out to 3 miles (4.8 kilometers) from the jurisdictional (mean high-tide) line of the state, as outlined in the Conveyance of Submerged Lands to Territories (48 U.S. Code [USC] Chapter 15).

3.7.1 Regulatory Setting

The Territorial Submerged Lands Act (48 USC Section 1705 et seq.) provided for the conveyance of submerged lands extending 3 miles (4.8 kilometers) seaward from the line of mean high-tide owned by the U.S. to Guam. Public Law 113-34 (September 17, 2013) added the Northern Mariana Islands to the Territorial Submerged Lands Act. The Act established federal law that recognizes the rights of states to jurisdictional authority over their coastlines and territorial waters. This authority is often referred to as the "jurisdictional waters." While this Act provides jurisdictional authority for submerged lands to the states, the U.S. Federal Branch (i.e., DoD) still reserves executive privilege to supersede the state's authority, particularly when it concerns issues of national security or public safety. Jurisdictional authority of submerged lands for CNMI falls under the purview of the CNMI Bureau of Environmental and Coastal Quality. However, this is not applicable to those submerged lands adjacent to the MLA on Tinian and around FDM as they are under the jurisdictional control of the U.S. government.

3.7.2 Affected Environment

Detailed descriptions of the submerged land use found on each JRM installation are included in Chapters 5, 8, 9, 11, and 12 of the 2019 JRM INRMP. For the descriptions of submerged land uses associated with the Proposed Action refer to the following INRMP sections:

- 5.3.1 - NBG Main Base
- 8.1 and 8.3.1 - NBG TS
- 9.3.1 - Andersen AFB
- 10.5 - CNMI
- 11.3.1 - Tinian MLA
- 12.3.1 - FDM

3.8 Socioeconomics

Socioeconomics is generally defined as the study of the interrelation between social behavior and economics. Socioeconomic analyses typically address issues such as population, demographics, business activity, employment, and income. Impacts to these fundamental socioeconomic components can also influence other systemic issues such as housing, the provision of public services (e.g., emergency services, education, and health services), cultural issues, and the general quality of life in a community. Due to the nature of the Proposed Action, the primary subject of socioeconomic analysis is recreational activity.

3.8.1 Regulatory Setting

The CEQ regulations implementing NEPA state that when economic or social effects and natural or physical environmental effects are interrelated, the Environmental Assessment (EA) would discuss these effects on the human environment (40 Code of Federal Regulations [CFR] Section 1508.14). The CEQ

regulations further state that the "human environment shall be interpreted comprehensively to include the natural and physical environment and the relationship of people with that environment." In addition, 40 CFR 1508.8 states that agencies need to assess not only direct effects but also "aesthetic, historic, cultural, economic, social, or health" effects. Following from these regulations, the socioeconomic analysis in this EA evaluates how elements of the human environment, such as population, employment, housing, and public services, might be affected by the Proposed Action.

There are military-specific federal regulations (10 USC Section 2391) and DoD Directives (3030.01 and 5410.12) that address the issue of what is a significant impact to communities due to changes in military programs.

3.8.2 Affected Environment

As of the 2010 Census, the population of Guam was 158,358, the median age in 2010 was 29.5 years old, and the average household size was 3.67 persons per household. Median household income on Guam, in 2010, was $48,247 and 19% of families had incomes below the poverty line (U.S. Census 2010a).

As of the 2010 Census, the population of Tinian was 3,136, the median age in 2010 was 32.3 years old, and the average household size was 3.21 persons per household. Median household income on Tinian, in 2010, was $24,470 and 34% of families had incomes below the poverty line (U.S. Census 2010b).

Examples of important recreational activities on Guam and Tinian include hunting, fishing, and gathering (both food and medicinal plants). Detailed descriptions of recreational resources found on each JRM installation are included in Chapters 5 through 9, 11, and 12 of the 2019 JRM INRMP. Hunting, fishing, and gathering activities on Guam and Tinian are often also done to supplement income (through, for instance, gathering and selling boonie peppers [*Capsicum frutescens*] on Tinian), for subsistence, and for cultural purposes, such as providing food for family gatherings.

3.9 Environmental Justice

USEPA defines environmental justice as the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies (USEPA 2017).

3.9.1 Regulatory Setting

Consistent with EO 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-income Populations* (February 11, 1994), DON's policy is to identify and address any disproportionately high and adverse human health or environmental effects of its actions on minority and low-income populations.

3.9.2 Affected Environment

According to the 2010 Census, the largest ethnic groups on Guam were Chamorro (37.7% of the population) and Filipino (26.3% of the population). The largest ethnic groups on Tinian were Chamorro (37.3% of the population) and Filipino (30.3% of the population). Due to the ethnic minority composition of the populations of Guam and Tinian, all portions of both islands are considered environmental justice areas.

4 Environmental Consequences

This chapter presents an analysis of the potential direct and indirect effects of each alternative on the affected environment. The following discussion elaborates on the nature of the characteristics that might relate to resources. "Significant," as used in National Environmental Policy Act (NEPA), requires considerations of both context and intensity. "Context" means that the significance of an action must be analyzed in several contexts, such as society as a whole (e.g., human, national), the affected region, the affected interests, and the locality. Significance varies with the setting of a proposed action. For instance, in the case of a site-specific action, significance would usually depend on the effects in the locale rather than in the world as a whole. Both short- and long-term effects are relevant. Intensity refers to the severity or extent of the potential environmental impact, which can be thought of in terms of the potential amount of the likely change. In general, the more sensitive the context, the less intense a potential impact needs to be in order to be considered significant. Likewise, the less sensitive the context, the more intense a potential impact would be expected to be significant. Impacts can be beneficial or adverse.

4.1 Geology, Topography, and Soils

2019 Joint Region Marianas (JRM) Integrated Natural Resources Management Plan (INRMP) Management Actions That Would Benefit Soils:

- monitor for soil erosion on JRM-administered lands
- rehabilitate degraded soils
- develop and implement erosion control best management practices (BMPs)
- remove invasive vegetation
- reforestation of native forests
- establish fuel breaks
- develop and implement long-term watershed and forest management plans
- implement ungulate management plans
- implement fire management plans

Geology, topography, and soils are analyzed in terms of drainage, erosion, prime farmland, land subsidence, beach stability and erosion, and seismic activity. The analysis of geology considers impacts to unique geologic features and examines potential impacts related to seismic events. The analysis of topography considers changes to topography and slope stability. The analysis of soils focuses on the area of soils that would be disturbed, the potential for erosion of soils from construction areas, and the potential for eroded soils to become pollutants in downstream surface water during storm events. BMPs are identified to minimize soil impacts and prevent or control pollutant releases into stormwater. The potentially affected environment for geology, topography, and soils includes all JRM-administered and leased lands on Guam, Tinian, and Farallon de Medinilla (FDM). Impacts may be adverse or beneficial.

4.1.1 Evaluation Criteria

Protection of unique geological features, the location of facilities and structures in relation to potential geologic hazards, alteration to topography, and minimization of soil erosion are considered in order to evaluate potential impacts of a Proposed Action on geology, topography, and soils. Impacts on soils would be significant if they were to change the soil composition, structure, or function. Generally, adverse impacts can be avoided or minimized if proper construction techniques, erosion control measures, and structural engineering designs are incorporated into project development.

4.1.2 No Action Alternative

The No Action Alternative would result in continued management as characterized in the 2013 JRM INRMP. The 2013 JRM INRMP does not involve the construction or siting of facilities that would impact geologic hazards, and no activities proposed as part of 2013 JRM INRMP would adversely impact unique geologic features or alter topography.

Continued implementation of the 2013 JRM INRMP would result in some beneficial reduction in soil erosion and sedimentation on JRM-administered lands. Objectives of the 2013 INRMP for watershed management include maintaining stable soils; reducing runoff, erosion, and gully formation; and revegetating areas with bare soils. To achieve these objectives, BMPs would continue to be implemented to reduce soil erosion and sedimentation. As part of that effort, existing sites where erosion is a problem would be rehabilitated, soil conditions would continue to be monitored, and control measures would continue to be implemented during construction and at other times when soil is exposed.

However, the 2013 JRM INRMP does not include an update to readdress soils in their current condition and to evaluate new strategies and actions. For example, the 2013 JRM INRMP includes implementation of long-term, ecosystem-based management plans for the Overlay units on Naval Base Guam (NBG), Andersen Air Force Base (AFB), and in JRM-administered submerged lands in Sumay Cove and Apra Harbor; however, it does not include an action to update the plans to include stabilization and restoration of new areas of erosion. Without updates to the long-term ecosystem-based plans for restoring and maintaining forests and other areas, there could be continued erosion and minor to moderate adverse impacts on soils. In addition, the No Action Alternative does not address the current ungulate populations found on JRM sites; thus, ground disturbances and soil erosion caused by ungulates would continue.

4.1.3 Proposed Action (Preferred Alternative)

The study area for the analysis of effects to geology, topography, and soils associated with the Proposed Action includes all JRM-administered and leased lands on Guam, Tinian, and FDM.

4.1.3.1 Effects on Geology, Topography, and Soils

Geology. The 2019 JRM INRMP does not include plans to construct facilities or conduct activities as part of the INRMP that would adversely affect unique geologic features or impact geologic hazards.

Topography. The 2019 JRM INRMP does not include plans to construct facilities or conduct activities as part of the INRMP that would adversely affect topography or increase the risk of landslides.

Soils. Implementation of the 2019 JRM INRMP would result in a long-term, beneficial reduction in soil erosion on JRM-administered lands as it adopts management projects to benefit current soil and erosion conditions. Beneficial management actions for soils include but are not limited to the following:

- manage all natural resources with a long-term goal of restoring and enhancing habitats for native species, including listed species, over the next 30-50 years
- protect native habitat diversity
- maximize use of regionally native plant species and avoid introduction of invasive, exotic species in revegetation projects

- enhance habitat for native species by removing invasive vegetation and replacing with native vegetation
- maintain and enhance vegetation community structure, functionality, and species diversity
- develop and implement ungulate management plans

To successfully carry out these management projects, existing and innovative soil management strategies and actions would be implemented and advanced beyond those in the 2013 JRM INRMP, which address current conditions. Soil erosion monitoring would allow for appropriate time efficient solutions to control, rehabilitate, or protect soil and vegetation. Reforestation of native forests would be implemented to maximize use of regionally native plant species and avoid introduction of invasive, exotic species in revegetation projects. This would enhance habitat for native species by removing invasive vegetation and replacing with native vegetation. The conversion of non-native tree species, which require understory clearing, to native tree species will ultimately reduce fuel loads within the forest and eliminate the need to clear the understory.

In addition, the 2019 JRM INRMP would expand the establishment of shaded fuel breaks in areas where non-fire fuel reduction (e.g., mechanical cutting and herbicide applications) have proven effective as a temporary solution. A shaded fuel break is a forest management strategy used for mitigating the threat of wildfire in areas where natural fire regimes have been suppressed, leading to a dangerous buildup of combustible vegetation. Constructing a shaded fuel break is the process of selectively thinning and removing more flammable understory vegetation while leaving the majority of larger, more fire tolerant tree species in place. The resulting reduction in wildfires would decrease the amount of exposed soils after fires and lead to a decrease in the potential for erosion.

As part of the long-term watershed and forest management plans associated with the 2019 JRM INRMP, BMPs would be implemented to reduce soil erosion and sedimentation. As part of that effort, existing sites where erosion is a problem would be rehabilitated, soil conditions would be monitored, and control measures would be implemented during construction and at other times when soil is exposed. Long-term management of ungulates would decrease exposed soils and the rate of erosion. As such, additional erosion control BMPs would be established, including the management and control of invasive ungulate species by installing and maintaining perimeter fencing around designated areas at several installations.

The long-term management projects proposed in the 2019 JRM INRMP would rehabilitate soils and increased implementation of BMPs would prevent or minimize soil erosion and sedimentation. Management projects also include long-term plans to restore natural processes, such as sustained reproduction of native vegetation on areas damaged by high densities of ungulates or otherwise having exposed soils. Therefore, implementation of the proposed 2019 JRM INRMP would result in long-term, beneficial impacts through the reduction in soil erosion, ungulate control, reduction in invasive vegetation, and an increase in native reforestation on JRM-administered lands.

4.2 Water Resources

2019 JRM INRMP Management Actions That Would Benefit Water Resources:

- identify and develop measures to reduce impacts on streams
- conduct water resources monitoring that assesses water quality
- develop and implement long-term watershed and forest management plans
- develop and implement erosion control BMPs
- implement ungulate management plans
- identify and characterize wetlands on JRM-administered lands
- ensure consistency of wetland mapping across JRM-administered lands

The analysis of water resources looks at the potential impacts on surface water (including wetlands and floodplains), groundwater, and marine waters. The analysis of surface water quality considers the potential for impacts that may change the water quality, including both improvements and degradation of current water quality. The impact assessment of wetlands considers the potential for impacts that may change the local hydrology, soils, or vegetation that support a wetland. The analysis of floodplains considers if any new construction is proposed within a floodplain or may impede the functions of floodplains in conveying floodwaters. Groundwater analysis focuses on the potential for impacts to the quality, quantity, and accessibility of the water. Marine waters analysis includes potential changes to physical and chemical characteristics. Impacts may be adverse or beneficial.

4.2.1 Evaluation Criteria

The evaluation of impacts on water resources is based on how an action might affect water availability, quality, and use; damage or improve wetlands; and increase or decrease the risk of flooding. An action could have significant negative impacts on water resources if it were to do one or more of the following:

- substantially reduce water availability or supply to existing users
- substantially and adversely affect water quality
- endanger public health by creating or worsening health hazards
- threaten or damage unique hydrologic characteristics
- violate established laws or regulations adopted to protect water resources

The significance of impacts on wetlands is based on the amount of wetland acreage affected and how an activity would affect the functions and values of wetlands. Impacts on wetland resources are considered significant if high-value wetlands would be adversely affected or if wetland acreage is lost.

Impacts on floodplains would be considered significant if the action increased the potential for or severity of flooding.

4.2.2 No Action Alternative

Under the No Action Alternative, the Proposed Action would not occur and there would be no change to baseline water resources. The No Action Alternative does not include any actions that require filling or otherwise adversely modifying wetlands, nor does it include the construction of facilities or other actions in floodplains that would reduce the flow of floodwaters or increase the severity of flooding.

Projects identified in the 2013 JRM INRMP would continue to be implemented, including those required by laws and regulations to protect waters, wetlands, and floodplains. Implementation of the 2013 JRM INRMP includes management projects and associated strategies for minimizing operational impacts on wetlands, maximizing native floral and faunal diversity of wetlands, and managing for no net loss of wetlands. Implementing these wetlands management projects would result in long-term, beneficial impacts.

Long-term, beneficial impacts on wetlands also would be expected following the implementation of long-term, ecosystem-based management plans for the Overlay units on NBG, Andersen AFB, and in JRM-administered submerged lands. These plans would include the restoration and maintenance of ecosystem processes, such as sustainable revegetation and soil production, which would improve water quality, promote the flow of surface waters into wetlands, and reduce flooding by increasing groundwater recharge and reducing surface water flow rates.

4.2.3 Proposed Action (Preferred Alternative)

The study area for the analysis of effects to water resources associated with the Proposed Action includes all JRM-administered and leased lands on Guam, Tinian, and FDM.

4.2.3.1 Effects on Water Resources

Surface Water. The Proposed Action establishes goals, objectives, and projects that would have long-term, beneficial impacts on surface water resources through management of natural resources. Some surface waters on Guam have high sediment loads caused by erosion in forests, savannahs, and other upland areas. The 2019 JRM INRMP describes rehabilitation of unstable rivers or stream reaches on JRM-administered lands, implementation of an Erosion and Sedimentation Control Plan, development of long-term management plans to restore ecosystem health on refuge Overlay units, and other actions. Beneficial management actions for water resources include but are not limited to the following:

- maintain, protect, and enhance water quality and contain/minimize runoff into marine waters
- work with other Guam, Commonwealth of the Northern Mariana Islands (CNMI), and federal partners to prioritize watershed restoration activities to protect key coral reef areas that have been identified as resistant or resilient to disturbance
- identify and develop measures to reduce impacts on streams
- conduct water resources monitoring that assesses water quality
- develop and implement long-term watershed and forest management plans
- conduct reforestation of native forests
- develop and implement erosion control BMPs
- implement ungulate management plans
- identify and characterize wetlands on JRM-administered lands
- ensure consistency of wetland mapping across JRM-administered lands

These management actions would reduce soil erosion, increase vegetation cover, and monitor water quality and would result in long-term, beneficial impacts by improving the quality of surface waters on JRM-administered lands and reducing sediment pollution in surface and coastal waters.

The 2019 JRM INRMP does not include any actions that require filling or otherwise adversely modifying wetlands. Nor does it include the construction of facilities or other actions in floodplains that would reduce the flow of floodwaters or increase the severity of flooding. The goals, objectives, and projects associated with the 2019 JRM INRMP would reduce soil erosion, increase vegetation cover, and monitor water quality resulting in long-term, beneficial impacts by improving the wetland quality on JRM-administered lands. Therefore, implementation of the Proposed Action would not result in significant impacts to surface water resources.

Groundwater. The goals, objectives, and projects identified under surface waters would also result in beneficial impacts to groundwater quality. Implementation of the 2019 JRM INRMP does not include any actions that would reduce water availability to current users, affect unique hydrologic characteristics, or violate laws or regulations that protect water resources. Therefore, implementation of the Proposed Action would not result in significant impacts to groundwater resources.

Marine Water. The goals, objectives, and projects identified under surface waters would also result in beneficial impacts to marine water quality, especially in areas of southern Guam where substantial amounts of erosion results in sediment discharge to nearshore waters. The 2019 JRM INRMP does not include any construction in marine waters or actions that would degrade marine water quality. Therefore, implementation of the Proposed Action would not result in significant impacts to marine water resources.

4.3 Cultural Resources

2019 JRM INRMP Management Actions That Would Benefit Cultural Resources:

- ungulate control resulting in reduction of damage to historic landmarks and culturally important plants
- native forest enhancement and restoration resulting in reduction of damage to historic landmarks and culturally important plants

Analysis of potential impacts to cultural resources considers both direct and indirect impacts. Direct impacts may be the result of physically altering, damaging, or destroying all or part of a resource; altering characteristics of the surrounding environment that contribute to the importance of the resource; introducing visual, atmospheric, or audible elements that are out of character for the period the resource represents (thereby altering the setting); or neglecting the resource to the extent that it deteriorates or is destroyed. Indirect impacts are those that may occur as a result of the completed project by altering characteristics of the surrounding environment through the introduction of visual or audible elements that are out of character for the period the property represents. An example of an indirect impact is increased vehicular or pedestrian traffic in the vicinity of the property. Impacts may be adverse or beneficial.

4.3.1 Evaluation Criteria

The methods for identifying, evaluating, and mitigating impacts on cultural resources have been established through federal laws and regulations including the National Historic Preservation Act (NHPA) and Archaeological Resources Protection Act. Under those regulations, a project is considered to affect a historic property if it alters the property's integrity or the characteristics that make the property eligible for inclusion on the National Register of Historic Places (NRHP). Adverse impacts can be direct or indirect and include physical destruction, damage, or alteration of all or part of the resources; alteration of the

character of the surrounding environment that contributes to the resource's qualifications for the NRHP; introduction of visual, audible, or atmospheric elements that are out of character with the resource; neglect of the resource resulting in its deterioration or destruction; and transfer, lease, or sale of the property without adequate and legally enforceable restrictions or conditions to ensure long-term preservation of the property's historic significance (36 Code of Federal Regulations [CFR] 800).

4.3.2 No Action Alternative

Under the No Action Alternative, the Proposed Action would not occur and there would be no change to cultural resources. Because the 2013 JRM INRMP considered under this alternative does not address all current adverse conditions on JRM-administered lands, or does so at a smaller scale than is currently needed, some adverse impacts on cultural resources and culturally important medicinal plants caused by the high abundance of ungulates and degradation of forests and other areas would continue. Therefore, some impacts to cultural resources may result with implementation of the No Action Alternative.

4.3.3 Proposed Action (Preferred Alternative)

The study area for the analysis of effects to cultural resources associated with the Proposed Action includes all JRM-administered and leased lands on Guam and Tinian. Natural resources management projects proposed in the 2019 JRM INRMP do not include actions incompatible with the management and protection of cultural resources on JRM-administered lands. Further, natural resource management projects would not significantly impact any identified historic properties.

4.3.3.1 Effects on Cultural Resources

Prehistoric and Historic Sites. Implementation of management projects in the 2019 JRM INRMP would benefit cultural resources on JRM-administered and leased lands on Guam, Tinian, and FDM. JRM will consult on any proposed activities in the 2019 JRM INRMP that have the potential to affect cultural resources. Management actions that would benefit prehistoric and historic sites include but are not limited to the following:

- management and control of invasive ungulate populations
- enhancement and restoration of native forest
- protection of the Orote Peninsula Ecological Reserve Area (ERA) within NBG Main Base and the Haputo ERA within NBG TS

Ungulates can damage prehistoric and historic sites by trampling and rooting. Therefore, by eradicating them from JRM-administered lands, archaeological sites will not incur as much damage as they did previously. Lands that are established as ERAs include characteristics or outstanding ecological, geological, and scenic features or processes. These areas are preserved, which will benefit and protect prehistoric and historic sites within their boundary.

Architectural Sites. Architectural sites are typically located within developed areas on JRM-administered lands. Further, natural resource management projects would not adversely affect any identified architectural sites. Therefore, implementation of the management projects identified in the 2019 JRM INRMP would have no potential to cause effects on architectural sites and are covered by Section 106 of the NHPA.

Traditional Cultural Properties. Implementation of management projects in the 2019 JRM INRMP would benefit cultural resources on JRM-administered and leased lands on Guam, Tinian, and FDM. JRM will consult on any proposed activities in the 2019 JRM INRMP that have the potential to affect cultural resources. Management actions that would benefit traditional cultural properties include but are not limited to the following:

- management and control of invasive ungulate species
- enhancement and restoration of native forest

Controlling invasive flora and fauna species would allow culturally important medicinal plants species, such as *Maytenus thompsonii*, to be restored. Ungulates reduce the distribution and abundance of native species and increase the abundance of invasive plant species. Native forest enhancement will result in management of ecosystems that provide habitat for culturally important plants and animals.

Therefore, implementation of the Proposed Action would have beneficial impacts within the Area of Potential Effect, the geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties. The Area of Potential Effect is influenced by the scale and nature of an undertaking and may be different for different kinds of effects caused by the undertaking as defined in 36 CFR 800.16(d).

4.4 Terrestrial Biological Resources

Terrestrial biological resources include living, native, or naturalized plant and animal species that live on land and the habitats within which they occur. Plant associations are referred to generally as vegetation, and animal species are referred to generally as wildlife. Habitat can be defined as the resources and conditions present in an area that support a plant or animal.

2019 JRM INRMP Management Actions That Would Benefit Terrestrial Biological Resources:

- baseline and long-term monitoring of native forest habitat, invasive species, wildlife populations, and habitat use would have long-term, beneficial impacts in identifying trends over time, their causes, and management projects to reduce stressors to terrestrial species and habitats
- improve ungulate management to reduce impacts to native vegetation
- update outreach and education programs to reduce human disturbance of all currently federally listed species and their habitats

Within this Environmental Assessment (EA), terrestrial biological resources are divided into two major categories: (1) terrestrial vegetation and (2) terrestrial wildlife. Threatened, endangered, and other special status species are discussed in their respective categories.

This analysis focuses on wildlife or vegetation types that are important to the function of the ecosystem or are protected under federal or state law or statute. Impacts may be adverse or beneficial.

4.4.1 Evaluation Criteria

The factors considered to determine the significance of impacts on terrestrial biological resources include (1) the importance (i.e., legal, commercial, recreational, ecological, or scientific) of biological resources, (2) the proportion of plant and animal populations and habitat that would be affected relative to its occurrence in the region, (3) the sensitivity of populations and habitat to proposed activities, and (4) the duration of ecological impacts. Impacts on biological resources are considered

significant if species or habitats of concern are adversely affected over relatively large areas, or disturbances cause reductions in population size or distribution of protected or sensitive species.

4.4.2 No Action Alternative

Under the No Action Alternative, natural resources would continue to be managed as characterized in the 2013 JRM INRMP, and JRM would continue to implement applicable regulatory requirements. Ongoing INRMP projects may result in minor, temporary, and non-significant disturbance to some terrestrial species, but would have beneficial impacts in identifying trends and their causes, and implementing management to reduce stressor effects, including human disturbance of species and habitats. However, because the 2013 JRM INRMP considered under this alternative does not address all current adverse conditions on JRM-administered lands, or does so at a smaller scale than is currently needed, some natural habitats, such as native forests, will decline in quality and complexity from new stressors, and some plant and animal species would continue to be adversely affected by those conditions without management updates. Forest ecosystem function, regeneration, and species diversity will be incrementally more expensive and difficult to address as stressors are allowed to continue. In addition, the 2013 JRM INRMP does not address management of species that occur on JRM-administered lands that were newly listed under the Endangered Species Act (ESA) in October 2015. As a result, some plant and animal species would continue to be adversely affected by those conditions. Therefore, some impacts to terrestrial biological resources may result with implementation of the No Action Alternative.

4.4.3 Proposed Action (Preferred Alternative)

The study area for the analysis of effects to terrestrial biological resources associated with the Proposed Action includes all JRM-administered and leased lands on Guam, Tinian, and FDM. Under the Proposed Action, the 2019 JRM INRMP would be implemented, superseding the previous INRMP and resulting in updated monitoring and adaptive management of terrestrial biological resources within the study area. The goal of the INRMP is to utilize adaptive management to maintain long-term ecosystem health and minimize impacts to natural resources consistent with the operational requirements of the Department of Defense's (DoD's) mission.

Thirty-four federally threatened and endangered species potentially occur in multiple locations in varying densities of the study area of the Proposed Action (see Table 3-1 and the baseline sections of the INRMP referenced above in Section 3.4.2). Table 2-1 includes a full list of management projects that address species-specific objectives, strategies, and monitoring criteria for threatened, endangered, and other special status species from the 2019 JRM INRMP. Some projects target multiple listed species found in Table 3-1 through ecosystem-wide projects, such as forest recovery and enhancement, while other projects include actions for regular species-specific surveys to assess status and inform management actions (e.g., the Mariana fruit bat and Mariana swiftlet [*Aerodramus bartschi*]). In addition, ESA section 7 consultations would be conducted, as appropriate, with the United States (U.S.) Fish and Wildlife Service (USFWS) before project implementation. Therefore, implementation of the Proposed Action would not result in significant impacts to special status terrestrial species.

The immediate direct effects of INRMP projects may include minimal, temporary, and non-significant disturbance of some terrestrial species and their habitats during monitoring and management projects,

for example, due to vehicular movement and noise, handling/tagging individuals, or the reactions of terrestrial species to human presence. These effects would be brief, localized to small areas, and inconsequential to individuals, populations, or habitats.

The long-term effects of INRMP projects – monitoring and adaptive management – would be beneficial, enabling the status of local populations and habitats to be tracked over time, facilitating stressor identification and importance, identifying and implementing appropriate measures to reduce stressor effects within the DoD's areas of control, promoting the awareness and protection of sensitive species and habitats by the local human populations, and contributing to the sustainment and recovery of terrestrial biological resources.

For example, the implementation of the Regional Biosecurity Plan for Micronesia and Hawaii and conservation measures from the Biological Opinion for the MITT Program (2015 MITT BO), which include species risk assessments and development and implementation of BMPs and quality assurance/quality control protocols, would decrease the likelihood of introducing species into the transportation network. The development of standard operating procedures for early detection and rapid response would eradicate or mitigate spread of any potential introductions. Therefore, implementation of the Proposed Action would result in significant positive impacts to biological resources. Additional discussion of effects to terrestrial biological resource categories is provided below.

4.4.3.1 Effects on Terrestrial Biological Resource

Terrestrial Vegetation

Goals of the 2019 JRM INRMP include reducing and controlling populations of invasive plant and animal species, controlling erosion, revegetating areas (including native forest restoration), and monitoring and adaptively managing ecosystems on JRM-administered lands. Long-term, beneficial impacts would be expected for terrestrial vegetation through implementation of various management projects in the 2019 JRM INRMP aimed at protecting and enhancing native habitat and species diversity and maintaining healthy vegetation communities. Beneficial management actions for terrestrial vegetation include but are not limited to the following:

- implementing terrestrial resource surveys and management plans at NBG Main Base and Andersen AFB
- reducing the acreage of badlands on NMS by planting vetiver grass (*Vetiveria zizanioides*) buffer strips along the base of barren hills
- rehabilitating and restoring degraded areas on NMS through implementation of the 2015 NBG Wildlands Fire Management Plan
- erecting and/or maintaining ungulate exclusion fencing on NMS and Andersen AFB to allow native vegetation propagation and growth
- monitoring changes to the terrestrial ecosystem caused by military activities on FDM to inform adaptive management over time
- implementing appropriate recommendations within the Regional Biosecurity Plan that will reduce the risk of introduction and spread of invasive species on NBG Main Base

Long-term, beneficial impacts would also be expected for protected plant species (e.g., *Cycas micronesica, Dendrobium guamense,* the fire tree, etc.). Management of terrestrial threatened and

endangered plant species on JRM-administered lands includes implementing programs to protect species from threats such as ungulate disturbance or predation by invasive insects. The following are examples of management actions that have been designed to protect existing and support the propagation and growth of ESA-listed plant species:

- conducting pre-construction surveys for federal ESA-listed species within construction footprints and translocating listed plant species or their seeds
- conducting surveys to document distribution and abundance of ESA-listed plants
- updating threatened and endangered species population distribution maps and Geographic Information System databases with data used to inform adaptive management of listed species
- conducting monthly monitoring of the mature fire tree at Ritidian Point and all other fire trees planted on Andersen AFB
- protecting ESA-listed plants against ungulates, invasive insects, and typhoons

Terrestrial Wildlife

Mammals. Long-term, beneficial impacts would be expected for the Mariana fruit bat, a federal and local ESA-listed endangered species and the only native terrestrial mammal to occur on JRM-administered lands. Many of the terrestrial management projects will have indirect benefits for the Mariana fruit bat (see Table 2-1). For example, one terrestrial invasive species management project will attempt to identify minimum thresholds of brown treesnake (BTS) suppression to support conditions conducive to threatened and endangered species persistence and recovery. A number of the management projects were developed particularly for Mariana fruit bat conservation. These include forest enhancement projects on Guam and Tinian that are aimed at protecting and restoring priority native habitats for the benefit of the Mariana fruit bat. Also planned are continued fruit bat population monitoring on Andersen AFB to maintain and identify habitat relationships. No adverse effect to native mammals would occur under the Proposed Action.

Birds. Long-term, beneficial impacts would be expected for native bird populations as a result of implementation of the Proposed Action. There would be long-term, beneficial impacts especially on Guam where the native bird population was decimated by the introduction of the BTS after World War II. BTS suppression on JRM-administered lands and the development of BTS free zones on Guam as well as BTS interdiction for Tinian and FDM will contribute to survival and recovery of protected bird species. One management project would look at the optimum levels of BTS suppression and control measures needed to reduce mortality before the reintroduction of the Guam Micronesian kingfisher using Micronesian starlings (*Aplonis opaca*) as a surrogate species, which would increase the probability of a successful reintroduction of the extirpated kingfisher. This project would also support the expansion of Micronesian starlings on Guam. Mariana swiftlet surveys would help examine long-term population trends on NMS. In addition, reproductive success, cave site selection, movement studies, and BTS control actions will provide valuable information to inform management actions to facilitate swiftlet population persistence and expansion. Micronesian megapode (*Megapodius laperouse*) surveys on Tinian and FDM would help examine long-term population trends and changes in habitat on the islands. Navy funded studies to collect basic natural history data of the Tinian monarch on Tinian, including timing of nesting, hatching success rate, habitat use, territory size, site fidelity, and adult and juvenile survival, will improve management capability in JRM leased lands by 2021. Similarly, monitoring moorhen at Lake Hagoi in the Tinian Military Lease Area (MLA) would help examine long-term

population trends and changes in the wetland habitat. No adverse effects to native birds would occur under the Proposed Action. In addition to surveys for listed birds, surveys will be conducted every five years on Tinian to document long-term trends in density and abundance of native forest and MBTA-listed bird populations.

Reptiles. Reptile populations would benefit from baseline monitoring and adaptive management that contributes to improved habitat conditions. Many of the terrestrial management projects will have indirect benefits for native reptiles (see Table 2-1). Forest enhancement projects on Guam and Tinian are aimed at protecting and restoring priority native habitats for the benefit of native skinks and geckos. A number of the management projects were developed particularly for native reptile conservation. Management projects on NMS and Andersen AFB to survey for the Guam ESA-listed moth skink (*Lipinia noctua*) and Pacific slender-toed gecko (*Nactus pelagicus*) would improve the understanding of their distributions, thus improving the ability to protect them. Predator control and beach habitat enhancement on NBG Main Base, NBG TS, Andersen AFB, and Tinian MLA to improve sea turtle nest success would protect sea turtle populations.

Invertebrates. Long-term, beneficial impacts would be expected for native invertebrate populations, including tree snails, butterflies, and land crabs as a result of implementation of the Proposed Action. Many of the terrestrial management projects will have indirect benefits for native invertebrates (see Table 2-1). Forest enhancement projects on Guam and Tinian are aimed at protecting and restoring priority native habitats. ESA-listed tree snails, such as the Guam tree snail (*Partula radiolata*) or the humped tree snail (*Partula gibba*), would benefit from the restoration of limestone native and coastal forests, which are characteristic of the shaded and humid conditions they require to thrive. The federal ESA-listed Mariana eight-spot butterfly (*Hypolimnas octocula marianensis*) relies on two native host plants (*Procris pedunculata* and *Elatostema calcareum*), and forest enhancement would provide more habitat for these host plants. Ungulate control and eradication projects will have benefits on ESA-listed tree snails and butterflies since a reduction in damage to host plants will increase availability of potential habitat. Ungulate control and eradication projects will also benefit other invertebrate species as well. It is speculated that feral pigs predate on small and young native land crabs, such as the land hermit crab (*Coenobita brevimanus*) and coconut crabs (*Birgus latro*); therefore, ungulate control and eradication would potentially have a benefit to populations of land crabs, which are omnivores and detritivores important for forest ecosystem function. A number of the management projects were developed particularly for native invertebrate conservation, including actions to conduct tree snail and butterfly surveys to identify new locations; locate, protect, and propagate native invertebrate host plants; and conduct studies that assess the impacts of parasitoids and develop methods for their control.

4.5 Marine Biological Resources

Marine biological resources include living, native, or naturalized aquatic algae, plant and animal species, and the marine habitats within which they occur, such as coral reefs or sea grass beds.

Within this EA, marine biological resources are divided into two major categories: (1) marine flora and (2) marine fauna. Threatened, endangered, and other special status species are discussed in their respective categories.

2019 JRM INRMP Management Actions That Would Benefit Marine Biological Resources:

- increased knowledge of movement patterns and habitat use of threatened and endangered species
- protection of essential fish habitat (EFH)
- monitoring and control of acute impacts to coral reefs
- implementation of a conservation law enforcement program in order to minimize restrictions on military operations and comply with federal regulations
- development and implementation of a Marine Invasive Species Management Plan

The study area for the analysis of effects to marine biological resources associated with the INRMP includes the JRM-administered submerged lands adjacent to Guam, NBG Main Base, NBG TS, Andersen AFB, the Tinian MLA, and FDM. The analysis of impacts to marine biological resources focuses on resources that are subject to regulatory protection or are otherwise of greatest importance and public concern, and considers both the direct (immediately resulting from the action) and indirect (removed in space and/or time but likely to occur as a result of intermediary processes) impacts of the Proposed Action. Impacts may be adverse or beneficial.

4.5.1 Evaluation Criteria

The factors considered to determine the significance of impacts on marine biological resources include (1) the importance (i.e., legal, commercial, recreational, ecological, or scientific) of biological resources, (2) the proportion of plant and animal populations and habitat that would be affected relative to its occurrence in the region, (3) the sensitivity of populations and habitat to proposed activities, and (4) the duration of ecological impacts. Impacts on marine biological resources are considered significant if species or habitats of concern are adversely affected over relatively large areas or disturbances cause reductions in population size or distribution of protected or sensitive species.

4.5.2 No Action Alternative

Under the No Action Alternative, natural resources would continue to be managed as characterized in the 2013 JRM INRMP, and JRM would continue to implement applicable regulatory requirements. Ongoing INRMP projects may result in minor, temporary, and non-significant disturbance to some marine species but would have beneficial impacts in identifying trends and their causes and implementing management to reduce stressor effects, including human disturbance of species and habitats. However, because the 2013 JRM INRMP considered under this alternative does not address all species currently ESA-listed as threatened or endangered, current adverse conditions on JRM-administered submerged lands and some natural habitats, such as coral reefs, would continue to decline in quality and complexity. As a result, some plant and animal species would continue to be adversely affected by those conditions. Therefore, some impacts to marine biological resources may result with implementation of the No Action Alternative.

4.5.3 Proposed Action (Preferred Alternative)

The study area for the analysis of effects to marine biological resources associated with the Proposed Action includes all marine waters that extend 3 miles (4.8 kilometers) out from JRM-administered lands. Under the Proposed Action, the 2019 JRM INRMP would be implemented, superseding the previous INRMP and resulting in updated monitoring and adaptive management of marine biological resources within the study area.

The immediate direct effects of INRMP projects may include minimal, temporary, and non-significant disturbance of some marine species during monitoring and management projects, for example due to vessel movement and noise, handling/tagging individuals, or the reactions of marine species to human presence. These effects would be brief, localized to small areas, and inconsequential to individuals, populations, or habitats.

The long-term effects of INRMP projects – monitoring and adaptive management – would be beneficial, enabling the status of local populations and habitats to be tracked over time, facilitating stressor identification and importance, identifying and implementing appropriate measures to reduce stressor effects within the DoD's areas of control, promoting the awareness and protection of sensitive species and habitats by the local human populations, and contributing to the sustainment and recovery of marine biological resources. In particular, the Marine Invasive Species Management Plan, which would be developed and implemented under the Proposed Action, would establish a watch list of invasive species, develop standard operating procedures for early detection and rapid response, and develop BMPs for contractors and military personnel to prevent and mitigate introductions of new marine invasive species. The development and implementation of this management plan would provide a direct benefit to marine resources. Additional discussion of effects to marine biological resource categories is provided below.

4.5.3.1 Effects on Marine Biological Resources

Marine Flora

INRMP management projects would have indirect, long-term, beneficial impacts to marine flora through implementation of management strategies and actions aimed at protecting habitat diversity, maintaining healthy coral reefs, and enhancing habitat. Beneficial management actions for marine flora include but are not limited to the following:

- monitoring to establish baseline conditions and support the adaptive management of seagrass beds at Dadi Beach, NBG Main Base
- marine resource surveys and management plans at NBG Main Base, NBG TS, and Andersen AFB
- water quality monitoring to define baseline conditions and stressor impacts to reef habitats at NBG Main Base, NBG TS, and Andersen AFB
- reviewing and updating as necessary Hull Husbandry and Ballast Water standards

The 2019 JRM INRMP aims at controlling populations of invasive marine species, controlling erosion, mapping benthic communities, restoring coral reefs, and monitoring and adaptively managing marine ecosystems on JRM-administered submerged lands. As maintaining a high level of habitat diversity that does not conflict with the military mission is a priority of this INRMP, implementation of the 2019 JRM INRMP would result in improved marine habitat conditions.

Marine Fauna

Invertebrates. Beneficial impacts to marine invertebrates and coral reef ecosystems, in particular, would result from the same actions identified above for marine flora. Additional management actions include but are not limited to the following:

- monitoring to detect invasive species and reef damage due to crown-of-thorns seastar (*Acanthaster planci*), *Terpios* sponges, coral diseases, and coral bleaching events
- promoting reef-safe sunscreens
- enforcing marine natural resource laws
- collecting, maintaining, and sharing of Geographic Information Systems data with resource agencies

The INRMP management actions are consistent with the directives of Executive Order (EO) 13089, *Coral Reef Protection*.

ESA-listed coral species that may occur in the area include *Acropora globiceps*, *Acropora retusa*, and *Seriatopora aculeata*. Occurrences of these species are described in Section 3.5.2. To the extent that these species occur, they may benefit from survey data that better define their distributions and the habitat conditions that support them. In addition, surveys help to identify locations where (a) impacts can be avoided or reduced or (b) opportunities may exist to enhance the habitat of local populations. Insofar as only beneficial effects would occur, there would be no significant adverse impacts on corals.

Fish. Fish populations and essential fish habitat (EFH) would benefit from baseline monitoring and adaptive management that contributes to improved habitat conditions. No adverse effect to EFH would occur under the Proposed Action.

One ESA-listed fish species, the scalloped hammerhead shark (*Sphyrna lewini*), may occur in waters of the study area (see Table 3-2), although documented occurrences are few. Beneficial impacts could accrue to scalloped hammerhead and other fish species of concern, including humphead wrasse (*Cheilinus undulatus*) and bumphead parrotfish (*Bolbometopon muricatum*), as a result of the new environmental deoxyribonucleic acid study to detect the occurrence and habitat use of these species in Apra Harbor. Given only beneficial, if any, effects to this species, there would be no significant adverse impacts on the scalloped hammerhead shark.

Turtles. All five species of sea turtles that may occur in the study area are ESA-listed but only two, the green turtle (*Chelonia mydas*) and hawksbill turtle (*Eretmochelys imbricata*), are reasonably likely to occur in areas affected by the Proposed Action. Under the 2019 JRM INRMP, extensive monitoring and protective management of nesting beaches within JRM-administered lands would occur. These actions and their beneficial effects are described under terrestrial biological resources. An existing project on sea turtle distribution and habitat use on JRM-administered submerged lands around Guam, using satellite tags, has potential to inform beneficial management actions for sea turtles in water.

Marine Mammals. The most common marine mammals that occur in the waters of the study area (within 3 miles of the coastline) are spinner dolphins (*Stenella longirostris*), bottlenose dolphins (*Tursiops truncatus*), and pantropical spotted dolphins (*Stenella attenuata*). Several other species, including ESA-listed sperm whales (*Physeter macrocephalus*) and humpback whales (*Megaptera novaeangliae*), have been infrequently encountered and/or usually occur farther offshore (see baseline

sections of the INRMP referenced above in Section 3.5.2). The Proposed Action includes the continuation of annual marine mammal surveys off Guam and the CNMI. The 2016 surveys resulted in encounters with the aforementioned species as well as rough-toothed dolphins (*Steno bredanensis*), short-finned pilot whales (*Globicephala marcrorhynchus*), and dwarf sperm whales (*Kogia sima*). Satellite tags were deployed on sperm and short-finned pilot whales as well as a pantropical spotted dolphin (Hill et al. 2017). Data from these surveys indirectly benefits marine mammals by enabling more informed assessments of the potential effects of DoD training activities.

4.6 Land Use

2019 JRM INRMP Management Action That Would Benefit Land Use:

- ecosystem management would result in long-term, beneficial impacts to ecosystem integrity and, therefore, could lead to a reduction of restrictions on military operations

The location and extent of a proposed action needs to be evaluated for its potential effects on a project site and adjacent land uses. Factors affecting a proposed action in terms of land use include its compatibility with on-site and adjacent land uses, restrictions on public access to land, or change in an existing land use that is valued by the community. Other considerations are given to proximity to a proposed action, the duration of a proposed activity, and its permanence. Impacts may be adverse or beneficial.

4.6.1 Evaluation Criteria

The significance of impacts on land use is evaluated primarily by considering the compatibility of an action with existing land uses and conditions. The Proposed Action could have a significant land use impact if it would result in any of the following:

- conflict with the military missions of JRM-administered lands
- be inconsistent or in noncompliance with land use plans or policies
- preclude existing land use
- preclude continued use or occupation of an area
- be incompatible with adjacent land use to the extent that public health or safety is threatened
- conflict with planning criteria established to ensure the safety and protection of human life and property

4.6.2 No Action Alternative

Under the No Action Alternative, the Proposed Action would not occur and there would be no change to land use. Continued implementation of the 2013 JRM INRMP would be compatible with existing land uses. Therefore, no significant impacts would occur with implementation of the No Action Alternative.

4.6.3 Proposed Action (Preferred Alternative)

The study area for land use analyses for the Proposed Action is defined as lands on Guam, Tinian, and FDM administered or leased by JRM.

4.6.3.1 Effects on Land Use

Existing and Planned Land Use. As required by the Sikes Act and DoD Instruction 4715.03, the 2019 JRM INRMP was developed in a manner that ensures that there would be no net loss of the capability of installations to support military missions and future mission requirements. As such, the 2019 JRM INRMP is consistent with current land use plans and policies of JRM-administered lands as well as for any planned military uses.

Ecosystem management is emphasized in the 2019 JRM INRMP (see Section 3.1) because the DoD recognizes that the mission of the JRM is inextricably linked to local, regional, and global ecological integrity and that sustaining ecosystem integrity is the best way to protect biodiversity, ensure sustainable use, and minimize the effort and cost of management. Thus, implementing the 2019 JRM INRMP would result in long-term, beneficial impacts on military use of JRM-administered lands and public use of surrounding areas, by ensuring that healthy and self-sustaining natural resources such as clean water, stable soils and beaches, and naturally vegetated areas continue to be available to support the use of JRM-administered lands and future growth and development of JRM-administered lands and surrounding areas.

Conservation Areas. The special conservation areas within JRM-administered lands are discussed in detail in each installation chapter of the 2019 JRM INRMP. Implementing management projects identified in the 2019 JRM INRMP and associated management plans to conserve or restore habitat or other natural areas would occur in priority areas that are compatible with operational and training needs. This could potentially cause long-term, minor, adverse impacts on planned use of lands. For example, protecting threatened and endangered species and restoring their habitat could require limiting activities in areas where Mariana fruit bats roost or forage on Andersen AFB in the future. In addition, restoring and maintaining the long-term health of forested areas and other ecosystems could require temporary or long-term restrictions in forests that are being restored after long-term damage by ungulates.

Public Health and Safety. There are no planned activities associated with the 2019 JRM INRMP that would result in undue safety risks or otherwise threaten public health or safety, or conflict with planning criteria established to ensure the safety and protection of human life and property on and surrounding JRM-administered lands. No impacts on coastal zone management would occur from implementation of the Proposed Action. Therefore, implementation of the Proposed Action would not result in significant impacts to land use.

4.7 Submerged Land Use

2019 JRM INRMP Management Action That Would Benefit Submerged Land Use:

- potential beneficial impacts due to increased knowledge of marine resources leading to lifting of restrictions on military operations

The location and extent of a proposed action needs to be evaluated for its potential effects on a project site and adjacent submerged land uses. Factors affecting a proposed action in terms of submerged land use include its compatibility with on-site and adjacent submerged land uses, restrictions on public access to land, or change in an existing submerged land use that is valued by the community. Other considerations are

given to proximity to a proposed action, the duration of a proposed activity, and its permanence. Impacts may be adverse or beneficial.

4.7.1 Evaluation Criteria

The significance of impacts on submerged land use is evaluated primarily by considering the compatibility of an action with existing submerged land uses and conditions. The Proposed Action could have a significant submerged land use impact if it would result in any of the following:

- conflict with the military missions of JRM-administered submerged lands
- be inconsistent or in noncompliance with submerged land use plans or policies
- preclude existing submerged land use
- preclude continued use or occupation of an area
- be incompatible with adjacent submerged land use to the extent that public health or safety is threatened
- conflict with planning criteria established to ensure the safety and protection of human life and property

4.7.2 No Action Alternative

Under the No Action Alternative, the Proposed Action would not occur and there would be no change to submerged land use. Continued implementation of the 2013 JRM INRMP would be compatible with existing submerged land uses. Therefore, no significant impacts would occur with implementation of the No Action Alternative.

4.7.3 Proposed Action (Preferred Alternative)

The study area for submerged land use analyses for the Proposed Action is defined as those lands between the low and high-tide line and extend 3 miles (4.8 kilometers) offshore from JRM-administered and leased lands on Guam, Tinian, and FDM.

4.7.3.1 Effects on Submerged Land Use

Existing and Planned Land Use. As required by the Sikes Act and DoD Instruction 4715.03, the 2019 JRM INRMP was developed in a manner that ensures that there would be no net loss of the capability of installations to support military missions and future mission requirements. As such, the 2019 JRM INRMP is consistent with submerged land use plans and policies of JRM-administered submerged lands and the ongoing and planned military uses of those sites, and implementation of the 2019 JRM INRMP would not adversely affect the short-term or long-term use of land for military activities.

The general strategy for managing marine resources in the 2019 JRM INRMP includes a general progression of knowledge through the implementation of a series of marine habitat studies and the follow-on management of the effects of stressors or threats on these resources. Maintaining healthy marine communities for listed and native species on submerged lands would potentially relieve some of the restrictions of military training and in-water activities (e.g., military construction, routine maintenance/repair of in-water facilities) on submerged lands by minimizing costs and mitigation requirements, avoiding work-around solutions, and preventing delays in activities due to regulatory compliance processes.

Ecosystem management is emphasized in the 2019 JRM INRMP because the DoD recognizes that the mission of JRM is inextricably linked to local, regional, and global ecological integrity, and that sustaining ecosystem integrity is the best way to protect biodiversity, ensure sustainable use, and minimize the effort and cost of management. Thus, implementing the 2019 JRM INRMP would result in long-term, beneficial impacts on military use of JRM-administered submerged lands and public use of surrounding areas, by ensuring that healthy and self-sustaining natural resources, such as clean water, stable soils and beaches, and naturally vegetated areas continue to be available to support the use of JRM-administered submerged lands and future growth and development of JRM-administered submerged lands and surrounding areas.

Conservation Areas. Sections 5.1.6, 8.1.4, and 9.1.5 of the 2019 JRM INRMP discuss in detail the marine special conservation areas within JRM-administered submerged lands. Implementing management projects identified in the 2019 JRM INRMP and associated management plans to conserve or restore habitat or other natural areas would occur in priority areas that are compatible with operational and training needs. This could potentially cause long-term, minor, adverse impacts on planned use of submerged lands. For example, restoration activities to protect key coral reef areas could require limiting activities in areas. In addition, restoring and maintaining the long-term health of ecosystems could require temporary or long-term restrictions.

Public Health and Safety. There are no planned activities associated with the 2019 JRM INRMP for submerged lands that would result in undue safety risks or otherwise threaten public health or safety or conflict with planning criteria established to ensure the safety and protection of human life and property on and surrounding JRM-administered submerged lands.

Implementation of the Proposed Action would not result in significant impacts to submerged land use.

4.8 Socioeconomics

Analysis of impacts to socioeconomics is focused on the effects of the alternatives on population, income, economic activity, tax revenue, and housing. Impacts may be adverse or beneficial.

2019 JRM INRMP Management Action That Would Benefit Socioeconomics:

- improved access to fishing for recreation and subsistence

4.8.1 Evaluation Criteria

Impacts are expected to primarily relate to recreational opportunities. As such, impacts would be considered significant if access is completely restricted to any area that is prominently used for recreational purposes.

4.8.2 No Action Alternative

Under the No Action Alternative, the Proposed Action would not occur and there would be no change to the socioeconomics of the local area. Therefore, no significant impacts would occur with implementation of the No Action Alternative.

4.8.3 Proposed Action (Preferred Alternative)

The study area for socioeconomic analyses for the Proposed Action is defined as Guam and Tinian.

4.8.3.1 Effects on Socioeconomics

Population and Public Services. The Proposed Action primarily relates to resource management and includes no direct or indirect population attractors. Since no population increase would be induced by the Proposed Action, no housing or public services impacts would be expected.

Economy. Similarly, while there may be some local expenditures related to resource management actions included in the Proposed Action, noticeable economic benefits would not be anticipated, and any economic or financial impacts would be less than significant.

Recreation. No access restrictions to areas currently used for recreation are proposed. Therefore, no adverse impacts associated with recreation are anticipated. Management projects proposed in the INRMP would likely have the effect of improving the sustainability of fishing on both Guam and Tinian, allowing for improved quality of this form of recreation over a longer period.

Subsistence Activity. In addition to improving the long-term quality of fishing for recreational purposes, management projects would improve the long-term quality of fishing for purposes of subsistence. This improvement would tend to reduce the portion of incomes required to be spent on food and better allow for those with no financial means of obtaining food to live off the land.

4.9 Environmental Justice

This analysis focuses on the potential for a disproportionate and adverse exposure of specific off-base population groups to the projected adverse consequences discussed in the previous sections of this chapter.

2019 JRM INRMP Management Action That Would Benefit Environmental Justice:

- improved quality of fishing for subsistence, which would disproportionately benefit low-income residents

4.9.1 Evaluation Criteria

Adverse impacts to environmental justice are identified where significant impacts to the human environment are determined in resource areas that relate to the human environment. Resources considered include: water resources, socioeconomics, land and submerged land use, and cultural resources.

4.9.2 No Action Alternative

Under the No Action Alternative, the Proposed Action would not occur and there would be no effect to environmental justice. Therefore, no significant impacts would occur with the implementation of the No Action Alternative.

4.9.3 Proposed Action (Preferred Alternative)

The study area for environmental justice analysis for the Proposed Action is defined as Guam and Tinian.

4.9.3.1 Effects on Environmental Justice

No significant impacts were identified for resources relating to the human environment. Therefore, implementation of the Proposed Action would not cause disproportionately high and adverse human health or environmental effects on any minority or low-income populations. As described in Section 4.8,

there may be beneficial effects on the long-term sustainability of subsistence activities, which would tend to primarily benefit those with low or no incomes.

4.10 Summary of Potential Impacts to Resources and Impact Avoidance and Minimization

A summary of the potential impacts associated with the action alternative and the No Action Alternative is presented in Table 4-1.

Table 4-1 Summary of Potential Impacts to Resource Areas

Resource Area	*No Action Alternative*	*Proposed Action*
Geology, Topography, and Soils	Continued implementation of the 2013 JRM INRMP would result in some beneficial impacts through the reduction in soil erosion, reduction in invasive vegetation, and an increase in native reforestation on JRM-administered lands; however, the 2013 JRM INRMP does not address soil conditions in their current state. Continued implementation of the 2013 JRM INRMP without updates to the comprehensive soil erosion and control plan and to the long-term, ecosystem-based plans for restoring and maintaining forests and other areas could result in continued erosion and minor to moderate, adverse impacts on soils. In addition, the No Action Alternative does not address the current ungulate (i.e., hoofed mammals such as pigs, deer, and carabao [*Bubalus bubalis*]) populations found on JRM-administered lands; thus, ground disturbances and soil erosion caused by ungulates would continue which would have adverse impacts on soils and increased erosion.	Implementation of the 2019 JRM INRMP would have long-term, beneficial reduction in soil erosion from implementation of updated erosion control practices and ecosystem-based management plans for restoring and maintaining forests and other areas. Eroded areas would be identified and revegetated to reduce erosion. Control of ungulates would improve soils by reducing digging and destruction of vegetation by those animals.
Water Resources	Continued implementation of the 2013 JRM INRMP would result in beneficial impacts to water resources by minimizing operational impacts on wetlands, maximizing native floral and faunal diversity of wetlands, and managing for no net loss of wetlands. These plans would include the restoration and maintenance of ecosystem processes, such as sustainable revegetation and soil production, which would improve water quality, promote the flow of surface waters into wetlands, and reduce flooding by increasing groundwater recharge and reducing surface water flow rates.	Implementation of the 2019 JRM INRMP would have long-term, beneficial impacts on surface water quality and aquatic habitats from rehabilitation of surface waters and actions to reduce erosion, such as the control of ungulates and restoration of disturbed areas. There would be no direct, adverse impacts on wetlands and floodplains.

Table 4-1 Summary of Potential Impacts to Resource Areas

Resource Area	*No Action Alternative*	*Proposed Action*
Cultural Resources	Continued implementation of the 2013 JRM INRMP would result in adverse impacts on cultural resources and culturally important medicinal plants. The No Action Alternative does not properly address the current ungulate populations on JRM-administered lands; thus, the high abundance of ungulates and degradation of forests and other areas could continue.	Implementation of the 2019 JRM INRMP would have no adverse impacts on cultural resources, including historic properties (as defined by Section 106 of the National Historic Preservation Act). Long-term, beneficial impacts on cultural resources could occur from implementation of updated actions such as those that seek to protect native forests (i.e., ungulate control). These actions would protect habitats in which culturally important plants are found and prevent or reduce degradation of historical landmarks.
Terrestrial Biological Resources	Continued implementation of the 2013 JRM INRMP would result in some beneficial impacts on terrestrial biological resources on JRM-administered lands. However, because the 2013 JRM INRMP considered under this alternative does not address all current adverse conditions on JRM-administered lands, some natural habitats, such as native forests, would continue to decline in quality and complexity, and some plant and animal species would continue to be adversely affected by those conditions. For example, the No Action Alternative does not include an updated plan to reduce ungulate populations on JRM sites; thus, degradation of native forest would continue and adversely affect recovery of threatened and endangered species. In addition, the 2013 JRM INRMP does not provide adequate management for the species listed under the federal Endangered Species Act in October 2015.	Implementation of the 2019 JRM INRMP would have beneficial impacts on terrestrial vegetation and wildlife, including newly protected species, from the implementation of updated long-term, ecosystem-based management plans to restore and enhance habitat for native species, prevent and control non-native species, and monitor native plant and animal populations.

Table 4-1 Summary of Potential Impacts to Resource Areas

Resource Area	*No Action Alternative*	*Proposed Action*
Marine Biological Resources	Continued implementation of the 2013 JRM INRMP would result in some beneficial impacts on marine biological resources on JRM-administered submerged lands. However, because the 2013 JRM INRMP considered under this alternative does not address all current adverse conditions on JRM-administered submerged lands, some marine habitats would continue to decline in quality and complexity, and some species would continue to be adversely affected by those conditions. For example, the No Action Alternative does not include a discussion on climate change and the effects of coral bleaching; thus, degradation of reef habitat would continue and adversely affect recovery of threatened and endangered species.	Implementation of the 2019 JRM INRMP would have beneficial impacts on marine wildlife, including protected species, from the implementation of long-term, ecosystem-based management plans to restore and enhance habitat for native species and prevent and control non-native species.
Land Use	Continued implementation of the 2013 JRM INRMP would be compatible with existing land uses. Therefore, no significant impacts would occur with implementation of the No Action Alternative.	Implementation of the 2019 JRM INRMP was developed in a manner that ensures no net loss of the capability of installations to support military missions and future mission requirements, and is therefore consistent with current land use plans and policies of JRM-administered and leased lands as well as for any planned military uses.
Submerged Land Use	Continued implementation of the 2013 JRM INRMP would be compatible with existing submerged land uses. Therefore, no significant impacts would occur with implementation of the No Action Alternative.	There would be no adverse impacts to submerged land use with the implementation of the 2019 JRM INRMP. Potential beneficial impacts due to increased knowledge of marine resources could lead to lifting of restrictions on military operations.
Socioeconomics	No change in social or economic conditions or use of public services would occur with continued implementation of the 2013 JRM INRMP.	No change in social or economic conditions or use of public services would occur with the implementation of the 2019 JRM INRMP. There would be a significant positive impact to the sustainability of fishing opportunities.
Environmental Justice	No adverse and disproportional impacts on minority or low-income populations would occur with continued implementation of the 2013 JRM INRMP.	No adverse and disproportional impacts on minority or low-income populations would occur with the implementation of the 2019 JRM INRMP.

Key: INRMP = Integrated Natural Resources Management Plan; JRM = Joint Region Marianas.

5 Cumulative Impacts

This section (1) defines cumulative impacts; (2) identifies the scope of cumulative impacts analysis; (3) describes past, present, and reasonably foreseeable actions relevant to cumulative impacts; and (4) evaluates potential cumulative impacts caused by the Proposed Action in combination with past, present, and reasonably foreseeable actions.

5.1 Definition of Cumulative Impacts

The approach taken in the analysis follows the objectives of the National Environmental Policy Act (NEPA), Council on Environmental Quality (CEQ) regulations, and CEQ guidance. Cumulative impacts are defined in 40 Code of Federal Regulations (CFR) 1508.7 as "the impact on the environment that results from the incremental impact of the action when added to the other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time."

In addition, CEQ and the United States (U.S.) Environmental Protection Agency (USEPA) have published guidance addressing implementation of cumulative impacts analyses: "Guidance on the Consideration of Past Actions in Cumulative Effects Analysis" (CEQ 2005) and "Consideration of Cumulative Impacts in USEPA Review of NEPA Documents" (USEPA 1999). CEQ guidance entitled *Considering Cumulative Impacts Under NEPA* (CEQ 1997) states that cumulative impacts analyses should "…determine the magnitude and significance of the environmental consequences of the proposed action in the context of the cumulative impacts of other past, present, and reasonably foreseeable actions...identify significant cumulative impacts…[and]…focus on truly meaningful impacts."

Cumulative impacts are most likely to arise when a relationship or synergism exists between a proposed action and other actions occurring or expected to occur in a similar location or during a similar period. Actions overlapping with, or in close proximity to, a proposed action would be expected to have more potential for a relationship than those more geographically separated. Similarly, relatively concurrent actions would tend to offer a higher potential for cumulative impacts. To identify cumulative impacts, an analysis needs to address the following three fundamental questions:

- Does a relationship exist such that affected resource areas of the proposed action might interact with the affected resource areas of past, present, or reasonably foreseeable actions?
- If one or more of the affected resource areas could be expected to interact, would the interaction increase the magnitude of impacts already identified as associated with the proposed action or lead to additional impacts not previously identified as associated with the proposed action?
- If impacts of increased magnitude or new impacts are identified, then what is the overall magnitude of the cumulative impacts?

5.2 Scope of Cumulative Impacts Analysis

The scope of the cumulative impacts analysis involves both the geographic extent of the effects and the period in which the effects could be expected to occur. For this 2019 Joint Region Marianas (JRM) Integrated Natural Resources Management Plan (INRMP) Environmental Assessment (EA), the study

area bounds the geographic extent of the analysis. In general, the study area will include those areas previously identified in Chapter 4 for the respective resource areas. The time frame for cumulative impacts centers on the timing of the Proposed Action.

Another factor influencing the scope of cumulative impacts analysis involves identifying other actions to consider. Beyond determining the geographic scope and time frame for the actions interrelated with the proposed action, the analysis employs the measure of "reasonably foreseeable" to include or exclude potential future actions. For the purposes of this analysis, public documents prepared by federal, state, and local government agencies form the primary sources of information regarding reasonably foreseeable actions. Documents used to identify other actions include notices of intent for Environmental Impact Statements (EISs) and EAs, management plans, land use plans, and other planning related studies.

5.3 Past, Present, and Reasonably Foreseeable Actions

To determine which projects to include in the cumulative impacts analysis, a preliminary determination was made as to whether a relationship exists between resource areas of the Proposed Action and a set of past, present, or reasonably foreseeable actions. If no such potential relationship was determined to exist, the project was not carried forward into the cumulative impacts analysis. In accordance with CEQ guidance (CEQ 2005), actions considered but excluded from further cumulative impacts analysis are not catalogued here, as the intent is to focus the analysis on the meaningful actions relevant to informed decision-making. Past, present, or reasonably foreseeable actions that were carried forward into this cumulative impacts analysis are listed in Table 5-1 and briefly described in Sections 5.3.1 and 5.3.2.

Table 5-1 Cumulative Action Evaluation

Action	*Location*	*NEPA Analysis Completed*
Past Actions		
Establishment and Operation of an Intelligence, Surveillance, Reconnaissance, and Strike Capability (*pending full implementation*)	Guam	Environmental Impact Statement and Record of Decision
Terminal High-altitude Area Defense Permanent Stationing on Guam	Guam	Finding of No Significant Impact
Present and Reasonably Foreseeable Future Actions		
Global Climate Change	Guam, CNMI	
Invasive Species	Guam, CNMI	
Beddown of Training and Support Initiatives at Northwest Field	Guam	Finding of No Significant Impact
Guam Military Relocation (2012 Roadmap Adjustments)	Guam, CNMI	Supplemental Environmental Impact Statement and Record of Decision
Pacific Air Forces Divert Marianas	CNMI	Environmental Impact Statement and Record of Decision
Mariana Islands Testing and Training	Guam, CNMI	Environmental Impact Statement and Record of Decision
Commonwealth of the Northern Mariana Islands Joint Military Training	Guam, CNMI	Public Draft Environmental Impact Statement
Construction of Munitions Storage Igloos at Andersen Air Force Base	Guam	Draft Environmental Assessment
Plumeria Resort	CNMI	Non-NEPA Impact Assessment

Key: CNMI = Commonwealth of the Northern Mariana Islands; NEPA = National Environmental Policy Act.

5.3.1 Past Actions

Establishment and Operation of an Intelligence, Surveillance, Reconnaissance, and Strike Capability (pending full implementation): This project involved the establishment of an Intelligence, Surveillance, Reconnaissance, and Strike and aerial refueling capabilities at Andersen Air Force Base (AFB) as part of the Pacific Command's Global Strike Task Force Initiative. Specific components of this action include 3 Global Hawk unmanned aerial Intelligence, Surveillance, Reconnaissance aircraft; 12 aerial refueling aircraft; 4 Global Hawk RQ-4 unmanned aerial vehicles (Global Hawk); and support personnel at Andersen AFB. Additionally, 48 fighter and 6 bomber aircraft and support personnel rotate to Andersen AFB from installations in the 50 states. Approximately 3,000 additional military, civilian, and contractor personnel are required to support this action. Facility construction, addition, and alteration projects took place to support the action. The Final EIS was published in November 2006 (71 Federal Register 67864) and a Record of Decision (ROD) was signed on January 12, 2007 (72 Federal Register 2871).

Terminal High-altitude Area Defense Permanent Stationing on Guam: The U.S. Army decided to maintain the Terminal High-altitude Area Defense (THAAD) ballistic missile defense battery at Northwest Field of Andersen AFB. As a secondary, connected action to the expeditionary deployment and proposed permanent stationing of the THAAD battery on Guam, the U.S. Army also expanded the Northwest Field cargo drop zone training area that is encumbered by THAAD operations.

5.3.2 Present and Reasonably Foreseeable Actions

Global Climate Change: Although the plant and animal communities found on Guam and in the Marianas are adapted for tropical weather patterns (i.e., wet and dry seasons), increases in the intensity and frequency of storms as well as increases in the occurrence and durations of droughts may negatively affect the ability for native species to recover from these events. Changes in temperature, rainfall, and wind patterns will likely change the distribution of vegetation and wildlife and the size of associated populations. The effects of global climate change may contribute to cumulative impacts on water, terrestrial biological, marine biological, and land use resource areas.

Invasive Species: Despite biosecurity measures, transportation between Guam, the Commonwealth of the Northern Mariana Islands (CNMI), and elsewhere poses a constant risk of introducing invasive species. These accidental but inevitable introductions may have the potential to increase negative impact to terrestrial and marine resources on an ongoing basis, irrespective of any JRM action. JRM activities and resources will be adversely affected by these invasions, even when they are not due to JRM actions.

Beddown of Training and Support Initiatives at Northwest Field: This project establishes the relocation of a Rapid Engineer Deployable Heavy Operations Repair Squadron Engineer of mobile engineering forces, the Pacific Air Force Commando Warrior training program, the Pacific Air Force SILVER FLAG training program, and a Combat Communication Squadron and its training program at the same location.

Guam Military Relocation (2012 Roadmap Adjustments): In September 2010, the Department of the Navy (DON) signed a ROD regarding the 2010 Final EIS for the Guam and CNMI Military Relocation. In April 2012, the U.S.-Japan Security Consultative Committee jointly announced an adjustment to the previous plans for the Guam Military Relocation. In accordance with these "2012 Roadmap Adjustments," the Department of Defense (DoD) adopted a new force posture in the Pacific providing for a materially smaller and reconfigured Marine Corps force on Guam. The DON prepared this Final

Supplemental EIS for the purpose of supplementing the portions of the 2010 Final EIS regarding the establishment on Guam of a Live-fire Training Range Complex, a cantonment area, a family housing area, and associated infrastructure to support the relocation of a substantially reduced number of Marines and dependents than was previously analyzed. The DON's preferred alternative is to construct and operate the proposed cantonment at the Naval Base Guam (NBG) Telecommunications Site (TS) at Finegayan, the proposed family housing on Andersen AFB, and the proposed Live-fire Training Range Complex at Northwest Field on Andersen AFB. For purposes of mitigation, the DON entered into a Memorandum of Agreement (MOA) with the U.S. Fish and Wildlife Service (USFWS) to ensure a sufficient amount of suitable survival and recovery habitat is conserved in northern Guam to support the reintroduction and recovery of the Guam Micronesian kingfisher. DON agreed to develop and implement specific management projects that support control, suppression, and eradication of invasive species, such as brown treesnake (BTS), ungulates, mammalian predators, and invertebrates, that negatively impact kingfisher nesting and fledging. Many of the projects listed in the 2019 JRM INRMP support the requirements of the Guam Micronesian kingfisher MOA.

Pacific Air Force Divert Marianas: Pending approval of the Federal Aviation Administration, the U.S. Air Force (USAF) will construct facilities and infrastructure needed to achieve divert capabilities in the Western Pacific and will conduct military exercises in the Military Lease Area (MLA) on Tinian. Facilities to be constructed include but are not limited to a parking apron north of the Tinian International Airport, a cargo pad, maintenance facilities, access roads, and a fuel storage tank system.

Mariana Islands Testing and Training: DON has developed a plan to maintain military readiness training and research, development, testing, and evaluation activities. The Mariana Islands Training and Testing (MITT) EIS/Overseas EIS (OEIS) is a follow-on study to the Mariana Islands Range Complex (MIRC) EIS/OEIS. The ROD for the MIRC was published in July 2010, and the ROD for the MITT was published in July 2015. The MITT supports the renewal of regulatory permits and authorizations, addresses training and testing not covered under existing permits and authorizations, and identifies those permits and authorizations necessary to support force structure changes and emerging training and testing requirements, including those associated with new platforms and weapons systems. A Supplemental EIS is underway to assess the potential environmental impacts associated with ongoing military readiness activities.

The MITT study area includes the existing MIRC, additional areas on the high seas, and a general transit corridor between Hawaii and MITT where training and testing activities may occur. The MIRC is the only major DON range complex in the MITT study area. Since the MITT study area is predominantly ocean, Guam, Tinian, and FDM represent a small part of the total area. Increased training tempo is proposed for the submerged lands that underlie warning area W-517 located south of Guam and small arms firing areas are proposed west of Agat Bay and the Haputo Point area.

Commonwealth of the Northern Mariana Islands Joint Military Training: The proposed action is to establish a series of live-fire ranges, training courses, and maneuver areas within the CNMI to reduce existing joint service training deficiencies and meet the U.S. Pacific Command Service Components' unit level and combined level military training requirements in the Western Pacific. The proposed action would take place on the islands of Tinian, Pagan, and potentially Saipan. A unit level Range and Training Area on Tinian and combined level Range and Training Area on Pagan would be established to meet the

purpose and need. One of the Tinian action alternatives would involve establishing an Airport Surveillance Radar and Remote Transmitter/Receiver at Saipan International Airport.

There are three Tinian unit level training action alternatives, primarily distinguished by varying real estate interests outside of the MLA and the level of utilization of the Port of Tinian, the Tinian International Airport, and the Saipan International Airport. The No Action Alternative on Tinian would allow currently authorized training to continue in addition to the previously approved development and use of four live-fire ranges on Tinian. There are two Pagan combined level training action alternatives, primarily distinguished by size of maneuver areas and the corresponding size of the High Hazard Impact Area. A Public Draft EIS/OEIS was published in 2015 for the CNMI Joint Military Training (CJMT) action, and a Revised Draft EIS/OEIS is planned.

Construction of Munitions Storage Igloos at Andersen Air Force Base: The construction of an additional 48 Hayman-style munitions storage igloos in Munitions Storage Area I at Andersen AFB is proposed to reduce the current existing munitions storage capacity shortfall and to enable 36th Wing's mission requirements under Title 10 U.S. Code Section 8062. The new igloos would require lighting and electrical support, intrusion detection system, ventilation, reinforced concrete foundation, rated 7-bar construction, floor slabs, columns, beams, and lightning protection system. Supporting facilities would include site development, utilities and connections, road improvements, and loading aprons. Project construction would occur between 2019 and 2021.

Plumeria Resort: The construction of this luxury, commercial resort would take place on 372 acres (151 hectares) on Tinian, approximately 1.5 miles (2.4 kilometers) north of central San Jose Village and approximately 0.5 mile (0.8 kilometer) south of the West Tinian Airport runway. The proposed site is bisected diagonally by 8th Avenue. The property borders the shoreline on the Philippine Sea, the Commonwealth Utilities Corporation power plant to the south, with San Jose Village to the southeast, and the Tinian International Airport to the north, with a "panhandle" extending along the shoreline cliffs.

As planned, facilities would be constructed in a phased development process; there would be three phases that would take four years each to complete. Phase 1 would be developed from 2015 to 2019, Phase 2 would be developed from 2019 to 2023, and Phase 3 would be developed from 2023 to 2027. The labor requirement for the construction phase of the project is anticipated to require approximately 2,000 workers for the entire work under Phase 1. Under Phases 2 and 3, it is anticipated that the project would require 1,000 construction workers.

Upon completion in 2027, the resort is planned to consist of two hotels with a total of 1,966 hotel rooms, 3,389 service apartments, 557 staff dorm rooms, 100 Very Important Person Villas, a golf course and golf club with associated amenities, a casino, a cultural center/museum, a health clinic, and a wide variety of retail shopping options, including a farmers market complex. Average daily population at the resort, including staff and guests, is anticipated to be 3,178 staff and 5,731 guests (total 8,909 people).

5.4 Cumulative Impacts Analysis

Where feasible, the cumulative impacts were assessed using quantifiable data; however, for many of the resources included for analysis, quantifiable data is not available and a qualitative analysis was undertaken. In addition, where a published analysis of potential environmental effects for reasonably

foreseeable actions is not available, assumptions were made regarding the potential impacts of those actions. The analytical methodology presented in Chapter 4, which was used to determine potential impacts to the various resources analyzed in this document, was also used to determine cumulative impacts.

5.4.1 Geology, Topography, and Soils

The geographic study area includes the terrestrial sites proposed for the Proposed Action and adjacent lands. Significant impacts to geology, topography, and soils would result from the implementation of the past, present, and reasonably foreseeable actions within the region of influence. Although the long-term trend in the health of geology, topography, and soils would not be improved by cumulative impacts, the benefits from implementation of the 2019 JRM INRMP would help mitigate and reduce this trend.

5.4.2 Water Resources

The geographic study area includes the terrestrial sites proposed for the Proposed Action and adjacent lands. Past, present, and reasonably foreseeable actions generally increase demands on water resources and reduce available water quality and quantity in and around the project areas. Although the long-term trend in the health of water resources would not be improved by cumulative impacts, the benefits from implementation of the 2019 JRM INRMP would help mitigate and reduce this trend.

5.4.3 Cultural Resources

The geographic study area includes archaeological resources, architectural resources, traditional cultural properties found on JRM-administered lands, coastal zones, and marine waters proposed for the preferred alternative. Although significant impacts to cultural resources would result from the implementation of the past, present, and reasonably foreseeable actions within the region of influence, implementation of the 2019 JRM INRMP would provide an overall beneficial impact to cultural resources.

5.4.4 Terrestrial Biological Resources

The geographic study area includes the JRM-administered lands proposed for the Proposed Action and adjacent lands. Climate change, invasive species, and past, present, and future human activities, both civilian and military, will continue to impose stressors on terrestrial biological resources within the areas of INRMP projects. Such effects are reduced by regulatory protection, such as the Endangered Species Act (ESA) for at-risk species. As a result of construction activities associated with the implementation of projects such as the Guam Military Relocation, CJMT, and the Plumeria resort, there would be a cumulative loss of forest habitat for several listed species (e.g., Guam Micronesian kingfisher, Guam rail, Mariana crow, Mariana fruit bat, *Cycas micronesica*, and fire tree). The Plumeria resort would also produce a cumulative loss of green turtle nesting beach habitat on Tinian at the Leprosarium pocket beaches due to construction activities, increased human activity in the area, and lighting disorientations. Although the long-term trend in the health of terrestrial biological resources would be reduced by cumulative impacts, the benefits from implementation of the 2019 JRM INRMP would help mitigate that reduction.

5.4.5 Marine Biological Resources

The geographic study area for marine biological resources includes the ocean waters and bottom substrates up to 3 miles (4.8 kilometers) offshore of JRM-administered lands. Climate change as well as past, present, and future human activities, both civilian and military, will continue to impose stressors on marine biological resources within the areas of INRMP projects. Such effects are reduced by regulatory protection: for threatened and endangered species under the ESA; for coral reefs and other essential fish habitat (EFH) under the Magnuson-Stevens Fishery Conservation and Management Act; and for marine mammals under the Marine Mammal Protection Act (MMPA). These statutes and their associated regulations include resource monitoring that enables better detection of trends, emerging threats, and the consequences of regulatory actions. As a result, the regulatory framework continually adjusts, mitigating the potential for cumulative impacts. The establishment of marine protected areas in the Mariana Islands, as well as the relative isolation of some islands and locations from human activities, contributes to the buffering of marine resources from cumulative impacts.

Nevertheless, as civilian and military activities increase within the region, continued incremental degradation of the marine environment is likely to occur as a result of land-based sources of pollution, overfishing, and diffuse disturbance (noise and visual presence) from human activity. Erosion of terrestrial sediments caused by activities conducted under present and reasonably foreseeable actions could cause detectable and potentially significant cumulative impacts to marine resources via the stressors of sedimentation and turbidity. Consequences of cumulative turbidity to marine resources most frequently manifest as decreased resilience. Implementation of the JRM Erosion and Sedimentation Control Plan, and related measures, may incidentally mitigate turbidity stressors unrelated to the JRM actions.

To the extent that marine populations and communities remain resilient to natural and anthropogenic perturbations, significant cumulative impacts will be avoided. When the combined effects of such stressors and global warming, which is associated with coral bleaching events, overwhelm the capacity of local populations and communities to recover (i.e., they remain in a perpetually disturbed condition), a significance threshold will have been crossed. This does not appear to be the case at present, as coral reef ecosystems in the region as a whole retain their natural diversity and productivity.

The 2019 JRM INRMP would have beneficial (i.e., localized, temporary, non-damaging) impacts on marine biological resources. Although the long-term trend in the health of marine biological resources may be down, the benefits from implementation of the 2019 JRM INRMP would help to improve this trend.

5.4.6 Land Use

The geographic study area includes the terrestrial sites for the Proposed Action and adjacent lands. Past, present, and reasonably foreseeable actions generally increase activities, change land uses, or increase restrictions on land use in and around the project areas. The Guam Military Relocation and CJMT projects tend to increase activities, change land uses, or increase restrictions on land use. Impacts to land use would result from the implementation of the past, present, and reasonably foreseeable actions within the study area. While the additional land use restrictions associated with the 2019 JRM INRMP would add to these impacts, the goal of the 2019 JRM INRMP is to utilize adaptive management to maintain long-term ecosystem health and minimize impacts to natural resources consistent with the

operational and training requirements of the DoD's mission. As such, any adverse cumulative impact would be caused primarily by the past, present, and reasonably foreseeable actions rather than by implementation of the 2019 JRM INRMP.

5.4.7 Submerged Land Use

The geographic study area includes the marine sites proposed for the Proposed Action and adjacent submerged lands. Although past, present, and reasonably foreseeable actions would be consistent with the Guam Submerged Lands Management Plan (Naval Facilities Engineering Command [NAVFAC] Marianas 2007), Haputo Ecological Reserve Area (ERA) Management Plan (NAVFAC Marianas 2010b), Orote ERA Management Plant (NAVFAC Marianas 2010c), and the CNMI Coastal Resources Management Program, impacts to submerged land use would result due to increased federal submerged land uses and restrictions. While the additional restrictions associated with the 2019 JRM INRMP would add to these impacts, the goal of the 2019 JRM INRMP is to utilize adaptive management to maintain long-term ecosystem health and minimize impacts to natural resources consistent with the operational and training requirements of the DoD's mission. As such, any adverse cumulative impact would be primarily caused by the past, present, and reasonably foreseeable actions rather than by implementation of the 2019 JRM INRMP.

5.4.8 Socioeconomics

The geographic study area includes Guam and Tinian. Past, present, and reasonably foreseeable actions generally reduce land available on these islands for public recreation and food gathering. The Guam Military Relocation and CJMT projects tend to increase federal land uses and restrict public access to areas used for recreation and food gathering. For Guam, significant impacts to recreation, due to restrictions to access, were identified in the ROD for the Guam Military Buildup. The socioeconomic benefits associated with the 2019 JRM INRMP would decrease the impacts to recreation that result from the Guam Military Buildup. On Tinian, the CJMT project could result in impacts related to socioeconomics, primarily caused by access restrictions. The 2019 JRM INRMP proposes no additional access restrictions on Tinian. As such, any adverse cumulative impact to socioeconomics would be caused primarily by the past, present, and reasonably foreseeable actions rather than by implementation of the 2019 JRM INRMP.

5.4.9 Environmental Justice

The geographic study area includes Guam and Tinian. The Guam Military Relocation and CJMT projects might interact with the Proposed Action to bring about cumulative impacts. The Guam Military Buildup ROD does not identify impacts to environmental justice and none are identified in association with the 2019 JRM INRMP. Therefore, no cumulative impacts to environmental justice are anticipated.

6 Other Considerations Required by National Environmental Policy Act

6.1 Consistency with Other Federal, State, and Local Laws, Plans, Policies, and Regulations

In accordance with 40 Code of Federal Regulations (CFR) Section 1502.16(c), analysis of environmental consequences shall include discussion of possible conflicts between the Proposed Action and the objectives of federal, regional, state, and local land use plans, policies, and controls. Table 6-1 identifies the principal federal and state laws and regulations that are applicable to the Proposed Action, and provides how compliance with these laws and regulations would be accomplished.

Table 6-1 Principal Federal and State Laws Applicable to the Proposed Action

Federal, State, Local, and Regional Land Use Plans, Policies, and Controls	*Status of Compliance*
National Environmental Policy Act; Council on Environmental Quality National Environmental Policy Act implementing regulations; Navy procedures for implementing National Environmental Policy Act	Complies (Environmental Assessment prepared)
Sikes Act (as amended)	Complies
Fish and Wildlife Coordination Act	Complies
Coast and Geodetic Survey Act of 1947	Complies
Clean Air Act	Complies (does not exceed *de minimis* levels)
Clean Water Act	Complies
Rivers and Harbors Act	Complies
Coastal Zone Management Act	Complies
National Historic Preservation Act	Complies (consultation in progress)
Endangered Species Act	Complies (consultation in progress)
Magnuson-Stevens Fishery Conservation and Management Reauthorization Act	Complies
Marine Mammal Protection Act	Complies
Migratory Bird Treaty Act	Complies
Bald and Golden Eagle Protection	NA
Comprehensive Environmental Response and Liability Act	Complies
Emergency Planning and Community Right-to-know Act	Complies
Federal Insecticide, Fungicide, and Rodenticide Act	Complies
Resource Conservation and Recovery Act	Complies
Toxic Substances Control Act	Complies
Farmland Protection Policy Act	Complies
Executive Order 11988, *Floodplain Management*	Complies
Executive Order 12088, *Federal Compliance with Pollution Control Standards*	Complies
Executive Order 12114, *Environmental Effects Abroad of Major Federal Actions* (Department of the Navy implementing regulation 32 Code of Federal Regulations part 287)	NA
Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-income Populations*	Complies
Executive Order 13045, *Protection of Children from Environmental Health Risks and Safety Risks*	Complies
Executive Order 13089, *Coral Reef Protection*	Complies

Table 6-1 Principal Federal and State Laws Applicable to the Proposed Action

Federal, State, Local, and Regional Land Use Plans, Policies, and Controls	*Status of Compliance*
Executive Order 13112 and 13751, *Safeguarding the Nation from the Impacts of Invasive Species*	Complies
Executive Order 13175, *Consultation and Coordination with Indian Tribal Governments*	NA
Executive Order 13693, *Planning for Federal Sustainability in the Next Decade*	NA
Executive Order 13766, *Expediting Environmental Reviews and Approvals For High Priority Infrastructure Projects*	NA
Executive Order 13807, *Establishing Discipline and Accountability in the Environmental Review and Permitting Process for Infrastructure*	NA

Key: NA = not applicable.

6.2 Irreversible or Irretrievable Commitments of Resources

Resources that are irreversibly or irretrievably committed to a project are those that are used on a long-term or permanent basis. This includes the use of non-renewable resources, such as metal and fuel and natural or cultural resources. These resources are irretrievable in that they would be used for this project when they could have been used for other purposes. Human labor is also considered an irretrievable resource. Another impact that falls under this category is the unavoidable destruction of natural resources that could limit the range of potential uses of that particular environment.

Implementation of the Proposed Action would involve human labor; the consumption of relatively small amounts of fuel, oil, and lubricants for vehicles; and the use of small amounts of construction materials (e.g., for fences) and ammunition (e.g., for ungulate control). Implementing the Proposed Action, however, would not result in significant irreversible or irretrievable commitment of resources.

6.3 Unavoidable Adverse Impacts

This Environmental Assessment (EA) has determined that the alternatives considered would not result in any significant impacts. Implementing the alternatives could result in the following unavoidable environmental impacts:

- minimal, temporary, localized, and non-significant disturbance of some terrestrial and marine species and their habitats during monitoring and management projects
- short-term, minor impacts to land use due to restrictions on operations in conservation and restoration areas

6.4 Relationship between Short-term Use of the Environment and Long-term Productivity

National Environmental Policy Act (NEPA) requires an analysis of the relationship between a project's short-term impacts on the environment and the effects that these impacts may have on the maintenance and enhancement of the long-term productivity of the affected environment. Impacts that narrow the range of beneficial uses of the environment are of particular concern. This refers to the possibility that choosing one development site reduces future flexibility in pursuing other options, or that using a parcel of land or other resources often eliminates the possibility of other uses at that site.

In the short-term, effects to the human environment with implementation of the Proposed Action would be minimal (see Section 6.3, above). In the long-term, there would be beneficial impacts to geology, topography, and soils; water resources; cultural resources; terrestrial biological resources; marine biological resources; land use; submerged land use; and socioeconomics. The Proposed Action would not result in any impacts that would significantly reduce environmental productivity or permanently narrow the range of beneficial uses of the environment.

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8 List of Preparers

This Environmental Assessment (EA) was prepared collaboratively between the Department of the Navy (DON) and contractor preparers.

Department of the Navy

Dana Lujan (EV2/Naval Facilities Engineering Command [NAVFAC] Marianas)
Responsible for: Overall Program Management

Charles Sayon (NAVFAC Marianas)
Responsible for: Contracting Officer's Representative/Project Manager

MJ Mazurek (NAVFAC Marianas)
Responsible for: Terrestrial resources support and document review

Noah Burrell (NAVFAC Marianas)
Responsible for: Natural resources support and document review

Stephen Mosher (NAVFAC Marianas)
Responsible for: Natural resources support and document review

Marc Hall (NAVFAC Marianas)
Responsible for: Natural resources support and document review

Maria Santos (NAVFAC Marianas)
Responsible for: Natural resources support and document review

Hilary Goodwin (NAVFAC Marianas)
Responsible for: Marine resources support and document review

Andres J. Reyes (NAVFAC Marianas)
Responsible for: Marine resources support and document review

Michael Doherty (NAVFAC Headquarters)
Responsible for: Environmental planning support and document review

Tammy Conkle (NAVFAC Headquarters)
Responsible for: Natural resources support and document review

Jennifer Oelke-Farley (NAVFAC Headquarters)
Responsible for: Natural resources support and document review

Nicole Pak (NAVFAC Headquarters)
Responsible for: Document review

Wayne Van Scoyoc (NAVFAC Headquarters)
Responsible for: Document review

Contractors

Stella Acuna
B.A., Environmental Design and Planning
Years of Experience: 27
Responsible for: Project Management

Peer Amble
B.A., Geography
Years of Experience: 27
Responsible for: Quality Assurance/Quality Control

Ben Berridge
B.A., Environmental Studies
Years of Experience: 8
Responsible for: Geology, Topography, and Soils

Wilfred Cassidy, PE
M.S., Architectural Engineering
Years of Experience: 37
Responsible for: Quality Assurance/Quality Control

Jackie Clark
B.S., Business Administration
Years of Experience: 8
Responsible for: Technical Editing

J. Scott Coombs
M.S., Marine Science
Years of Experience: 18
Responsible for: Water Resources; Geology, Topography, and Soils; and Cumulative Impacts

Michael Dungan
Ph.D., Ecology and Evolutionary Biology
Years of Experience: 34
Responsible for: Marine Biological Resources

John Ford
M.S., Zoology
Years of Experience: 36
Responsible for: Project Management

Caitlin Jafolla
B.A., Urban Studies and Planning
Years of Experience: 4
Responsible for: Administrative Record

David Kiernan
M.A., Urban and Regional Planning
Years of Experience: 15
Responsible for: Socioeconomic Resources, Environmental Justice, and Cumulative Impacts

Amanda Kreider
M.S., Fire Ecology
Years of Experience: 14
Responsible for: Land Use and Submerged Land Use

Isla Nelson
B.A., Anthropology
Years of Experience: 15
Responsible for: Cultural

Christopher Noddings
M.S., Environmental Science and Management
Years of Experience: 10
Responsible for: Description of Proposed Action and Alternatives

Aja Reyes
B.S., Marine Biology
Years of Experience: 15
Responsible for: Technical Editing

Lorraine Shaughnessy
M.S., Ecology and Evolutionary Biology
Years of Experience: 11
Responsible for: Project Management, Cultural, Terrestrial Biology, and Cumulative Impacts

Rick Spaulding
M.S., Wildlife and Fisheries Science
Years of Experience: 33
Responsible for: Senior Technical Review

Natalie Vergara
B.S., Coastal Environmental Science
Years of Experience: 5
Responsible for: Technical Editing, Document Production, Management Projects, and INRMP Consistency

Robert Wardwell, AICP
B.A., Economics; M.B.A Logistics; M.S. Environmental Science
Years of Experience: 40
Responsible for: Quality Assurance/Quality Control

Kerry Wells
B.S., Physics
Years of Experience: 13
Responsible for: Geographic Information Systems

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9 Distribution List

The Draft Environmental Assessment (EA) was distributed to the agencies listed below.

9.1 Department of Defense

9.1.1 Department of the Navy

Dr. Kelly Ebert, Chief of Naval Operations, N45

Tamara Conkle, Naval Facilities Engineering Command (NAVFAC) Headquarters

Jennifer Oelke-Farley, NAVFAC Headquarters

John F. Salas, NAVFAC

Julie Rivers, Commander United States (U.S.) Pacific Fleet (COMPACFLT)

Rear Admiral Shoshana Chatfield, Commander Joint Region Marianas

Commander Todd Geyer, Mariana Islands Range Complex (MIRC) Operations, Joint Region Marianas (JRM)

Randy Sablan, Commonwealth of the Northern Mariana Islands (CNMI) JRM Coordination Office

Frans Juola, NAVFAC Pacific

Captain Daniel P. Turner, Commander NAVFAC Marianas

Dana Lujan, NAVFAC Marianas

Captain Jeffrey M. Grimes, Naval Base Guam (NBG)

Ed Moon, NBG

9.1.2 United States Marine Corps

Jacqueline Rice, U.S. Marine Corps, Headquarters

Amanda Peyton, Marine Corps Forces Pacific (MARFORPAC)

Al Borja, Marine Corps Activity Guam

9.1.3 Department of the Air Force

Joseph Vinch, Andersen Air Force Base (AFB)

Brigadier General Douglas A. Cox, Andersen AFB

Leutenant. James Hammons, Andersen AFB

Tom Spriggs, Andersen AFB

9.1.4 Department of the Army

Major Andrew James, U.S. Army Pacific

9.2 Federal, Territory of Guam, and Commonwealth of the Northern Mariana Islands Agencies

9.2.1 Federal Agencies

Katherine Mullett, U.S. Fish and Wildlife Service (USFWS), Pacific Islands Fish and Wildlife Office

Jacqueline Flores, USFWS

Michael Tosatta, National Marine Fisheries Service (NMFS), Pacific Islands Regional Office

Joel Moribe, NMFS

Kevin Brindock, NMFS

9.2.2 Territory of Guam Agencies

Chelsa Muna-Brecht, Guam Department of Agriculture

Celestino Aguon, Guam Division of Aquatic and Wildlife Resources (Guam DAWR)

Diane Vice, Guam DAWR

Lynda Aguon, Guam Historic Preservation Office, Department of Parks and Recreation

9.2.3 Commonwealth of the Northern Mariana Islands Agencies

Manny Pangelinan, CNMI Division of Fish and Wildlife (DFW)

Anthony T. Benavente, CNMI DFW

Jill Liske-Clark, CNMI DFW

Rita Chong-Dela Cruz, CNMI Historic Preservation Office, Department of Community & Cultural Affairs

Appendix A
Comments

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CONSOLIDATED COMMENT RESPONSE FORM

DOCUMENT: INRMP EA Public Drafts	**DATE OF DOCUMENT**: 14 November 2018 and 15 February 2019
COMMENTERS: Public	
COMMENT RESPONDER: JRM, Cardno	**DATE OF COMMENTS**:15 November through 16 March 2019

Item #	*Date of Comment*	*Method of Submission*	*Document*	*Commenter/ Organization, as applicable*	*Email*	*Phone Number*	*Street Address*	*State/ Territory*	*Comment/Recommended Changes*	*Response to Comment (Requested edits made or incorporated)*
1	12/12/2018	Email (dana.lujan@fe.navy.mil)	JRM INRMP and JRM INRMP EA	Arlene Pangelinan PIRO HCD	arlene.pangelinan@noaa.gov	808-725-5082			NMFS PIRO HCD has no substantive comments on Version 5 of the draft JRM INRMP for the Guam components. Navy sufficiently addressed concerns for the Guam installations and sets up a reasonable marine management program. Regarding project implementation, Navy acknowledged our concerns for actual implementation of a few project during the recent INRMP metrics meetings and are working to address those issues. Although we do not have specific comments on EA, we concur with the EA's finding that the 2018 JRM INRMP will provide additional benefit to marine resources and NOAA trust resources. Thanks for the opportunity to comment on the draft JRM INRMP and EA. Sincerely, Arlene Pangelinan	Thank you for your comment. The development of the JRM INRMP was a collaborative effort with our Resource Partners. The DON appreciates the extensive support from our Resource Partners.
2	12/12/2018	Email (W-GU-NAVFAC-EV2-GS@fe.navy.mil)	JRM INRMP and JRM INRMP EA	William Fife					To Whom It May Concern, I support the US military and our national security, but not at the expense of our environment and culture. Bombing/live-fire practice has no place in the CNMI--at least not on Tinian and Pagan. PLEASE DO NOT DESTROY THE ENVIRONMENT HERE!!! It is a beautiful place that my family has made home. There is no environmental recovery from military testing, and we do NOT want that here!! Please find another place to bomb. Thank you, William Fife	Thank you for your comment. The INRMP is the Navy's planning document for management of its natural resources.

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Appendix J
Organization of the Department of Navy Installation under Joint Region Marianas Management

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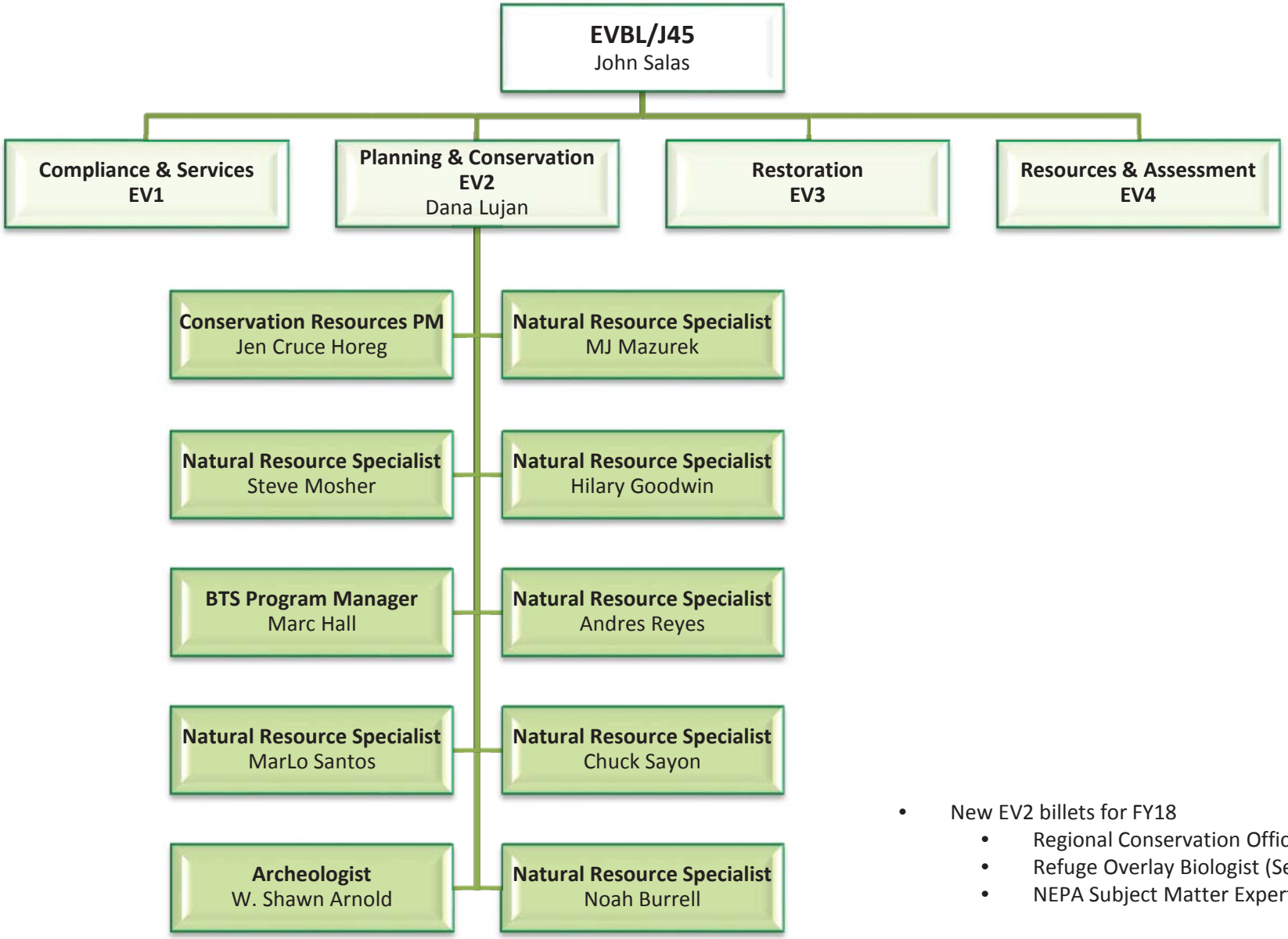
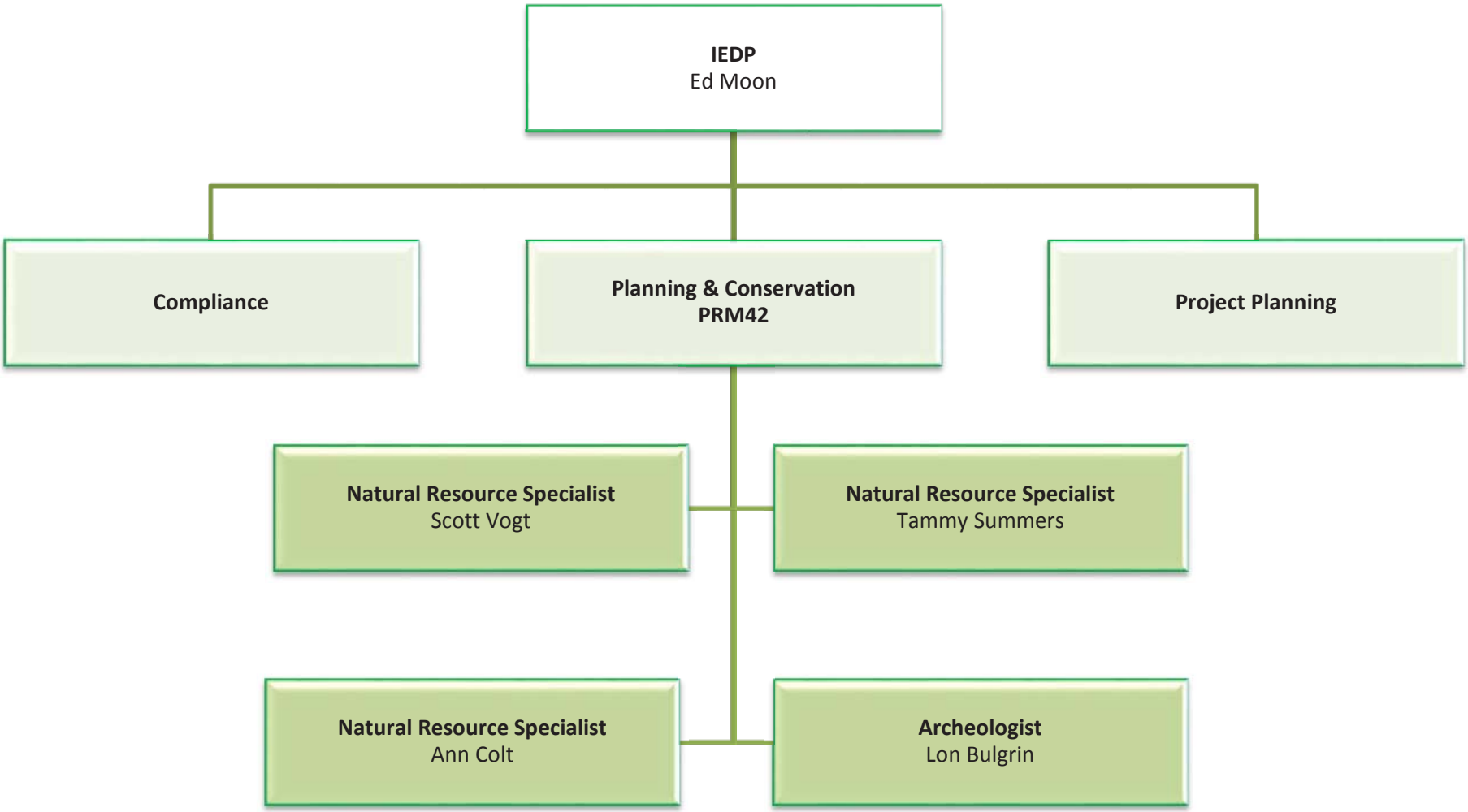
JRM / NAVFAC MAR - ENVIRONMENTAL

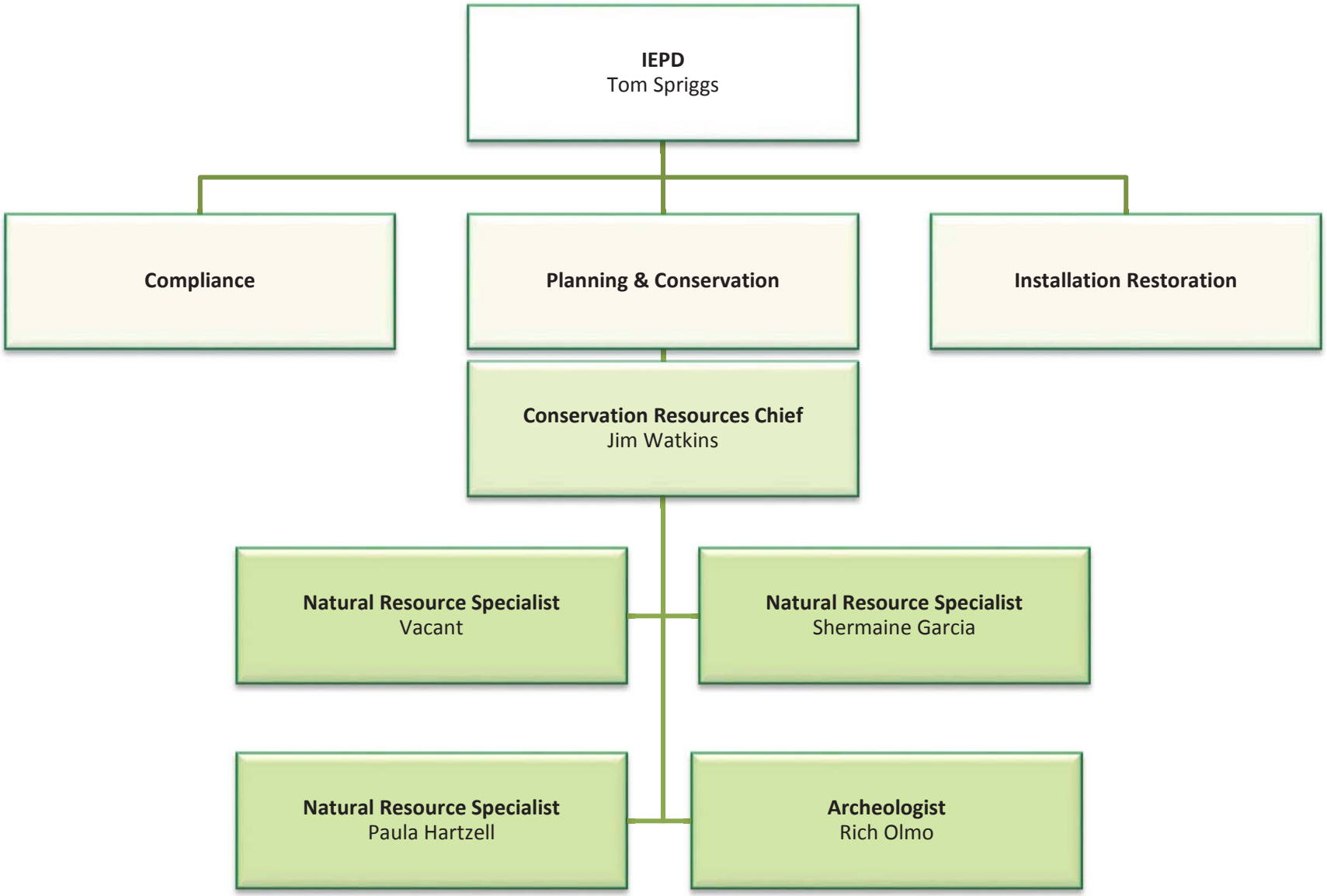


- New EV2 billets for FY18
  - Regional Conservation Officer
  - Refuge Overlay Biologist (Section 7)
  - NEPA Subject Matter Expert

NAVAL BASE GUAM – PWD ENVIRONMENTAL



ANDERSEN AIR FORCE BASE - ENVIRONMENTAL



MARINE CORPS ACTIVITY GUAM (PLANNING & DESIGN)
NCTS currently under NBG

